Empirical Investigation of Comparative Advantage among OECD Countries[*]

Mika Saito[†]

November 1, 1999

Abstract

This paper analyzes the impact of different production technologies across countries on the relative prices of goods and through them on the pattern of trade. It assumes different production technologies and perfect capital mobility across OECD countries during the period, 1970-1992. These assumptions are consistent with the Kemp-Jones model. The econometric estimation of sector-specific production functions (at 2-digit classification of ISDB) for each of 14 OECD countries shows that changes in comparative advantage in the 1970s and 1980s are highly correlated with changes in technological progress (in light industries) and in the capital-labor ratio (in heavy industries).

JEL Classification: F11, F14.

---

[*] I would like to thank Gaetano Antinolfi, George Jakubson, Todd Keister, Lawrence Lau, Karl Shell, Erik Thorbecke, Ichiro Tokutsu, Tim Vogelsang, Henry Wan, Jr. and participants at the Western Economic Association's Meeting in San Diego and the Work in Progress Workshop at Cornell University for their support and comments. All remaining errors are mine.

[†] Address: 449A Uris Hall, Department of Economics, Cornell University, Ithaca, NY 14853. Phone: (607) 255-5620. Fax: (607) 255-2818. E-mail: ms83@cornell.edu.

1. Introduction

Throughout the development of trade theories since the beginning of the last century, the key factors that each trade theory used to explain the pattern of trade reflected the initial conditions prevailing at the time and stylized facts reflecting these conditions. For instance, when there was a large volume of exports of goods from countries with absolute disadvantage, Ricardo (1817) explained the pattern of trade with comparative advantage in relative labor productivity. His focus on relative labor costs reflected the labour theory of value, which was the dominant theoretical framework at the time. In the first half of this century, when goods became much more mobile across boarders (while factors of production remained highly immobile), Heckscher (1919), Ohlin (1933) and many others suggested that trade was a substitute for factor movements. They argued that goods were traded so that factors (as the contents of goods) could be shipped from where they were relatively abundant to where they were relatively scarce. In more recent years, when the volume of intra-industry trade became the dominant portion of the total trade volume, trade theorists such as Krugman began to analyze each country's demand behavior for foreign goods, each of which could be uniquely produced by different foreign countries. To understand the world in which these theories have been developed is very important for the choice of theoretical framework for any empirical studies.

This study is interested in the pattern of trade of 10 traded good sectors (at 2 digit classification of International Sectoral Data Base (ISDB)) among 14 OECD countries during the period, 1970-92.[1] In the analysis of the pattern of trade among this particular set of countries during this particular period, there are two important features one must take into account. First of all, countries differ in factor productivity, namely labor and capital productivity. More specifically, we observe different countries possessing, not necessarily different production technologies (because of relatively easy transmission of information among them), but different efficiency levels of labor and capital inputs. Differences in productivity among industrialized countries are well discussed in the empirical growth literature, for instance Baskin and Lau (1992). Secondly, capital mobility among industrialized countries has been very high. The high level of capital mobility, particularly in the 1980s, is discussed in many of the Foreign Direct Investment literature, reviewed in Saito (1998). The choice of a theoretical framework for this paper is based on how closely these two features are modelled.

The theoretical model adopted in this paper is developed by Kemp (1966), Jones (1967), Jones and Ruffin (1975) and others. In the Kemp-Jones model, technological differences and perfect capital mobility across countries are introduced into the Heckscher-Ohlin model. The model shows that trade patterns in such a world is "Ricardian" since they reflect technology differences rather than factor endowments. In other words, the analysis of comparative advantage among OECD countries could be adequately carried out by analyzing differences in labor productivity among OECD countries.

---

[1] In the international trade literature, particularly in recent years, some have dealt with a 3-digit ISDB classification level, for instance Dunkin and Krygier (1998). This paper, however, faces a data constraint in the sector level capital input data, which is used to estimate the technological parameters, as in the case of Harrigan (1997).

Adopting the Kemp-Jones model, and hence analyzing differences in labor productivity, is consistent with what we have been observing in the empirical Heckscher-Ohlin literature. Trefler (1995) rejected the Heckscher-Ohlin model in favor of alternative models that took account of the home bias (Armington bias) in consumption and international technology differences. In his study, he used the 1983 data for 33 countries with 9 factors. Maskus and Webster (1995) also looked at both differences in consumption behavior and technology for a smaller number of countries, the U.S. and U.K., but for a finer disaggregation of factors. They, too, rejected the Heckscher-Ohlin theorem in favor of alternative models. Harrigan (1997) found both relative technology and endowment differences to be important determinations of specialization. He used industry-specific factors, capital and labor, for OECD countries to compute the total factor productivity (TFP) as a technological parameter. This was a new approach to the estimation of technology parameters, in comparison with earlier works, which were based on input-output tables. In all of these studies, one of the key element in explaining the pattern of trade is considered to be the differences in labor productivity.

Despite the generally agreed importance of differences in labor productivity across countries in international trade, a careful analysis of labor productivity is missing in the empirical trade literature. Trade models typically predict that differences in labor productivity are derived from differences in the rate of technical progress. Differences in the rate of technical progress are not necessarily the only source of differences in labor productivity. For instance, in the presence of any friction in labor mobility across sectors (within a country), sector-specific wage rates may be changing at different rates. Changes in the sector-specific wage-rental ratio causes the capital-labor ratio to change over time in each sector. Any increase in the capital-labor ratio could reduce the labor cost component (and increase the capital cost component). In data, labor cost reductions from technological progress cannot be distinguished from those from an increase in the capital-labor ratio. This paper, by estimating sector- and country-specific production functions, decomposes the differences in labor productivity across OECD countries into two components: one component captures the effect of different rates of technical progress on labor productivity, and the other picks up the effect of different capital-labor ratio on labor productivity.

This paper does not discuss one very important feature of the pattern of trade among OECD countries; goods disaggregated at 2-digit classification of ISDB are far from homogenous. The heterogeneity of goods within each sector has been one of the main pillars of the increasing-returns-to-scale trade literature and has been argued to be the reason for the bulk of intra-industry trade among industrialized countries. Saito (1999) incorporates differences in each country's demand behavior for foreign goods to analyze the relationship between trade patterns and the comparative advantage discussed in this paper.

Section 2 of this paper discusses the main theoretical framework, the Kemp-Jones model, and the decomposition of differences in labor productivity. Section 3 discusses the estimation method and hypothesis tests for the sector- and country-specific production functions. Since the results of this empirical study are broad and varied, the following three representative topics are discussed in this paper. Section 4 analyzes the comparative advantage between Japan and the U.S. It finds that the selective technological improvements in Japan with respect to the U.S. during the 1970s and 1980s are observed to have led to a shift in comparative advantage in Japan from light to heavy industries. Section 5 analyzes the extent of comparative advantage or disadvantage of the U.S. vis-à-vis other OECD countries sector by sector over the same period. Technological progress in some sectors seems to have improved the U.S. competitiveness, namely in the food, textile, chemical products and other manufacturing products industries. Section 6 turns to the overall findings of the decomposition of cross-country differences in labor productivity (relative to those of other sectors within each country). Cross-country differences in relative labor productivity are highly correlated with (i) cross-country differences in relative rates of technical progress in light industries and (ii) cross-country differences in the relative capital-labor ratio in heavy industries. The findings in this section indicate that differences in the capital-labor ratio is a much more important determinant of comparative advantage in heavy industries, particularly the early 1990s. Section 7 presents the conclusions.

2. The Model

2.1. The Kemp-Jones Model

The Kemp-Jones model presented here is based on Ruffin (1984). Let a_{Li} and a_{Ki} denote the labor and capital requirements for good i; respectively. When two goods, labor-intensive good X_1 and capital-intensive good X_2, are both produced in an economy, we know that competitive pricing requires:

$$\begin{aligned} a_{L1}w + a_{K1}r &= 1; \\ a_{L2}w + a_{K2}r &= p; \end{aligned} \tag{2.1}$$

where w, r and p are wage rates, rental rates and the price of X_2; respectively. Let θ_{ji} denote the cost shares, e.g., $\theta_{L1} = a_{L1}w$: By totally differentiating (2.1) and letting ^ indicate the proportionate change in a variable, e.g., $\hat{w} = \frac{\partial w}{w}$; we obtain:

$$\begin{aligned} \theta_{L1}\hat{w} + \theta_{K1}\hat{r} &= \pi_1; \\ \theta_{L2}\hat{w} + \theta_{K2}\hat{r} &= \pi_2 + \hat{p}; \end{aligned} \tag{2.2}$$

where $\pi_1 = -(\theta_{L1}\hat{a}_{L1} + \theta_{K1}\hat{a}_{K1})$ and $\pi_2 = -(\theta_{L2}\hat{a}_{L2} + \theta_{K2}\hat{a}_{K2})$: When there is technical progress (that is to say that the percentage change in factor requirements a_{ji} is negative), π_i takes a positive value, $\pi_i \geq 0$. In other words, π_i is the percentage reduction in the cost of producing X_i due to reduction in the a_{ji} coefficients at constant factor prices. [2]

Solving (2.2) for $\hat{r}$ yield:

$$\hat{r} = \frac{\theta_{L1}(\pi_2 + \hat{p}) - \theta_{L2}\pi_1}{\theta}; \ \theta = \theta_{K2} - \theta_{K1} = \theta_{L1} - \theta_{L2} > 0: \tag{2.3}$$

---

[2] If we assume the Hick-Neutral technical progress, that is to assume that the rate of technical progress in both labor and capital inputs are the same, then we have

$$-(\hat{a}_{L2}\theta_{L2} + \hat{a}_{K2}\theta_{K2}) = -\hat{a}_{L2}(\theta_{L2} + \theta_{K2}) = -\hat{a}_{L2} = \pi_2:$$

Equation (2.3) gives us three important information.

First, when there is no technical progress (or cost reduction) in both sectors, $¼_i = 0$ for both i = 1 and 2; the Stolper-Samuelson theorem holds:

$$\hat{r} = \frac{µ_{L1}}{µ}\hat{p} \text{ or } \frac{\hat{r}}{\hat{p}} = \frac{µ_{L1}}{µ} > 1:$$

This is equivalently shown in a positively sloped p ¡ r curve of Figure 1.

Secondly, technical progress with the following condition leads to a horizontal shift of the p ¡ r curve to the right ($\hat{r} > 0$); see Figure 1:

$$µ_{L1}¼_2 ¡ µ_{L2}¼_1 > 0: \tag{2.4}$$

The shift of the p ¡ r curve could equivalently be expressed as

$$1 > \frac{µ_{L2}=(1 + ¼_2)}{µ_{L1}=(1 + ¼_1)}; \tag{2.5}$$

where $\frac{µ_{Li}}{(1+¼_i)}$ represents the share of labor costs in sector i discounted by technological progress.

Thirdly, suppose that there are two countries, home and foreign countries, with different rates of technical progress, see Figure 2. Given that both countries face the equilibrium rate of return on capital $r^{¤}$ in the world market, the relative price of capital-intensive good in foreign country p^f is higher than that of home country p^h, resulting in the comparative advantage in the production of capital-intensive good in home country.

Along the line of equation (2.5), for any positive technical progress ($¼_i^A$ ¸ 0 for both countries A = h and f and both sectors i = 1 and 2); the comparative advantage in the production of the capital-intensive good in home country could also be expressed as follows:

$$\frac{\mu^h_{L2}=(1 + ¼^h_2)}{\mu^h_{L1}=(1 + ¼^h_1)} < \frac{\mu^f_{L2}=(1 + ¼^f_2)}{\mu^f_{L1}=(1 + ¼^f_1)}; \tag{2.6}$$

where $\frac{\mu^A_{Li}}{(1+¼^A_i)}$ represents the share of labor costs in sector i discounted by technological progress for both countries A = h and f:

2.1.1. The Application: The Comparative Advantage Index (CAI)

The Kemp-Jones model suggests that the analysis on comparative advantage could focus on the analysis on labor cost shares (relative to labor cost shares of other sector). This is a useful result for two reasons. First, this result has empirical applicability since the data on sector-specific labor cost are available. Secondly, it provides a theoretical justification for why we observe so much emphases on labor productivity in trade disputes.. This section shows how the analytical framework of the Kemp-Jones model could be implemented in data analyses.

We are interested in 10 traded good sectors (at 2 digit-classification of International Sectoral Data Base (ISDB)) for 14 OECD countries in this study. This data set provides data on labor costs, which are the compensation of employees, for more than two sectors and more than two countries, home and foreign countries. Equation (2.6) is, therefore, expressed in a more explicit form. For all countries m and n (indicated by superscripts) and for all sectors i and j (indicated by subscripts), the Comparative

Advantage Index (CAI) is defined as follows:[3]

$$CAI_{ij}^{mn} = \ln \frac{w_i^m \frac{l_i^m}{X_i^m}}{w_j^m \frac{l_j^m}{X_j^m}} - \ln \frac{w_i^n \frac{l_i^n}{X_i^n}}{w_j^n \frac{l_j^n}{X_j^n}}; \qquad (2.7)$$

where $w_i^m; l_i^m$ and X_i^m stands for wage rates, labor inputs and output of country m(or n) for sector i(or j): If CAI_{ij}^{mn} is negative, then the $p - r$ curve for country m is below that of country n. For a given level of r^*; the price of good i (relative to good j) in country m is lower than that in country n; giving the comparative advantage of the production of good i in country m.

There is a very important point in the interpretation of the comparative advantage index. The Kemp-Jones model assumes that factor prices are equalized across sectors. Under this assumption, technical progress is the only source of a reduction in labor cost shares. We do, however, observe different wage rates across sectors in each country, possibly due to frictions in labor mobility across sectors (within country). In the presence of wage differentials across sectors, technical progress is not necessarily the only source of reductions in labor cost shares.

Figure 3 shows how labor market distortions could be incorporated in the labor cost shares (and hence the comparative advantage index). Suppose that there are no changes in technical progress in the labor-intensive good sector ($\pi_1 = 0$) and the world interest rates ($\hat{r} = 0$). These assumptions are simplifying assumptions; they imply no changes in wage rates ($\hat{w} = 0$), see equation (2.2).

---

[3] The expression in terms of natural logarithm allows us to see the different determinants of comparative advantage (the wage effect, the productivity effect, the endowment effect and the technology effect) in an additive form (see section 2.3 for details).

Figure 3 depicts the unit isoquant for the capital intensive good sector. Let 0 denote the initial choice of the capital-labor ratio. The labor cost share at this point is $\mu_{L2} = a_{L2}w$: Let us suppose that there is a cost reduction in this sector and the unit isoquant shifts to the origin, moving from 0 to A. The labor cost share at this point is $\mu_{L2}^{A} = a_{L2}^{A}w$ and is lower than μ_{L2}: Let us consider another case where there is no cost reduction, but due to less than perfect labor mobility, production takes place at point B (the sector-specific wage rate is higher than w at this point). The labor cost share at this point is $\mu_{L2}^{B} = a_{L2}^{B}w^{B}$, which could again be lower than μ_{L2}: The important point is that the labor cost shares we observe in data cannot distinguish these two cases.

In interpreting the comparative advantage index (a measurement based on labor cost shares), one must be aware that data on labor cost shares contain other effects (such as of wage differentials across sectors) besides the effects of technological progress. The contribution of this paper is not only to compute the comparative advantage index, but to distinguish these two determinants of labor cost shares and thus of comparative advantage.

2.2. Comparative Advantage Index (CAI)

2.2.1. Production Technology

This section describes the specification of production technology. The estimation of production function specified in this section allows us to proceed the decomposition of the comparative advantage (or labor cost shares) in the following section.

The production technology for all countries, $m = 1; :::; M$; and all traded sectors,

$i = 1, \ldots, N,$ are specified under the following assumptions.

(A 2.1) 14 OECD countries are assumed to have access to the same production technology.[4]

This assumption allows application of the so-called meta-production functions literature, introduced by Hayami and Ruttan (1970), and fully exploited by Lau and Yotopoulos (1989), Boskin and Lau (1992). To have access to a common technology implies that countries have the same underlying industry-specific aggregate production functions $F_{it}(\cdot)$ for each of all traded good sectors, $i = 1, \ldots, N,$ but may operate on different parts of it under different values of function parameters. The underlying industry-specific aggregate production function in terms of the so-called "efficient-equivalent" quantities of outputs and inputs is as follows: for $m = 1, \ldots, M,$ $t = 1, \ldots, T,$ $i = 1, \ldots, N,$

$$X_{it}^{m*} = F_{it}(k_{it}^{m*}, l_{it}^{m*}, K_{it}^{*}). \tag{2.8}$$

X_{it}^{m*}, k_{it}^{m*} and l_{it}^{m*} are the "efficiency equivalent" quantities of output, capital and labor, respectively.[5] K_{it}^{*} is the "efficiency equivalent" level of aggregate capital in the ith sector. This production function thus allows for the existence of external economies of scale. The external economies of scale originated with Marshall (1890), and were later refined by Edgeworth and others.

(A 2.2) The efficiency equivalent quantities of output and inputs are linked to

---

[4] This assumption is tested in section 3.2.

[5] More precisely, output X_{it}^{m*}, should be gross output, but not value added or output originating in industry i. Owing to the limited availability of data, however, in what follows, as in most empirical studies of industrial production, X_{it}^{m*} implies value added for industry i, whose quantity is determined by capital input, labor input and the level of technology. This treatment assumes constancy of the ratio between gross output and value added, or non-substitutability between materials and capital (or labor).

the measured quantities of output and inputs $X_{it}^{m}, k_{it}^{m}, l_{it}^{m}$ and K_{it} as follows: for $m = 1, \ldots, M;\ t = 1, \ldots, T;\ i = 1, \ldots, N;$

$$
\begin{aligned}
X_{it}^{m*} &= X_{it}^{m}; \\
k_{it}^{m*} &= A_i^m \exp(\lambda_i^m \cdot t) * k_{it}^{m}; \\
l_{it}^{m*} &= A_i^m \exp(\lambda_i^m \cdot t) * l_{it}^{m}; \\
K_{it}^{*} &= K_{it}.
\end{aligned}
$$

The efficiency equivalent quantities of output and inputs for each country are not directly observable. In this paper, the efficiency equivalent quantities of output, X_{it}^{m*}, and the industry's aggregate level of capital, K_{it}^{*}, are assumed to be the same as what are observed in data. On the other hand, the degree of efficiency of inputs is represented by the initial efficiency level of inputs, A_i^m, and the rate of technical progress, λ_i^m. All the parameters with superscript m and subscript i indicate that they are country-specific and industry-specific parameters, respectively. Notice, also, that Hicks-neutral technical progress is assumed as in section 2.2. In other words, the rate of technical progress in labor and capital inputs are the same for each country and each industry.

(A 2.3) The production function $F_{it}(.)$ has a transcendental logarithmic (translog) functional form.

The translog functional form was introduced by Christensen, Jorgenson, and Lau (1973). For the production function above, it takes the following form: for m =

$1, \ldots, M;\ t = 1, \ldots, T;\ i = 1, \ldots, N,$

$$\begin{aligned}
\ln X_{it}^{m*} = {} & \ln X_{0i} + \alpha_{ki} \ln k_{it}^{m*} + \alpha_{li} \ln l_{it}^{m*} + \alpha_{Ki} \ln K_{it}^{*} \\
& + \beta_{kki} \frac{(\ln k_{it}^{m*})^2}{2} + \beta_{lli} \frac{(\ln l_{it}^{m*})^2}{2} + \beta_{KKi} \frac{(\ln K_{it}^{*})^2}{2} \\
& + \beta_{kli} (\ln k_{it}^{m*})(\ln l_{it}^{m*}) + \beta_{kKi} (\ln k_{it}^{m*})(\ln K_{it}^{*}) + \beta_{lKi} (\ln l_{it}^{m*})(\ln K_{it}^{*}).
\end{aligned} \tag{2.9}$$

Having such a general functional form allows us to test some of the standard assumptions in the estimation of technological parameters: for instance, constant returns to scale or constant elasticity of output with respect to factors.

(A 2.4) The only source of increasing returns to scale is assumed to be through external economies of scale from the worldwide size of capital in each industry.

This assumption is equivalent to assume that firms are in competitive markets, perceiving that their production functions exhibit constant returns to scale.[6] This assumption implies the following conditions: for each industry i, $\alpha_{ki} + \alpha_{li} = 1$ and $\beta_{kki} + \beta_{kli} = \beta_{lli} + \beta_{kli} = \beta_{kKi} + \beta_{lKi} = 0$.

The production function in this paper is, therefore, as follows: for $m = 1, \ldots, M$, $t = 1, \ldots, T$, $i = 1, \ldots, N$,

$$\begin{aligned}
\ln \frac{X_{it}^{m}}{l_{it}^{m}} = {} & \ln X_{0i} + \ln A_i^m + \lambda_i^m \cdot t + \alpha_{ki} \ln \frac{k_{it}^{m}}{l_{it}^{m}} + \alpha_{Ki} \ln K_{it} \\
& + \frac{\beta_{kki}}{2} \left(\ln \frac{k_{it}^{m}}{l_{it}^{m}}\right)^2 + \frac{\beta_{KKi}}{2} (\ln K_{it})^2 + \beta_{kKi} \left(\ln \frac{k_{it}^{m}}{l_{it}^{m}}\right)(\ln K_{it}) + u_{it}^m,
\end{aligned} \tag{2.10}$$

---

[6] To be very rigorous, this assumption must be tested, too. There are two reasons to make this assumption. One is to reduce the number of parameters. A CRS assumption at firm level reduces the number of parameters to be estimated and thereby mitigates possible multicollinearity among the data on capital, labor and time. The other reason rests on the focus of this paper. Given that the number of parameters cannot be too large, emphases are placed on testing the presence of externality via the industry aggregate capital.

where $u_{it}^m = \rho^m u_{it-1}^m + v_{it}^m.$

2.2.2. CAI Decomposition

The Comparative Advantage Index (CAI) is decomposed in two steps. The first step of decomposition is very simple. The comparative advantage index, CAI_{ij}^{mn} can be decomposed into the wage effect, WE_{ij}^{mn}, and the (labor) productivity effect, PE_{ij}^{mn}, as follows:

$$CAI_{ij}^{mn} = WE_{ij}^{mn} + PE_{ij}^{mn}, \tag{2.11}$$

where $WE_{ij}^{mn} = \ln \frac{w_i^m}{w_j^m} - \ln \frac{w_i^n}{w_j^n}$ and $PE_{ij}^{mn} = \ln \frac{\frac{l_i^m}{x_i^m}}{\frac{l_j^m}{x_j^m}} - \ln \frac{\frac{l_i^n}{x_i^n}}{\frac{l_j^n}{x_j^n}}.$ In other words, the comparative advantage in relative labor costs is decomposed into relative wage and relative labor requirement.

The second step of decomposition, decomposing the productivity effect, PE_{ij}^{mn}, into two parts, the direct technology effect, TE_{ij}^{mn}, and the indirect endowment effect, EE_{ij}^{mn} is carried out as follows. The productivity effect, PE_{ij}^{mn}, in equation (2.11) can be written as

$$PE_{ij}^{mn} = \Delta \ln \frac{X_i}{l_i} - \Delta \ln \frac{X_j}{l_j}, \tag{2.12}$$

where $\Delta \ln \frac{x_i}{l_i} = \ln \frac{x_i^n}{l_i^n} - \ln \frac{x_i^m}{l_i^m}$, and $\Delta \ln \frac{x_j}{l_j} = \ln \frac{x_j^n}{l_j^n} - \ln \frac{x_j^m}{l_j^m}.$

Let us recall the production function, equation (2.10). For country m and n, the production functions are given as follows:[7]

$$\ln \frac{X_i^m}{l_i^m} = \ln X_{0i} + \ln A_i^m + \lambda_i^m \Delta t + \alpha_{ki} \ln \frac{k_i^m}{l_i^m} + \alpha_{Ki} \ln K_i$$

---

[7] The subscript t is dropped since the translog functional form will be identical to all $t = 1, \ldots, T$.

$$+\frac{\beta_{kki}}{2}\left(\ln\frac{k_i^m}{l_i^m}\right)^2 + \frac{\beta_{KKi}}{2}(\ln K_i)^2 + \beta_{kKi}\ln\frac{k_i^m}{l_i^m}\ln K_i;$$

where $m = m$ and n:

The difference between $\ln\frac{X_i^n}{l_i^n}$ and $\ln\frac{X_i^m}{l_i^m}$, that is, $\Delta\ln\frac{X_i}{l_i}$, can be expressed as follows:

$$\begin{aligned}\Delta\ln\frac{X_i}{l_i} &= \Delta\ln A_i + \Delta\lambda_i\Delta t + \alpha_{ki}\Delta\ln\frac{k_i}{l_i} + \alpha_{Ki}\Delta\ln K_i \\ &\quad \beta_{kki}\Delta\ln\frac{k_i}{l_i}^2 + \beta_{KKi}\Delta\ln K_i^2 + \beta_{kKi}\Delta\ln\frac{k_i}{l_i}\ln K_i;\end{aligned} \tag{2.13}$$

where $\Delta\ln A_i = \ln A_i^m - \ln A_i^n$; $\Delta\lambda_i = \lambda_i^m - \lambda_i^n$; $\Delta\ln\frac{k_i}{l_i} = \ln\frac{k_i^m}{l_i^m} - \ln\frac{k_i^n}{l_i^n}$ and $\Delta\ln\frac{k_i}{l_i}^2 = \ln\frac{k_i^m}{l_i^m}^2 - \ln\frac{k_i^n}{l_i^n}^2$. Two terms, $\alpha_{Ki}\Delta\ln K_i$ and $\beta_{KKi}\Delta\ln K_i^2$; drop out since both countries m and n face the same aggregate level of industry capital, K_i. The first two terms of (2.13) together are called the technology effect for industry i between countries m and n; TE_i^{mn}; and the rest are called the endowment effect for industry i between countries m and n; EE_i^{mn}:

$$\Delta\ln\frac{X_i}{l_i} = TE_i^{mn} + EE_i^{mn} \tag{2.14}$$

where $TE_i^{mn} = \Delta\ln A_i + \Delta\lambda_i\Delta t$ and $EE_i^{mn} = \alpha_{ki}\Delta\ln\frac{k_i}{l_i} + \beta_{kki}\Delta\ln\frac{k_i}{l_i}^2 + \beta_{kKi}\Delta\ln\frac{k_i}{l_i}\ln K_i$:

Similarly, for industry j; $\Delta\ln\frac{X_j}{l_j}$ is decomposed into the technology effect for industry j between countries m and n; TE_j^{mn}; and the rest as the endowment effect for industry j between countries m and n; EE_j^{mn}:

$$\Delta\ln\frac{X_j}{l_j} = TE_j^{mn} + EE_j^{mn}$$

where $TE_j^{mn} = \Delta \ln A_j + \Delta \lambda_j \cdot t$ and $EE_j^{mn} = \alpha_{kj} \Delta \ln \frac{k_j}{l_j} + \beta_{kkj} \Delta \ln \frac{k_j}{l_j}^2 + \beta_{kKj} \Delta \ln \frac{k_j}{l_j} \ln K_j.$

The productivity effect between countries m and n and sectors i and j, can, therefore, be decomposed as follows:

$$PE_{ij}^{mn} = TE_{ij}^{mn} + EE_{ij}^{mn}, \tag{2.15}$$

where $TE_{ij}^{mn} = TE_i^{mn} - TE_j^{mn}$ and $EE_{ij}^{mn} = EE_i^{mn} - EE_j^{mn}.$

The summary of the two-step decomposition is given by

$$\begin{aligned} CAI_{ij}^{mn} &= WE_{ij}^{mn} + PE_{ij}^{mn}, \qquad (2.16) \\ \text{where } PE_{ij}^{mn} &= TE_{ij}^{mn} + EE_{ij}^{mn}. \end{aligned}$$

The interpretations of this decomposition are given in the next section.

2.2.3. Interpretation of CAI Decomposition

In the previous section, the comparative advantage index CAI_{ij}^{mn} was decomposed in two steps. In the first step, CAI_{ij}^{mn} was decomposed into the wage effect, WE_{ij}^{mn}, and the productivity effect, PE_{ij}^{mn}. In the second step, the productivity effect, PE_{ij}^{mn}, was decomposed into the technology effect, TE_{ij}^{mn} and the endowment effect, EE_{ij}^{mn}.

The interpretation of the first step of decomposition is straightforward. The productivity effect captures the effect of different labor productivity on comparative advantage. On the other hand, the wage effect represents how differences in relative wage rates affect the comparative advantage. If factor prices are equalized across sectors, then the wage effect must be zero. We, however, observed that wage rates are not necessarily equalized across sectors in any of the 14 OECD countries.

The technology effect in the second step of decomposition captures the impact of different technological progress on labor productivity, and through it on comparative advantage. Technological progress improving labor productivity and thus reducing the labor cost share is the movement from 0 to A in Figure 3. It is interesting to note that the direct effect is not the only source of differences in labor productivity across countries, in the presence of less than perfect labor mobility across sectors (within a country).

The endowment effect captures the effect of differences in the capital-labor ratio on labor productivity and consequently on labor cost shares. The endowment effect is shown in the movement from 0 to B in Figure 3. Typically, any changes in labor cost shares are the combination of these two effects, the technology and endowment effects.

3. Empirical Results

3.1. Estimation Method

The industries and countries used in this paper are given in Tables 1 (a) and 1 (b). The structural parameters estimated for 10 sectors are given in Table 2.

There are three points to note. First, the production function are expressed in terms of first differences since output data exhibits a unit root process, see Appendix for the unit root tests:

$$\begin{aligned}\Delta \ln \frac{X_i^m}{l_i^m} = {} & \lambda_i^m + \alpha_{ki}\,\Delta \ln \frac{k_i^m}{l_i^m} + \alpha_{Ki}\,\Delta \ln K_{it} + \frac{\beta_{kki}}{2}\,\Delta \ln \frac{k_i^m}{l_i^m}^2 \\ & + \frac{\beta_{KKi}}{2}\,\Delta \ln K_i^2 + \beta_{kKi}\,\Delta \ln \frac{k_i^m}{l_i^m} \ln K_{it} + v_i^m;\end{aligned} \qquad (3.1)$$

where $\Delta \ln \frac{X_i^m}{l_i^m} = \ln \frac{X_{it}^m}{l_{it}^m} - \ln \frac{X_{it-1}^m}{l_{it-1}^m}$; $\Delta \ln \frac{k_i^m}{l_i^m} = \ln \frac{k_{it}^m}{l_{it}^m} - \ln \frac{k_{it-1}^m}{l_{it-1}^m}$; $\Delta \ln \frac{k_i^m}{l_i^m}^2 = \ln \frac{k_{it}^m}{l_{it}^m}^2 - \ln \frac{k_{it-1}^m}{l_{it-1}^m}^2$; $\Delta \ln K_i = \ln K_{it} - \ln K_{it-1}$; $\Delta \ln K_i^2 = \ln K_{it}^2 - \ln K_{it-1}^2$; and $\Delta \ln \frac{k_i^m}{l_i^m} \ln K_i = \ln \frac{k_{it}^m}{l_{it}^m} \ln K_{it} - \ln \frac{k_{it-1}^m}{l_{it-1}^m} \ln K_{it-1}$:

Second, given the production function of equation (2.10), the output elasticity with respect to country-specific capital is as follows: For all industry i and country m;

$$\varepsilon_{ki}^m = \alpha_{ki} + \beta_{kki} \ln \frac{k_i^m}{l_i^m} + \beta_{kKi} \ln K_i: \qquad (3.2)$$

Under profit maximization with competitive markets, the elasticity of output with respect to capital equals the share of capital cost (or 1 minus the share of labor cost) in the value of total output. The labor share for each country m and industry i, that is, $\frac{w_i l_i^m}{X_i^m}$; is observed and used in the estimation of the production function. In other words, this paper estimates a simultaneous equations system of (3.1) and (3.2), with the parameter restrictions between the two equations for each country. Since the 14 countries share the common parameters, αs and βs, what we have here is a 28-equations system for each industry; see the Appendix for details. The instrumental variables, which are taken from Baskin and Lau (1992), are as follows: relative price of cotton to wheat, relative price of oil to wheat, relative price of iron to wheat, world population, male population, female population, arable land, permanent crops, male life expectancy and female life expectancy.

Third, the shift parameters, or the parameters that capture differences in the efficiency level of inputs, $\ln A_i^m$, could not be estimated since a constant term drops out by first differencing. $\ln A_{it}^m$ is computed for each country and each industry for 1970, 1980 and 1990 such that the residuals for these years are set to zero (see Table 2).[8]

$$\begin{aligned}\ln A_{it}^m = \; & \ln \frac{X_{it}^m}{l_{it}^m} - \lambda_i^m \cdot t - \alpha_{ki} \ln \frac{k_{it}^m}{l_{it}^m} - \alpha_{Ki} \ln K_{it} \\ & - \frac{\beta_{kki}}{2} (\ln \frac{k_{it}^m}{l_{it}^m})^2 - \frac{\beta_{KKi}}{2} (\ln K_{it})^2 - \beta_{kKi} \ln \frac{k_{it}^m}{l_{it}^m} \ln K_{it},\end{aligned} \tag{3.3}$$

for $t = 1970$, 1980 and 1990.

3.2. Hypothesis Testing

A couple of assumptions are tested. First, the assumption (A1) is rejected for an alternative hypothesis that the underlying aggregate production functions are different for countries of different size (in terms of parameters, this means that the commonly shared parameters, αs and βs, are commonly shared among countries of similar size). This is to say that the parameters for G7 countries (USA, CAN, FRA, DEU, ITA, JPN and GBR) and those for non-G7 countries, are estimated separately. This implies

---

[8] λ is supposed to capture all the changes in the quality of capital and labor input and $\ln A$ the initial efficiency level of capital and labor input. λ, however, does not seem to capture all the changes and thus the residuals by the end of the sample period, that is, $u_{i,1992}^m = \sum_{t=1970}^{1992} v_{it}^m$, tend to be large. The shift parameter are computed, not only for the initial period, 1970, but for 1980 and 1990 as well.

that the decomposition equation (2.13) is as follows:

$$\Delta \ln \frac{X_i}{l_i} = TE_i^{mn} + EE_i^{mn}, \tag{3.4}$$

where $TE_i^{mn} = \Delta \ln A_i + \Delta \lambda_i \Delta t + \Delta\alpha_{ki} \ln \frac{k_i^m}{l_i^m} + \Delta\alpha_{Ki} \ln K_i + \Delta\beta_{kki} \ln \frac{k_i^m}{l_i^m}^2 + \Delta\beta_{KKi} \ln K_i^2 + \Delta\beta_{kKi} \ln \frac{k_i^m}{l_i^m} \ln K_i$ and $EE_i^{mn} = \alpha_{ki}^n \Delta \ln \frac{k_i}{l_i} + \beta_{kki}^n \Delta \ln \frac{k_i}{l_i}^2 + \beta_{kKi}^n \Delta \ln \frac{k_i}{l_i} \ln K_i$ ($\Delta\alpha_{ki} = \alpha_{ki}^m - \alpha_{ki}^n$; $\Delta\alpha_{Ki} = \alpha_{Ki}^m - \alpha_{Ki}^n$; $\Delta\beta_{kki} = \beta_{kki}^m - \beta_{kki}^n$; $\Delta\beta_{KKi} = \beta_{KKi}^m - \beta_{KKi}^n$; and $\Delta\beta_{kKi} = \beta_{kKi}^m - \beta_{kKi}^n$).

Second, this paper tests the presence of externality and the returns from the aggregate capital. The first test is to see if the economy is growing in proportion to capital accumulation (to see if the economy resembles an AK model). This test is equivalent to test whether the returns on the aggregate capital are the same as the returns on labor. With the production function specified in equation (2.10), the output elasticity with respect to aggregate capital, K, is

$$\varepsilon_{Ki}^m = \alpha_{Ki} + \beta_{kKi} \ln \frac{k_i^m}{l_i^m} + \beta_{KKi} \ln K_i. \tag{3.5}$$

To assume the returns on aggregate capital and labor to be the same implies that

$$\frac{w_i^m l_i^m}{X_i^m} = \varepsilon_{Ki}^m.$$

This is equivalent to having the following parameter restrictions (see equations (3.2) and (3.5)):

$$\alpha_{Ki} = 1 - \alpha_{ki}, \tag{3.6}$$

$$\beta_{kKi} = -\beta_{kKi}, \text{ and} \tag{3.7}$$

$$\beta_{KKi} = \beta_{kki}. \tag{3.8}$$

This assumption was not rejected for any sector in the case of G7 countries, except for the other manufacturing products industry. In the case of non-G7 countries, the assumption was rejected for the food products, chemical products, non-metallic products, machineries and equipments and other manufacturing products industries. For those rejected, no externality (or a constant returns to scale) tests are carried out; that is to see whether the following parameter restrictions hold:

$$\alpha_{Ki} = 0, \tag{3.9}$$

$$\beta_{kKi} = 0, \text{ and} \tag{3.10}$$

$$\beta_{KKi} = 0. \tag{3.11}$$

A constant returns to scale assumption was rejected for the food products and chemical products industries for non-G7 countries and the other manufacturing products sector for G7 countries. In those cases, the parameter restriction (3.10) is only imposed. For the remaining cases, namely the non-metallic products, machineries and equipments and other manufacturing products industries for non-G7 countries, the parameter restrictions (3.9) to (3.11) are applied.

3.3. Organizational Notations for the Decomposition

The comparative advantage index, CAI_{ij}^{mn}; is computed for all 91 combinations of countries for each of the 45 industry combinations and for each period since the sample has 14 countries and 10 industries. Each of the comparative advantage indices is decomposed into 5 components, the wage effect, WE_{ij}^{mn}; the productivity effect, PE_{ij}^{mn}; the technology effect, TE_{ij}^{mn}, the endowment effect, EE_{ij}^{mn} and the residual term. The number of results to present is very large, and thus some organizational notation is necessary. In the rest of the paper, when two countries, such as Japan and the U.S., are discussed, m represents the first country and n the second country. Similarly, when two industries, such as the basic metal industry (BMI) relative to the agricultural sector (AGR) are discussed, i represents the first industry (the industry in the numerator) and j the second industry (the industry in the denominator). Each country combination and industry combination has an index number, which is given in Tables 1 (c) and 1 (d), respectively. For example, if one is interested in the comparative advantage of the basic metal industry (BMI) relative to agriculture (AGR) in the case of Japan with respect to the U.S., he/she should refer to country combination index 81 and industry combination index -7.

4. Comparative Advantage between Japan and the U.S.

The comparative advantage index decomposition of this study permits an analysis of bilateral trade relations across sectors and across time. This section discusses the Japan-U.S. relation. It is very interesting to examine the empirical results in light of the structural changes in Japan and thus consequential changes in comparative advantage over the U.S. The structural changes in Japan shifted prosperity from the light industries to the heavy industries and can be seen as changes in comparative advantages.

Table 3 gives a summary of the comparative advantage in each industry between Japan and the U.S. for 1971 and 1992. The non-shaded columns are for 1971 and the shaded columns are for 1992. The comparative advantage index (CAI) for the machinery and equipment industry in 1971, 0:540, is the average of the CAI for the machinery and equipment sector relative to all other 9 sectors, i.e., the average of CAI for the industry combination index -8, -16, -23, -29, -34, -38, -41, -43 and 45 of Table 1 (d). The positive sign implies that Japan, in fact, had a comparative dis-advantage over the U.S. in the machinery industry relative to other industries on average in 1971. To indicate the comparative advantage in Japan, all the numbers with negative signs are bolded in Table 3. The magnitude is in natural logarithm; therefore, 0:540 implies that the relative labor cost in Japan was approximately 1:71 times higher that in the U.S.

4.1. Structural Changes and the Comparative Advantage Reversal

The comparative advantage reversal between the two countries started in the textile industry in the 1950s and 1960s. The Japanese textile and basic metal industries, in particular, steel, became competitive and started enjoying comparative advantage over the U.S. in the 1960s. This phenomenon can be seen from the negative signs of the CAI in 1971 for both the textile industry, ¡0:128; and the basic metal industry,

-0.146. The magnitude implies that the relative cost of production in Japan was 12 and 14 percent lower than those in the U.S., respectively. On the other hand, machine tools, autos, videos, semiconductors, and other products belonging to the machinery industry, MEQ, were still at a comparative "dis"advantage in the early 1970s. The CAI in the machinery industry in 1971, 0.540; indicates that the relative cost of production in Japan was higher (approximately 1.71 times) than that in the U.S.

There was a large structural change and thus a large shift in comparative advantages in international trade as industrialization in Japan continued during the 1970s and 1980s. Light industries, such as the food industry, FOD and textile industry, TEX, lost their comparative advantages by 1992. This can be seen from the positive signs of the CAI for FOD and TEX, 0.072 and 0.290, respectively (the relative cost of production in the food and textile industries in Japan was approximately 1.07 and 1.34 times higher those in the U.S., respectively). On the other hand, the comparative "dis"advantage in the machinery and equipment industry, MEQ, turned to comparative advantage by 1992. The negative value, -0.135; indicates that the relative cost of production in Japan was 0.87 times lower that in the U.S. [9]

---

[9] Gagnon and Rose (1991) looked at trade flows between the U.S. and Japan for 1962-1988 in the 4-digit SITC classification and found very little evidence of product-cycle dynamics. In other words, goods that were in surplus (deficit) in 1962 tended to remain in surplus (deficit) in the late 1980s. The analysis of the comparative advantage in a unit labor cost in this paper is not a explicit analysis of trade flows and thus has not taken the demand side factors as the determinants of international trade. The contradiction between their findings and mine must be, therefore, examined carefully in a demand side analysis, which is the topic of Saito (1999).

4.2. Source of Comparative Advantages

We now turn to the source of comparative advantages. Japan's comparative "dis-"advantage over the U.S. in the machinery industry in 1971 was mainly due to the productivity effect, 0.734. The relative labor requirement in Japan was more than twice that in the U.S. In fact, with regards to the wage effect, Japan had a comparative advantage over the U.S. in 1971. -0.194 implies that the relative wage in Japan was approximately 0.82 times lower that in the U.S.

More interestingly, the productivity effect decomposition indicates that the comparative "dis"advantage in productivity was mainly due to the effect of relative technology, 0.810; and not that of capital-labor ratio, -0.149. This is to say that, keeping the capital-labor ratio the same, the relative labor requirement in the machinery industry in Japan was as high as 2.25 times that of the U.S. due to the less-advanced Japanese technology. On the other hand, keeping technologies the same, differences in the capital-labor ratio in the machinery industry (with respect to the rest of the industries in each country) brought about comparative advantage in Japan. The relatively higher use of capital to the machinery industry is consistent with the industrial policies of the Japanese Government in the 1970s and before it (Komiya, 1990 and Komiya and Irino, 1992).

By 1992, the technology effect had turned to a negative sign, -0.130; while the endowment effect had become positive, $0.030.$ This implies that the relative technology in the machinery industry became more competitive, while the relative endowment effect less competitive. The comparative advantage in the technology effect exceeded the comparative "dis"advantage in the endowment effect to bring about a comparative advantage in productivity effect.

The structural changes in Japan in the 1970s and 1980s seem to be well-reflected in the reversal of the comparative advantage index from positive to negative in the heavy industries and from negative to positive in the light industries.

5. U.S. Competitiveness: By Sector

This section shows how a country's trade competitiveness can be analyzed using the comparative advantage index decomposition. U.S. competitiveness in 1971 and 1992 is presented in this section. The key features of U.S. competitiveness in the 1980s were threefold.

First, the U.S. saw a substantial improvement in comparative advantage in food, textiles, chemical products, and other manufacturing products, but some decline in mining and the basic metal industry (other sectors remained unchanged). It is a well-discussed issue that U.S. labor productivity in the 1990s has improved substantially, but it was also the case in some industries prior to the 1990s. The key determinant in explaining these changes is the productivity (or labor requirement) effect and not the wage effect.

Second, the productivity effect in the U.S. was predominantly determined by the technology effect. In other words, the change in the comparative advantage in relative technology was a key factor.

Third, the wage effect remained unchanged over the period:[10] it remained strong

---

[10] The average wage across countries may have been converging as stated in Madsen (1996), who

in the agriculture and textile industries (i.e., the relative wage in these sectors was low in comparison with other countries) and remained weak in the chemical products and machinery and equipment industries (i.e., the relative wage in these sectors remained high in comparison with other countries). This steady nature of relative wages may be due to the fact that wages are not necessarily changing according to changes in labor productivity, but are largely fixed by other factors. For instance, wages are typically determined by skills required in each sector (which are captured by education, experience and abilities). This may not necessarily reflect changes in labor productivity.

The details of these findings can be found in Table 4, which consists of 10 sub-tables. The first sub-table presents U.S. competitiveness in agriculture in 1971 and 1992. The non-shaded columns present the 1971 result and the shaded columns present the 1992 result. The ninth row is U.S. competitiveness over Japan in agriculture in 1971 and is identical to the first row of Table 3. In other words, the comparative advantage index (CAI) for the ninth row of this sub-table, -0.014, is the average of the CAI for the agriculture sector relative to all other 9 sectors for the country combination of JPN-USA; that is, the average of the CAI for the industry combination index 1 to 9 of Table 1 (c) and for the country combination index 81 of Table 1 (d). In Table 4, a positive sign (in bold) indicates that the U.S. had a comparative advantage over the country in comparison. The following sections 5.1 to 5.10 present a summary of findings for each industry. They correspond to sub-tables

---

looked at 21 OECD countries for the period of 1960 to 1993. The wage effect remained unchanged, however, implying that the wage differential across sectors was not converging.

of Table 4.

5.1. Agriculture

The U.S. agricultural industry remained reasonably competitive during the period of 1971-92; it had a comparative advantage over 6 out of 14 countries, Canada, West Germany, Italy, the Netherlands, Sweden and the U.K., in 1971, and over 7 countries, Australia, Canada, Denmark, Italy, Japan, the Netherlands and the U.K., in 1992.

It is very interesting to note that the key driving force of the strong U.S. agricultural industry was the relative wage component. The comparative advantage in the wage effect was over 9 countries in 1971, and over 12 countries in 1992. This may be due to the fact that most countries tend to have some kind of protection in agriculture. This could be driving the relative wage of agriculture in these countries higher than that in the U.S.

It is also interesting to note that the comparative advantage in the productivity (or labor requirement) effect was mainly driven by the technology effect. In terms of technology, the U.S. had a comparative advantage over only 3 countries in 1971, but over 7 countries in 1992.

5.2. Mining

The U.S. mining sector was strongly competitive in 1971, but seemed to have fallen slightly in 1992; it had a comparative advantage over 10 out of 12 countries in 1971, but only 6 countries in 1992. The key player in both periods was the productivity effect and not the wage effect as in the case of agriculture.

The cause of the fall in productivity (or labor requirement) effect was in both the direct technology effect and the endowment effect.

5.3. Food

The U.S. food industry gained a comparative advantage substantially between 1971 and 1992. It had a comparative advantage over only 1 country in 1971, but over 7 countries in 1992. This improvement was driven mainly by the productivity effect. It is interesting to note that productivity enhancements to recover U.S. competitiveness in international trade (which is believed to have brought prosperity in recent years to the U.S. economy) were already taking place in the late 1980s (Hickman, 1992).

As in the case of other industries, the technology effect was an important component of the comparative advantage in productivity. The U.S. food industry had a comparative advantage in relative technology over 3 countries in 1971, but over 7 countries in 1992.

5.4. Textile

U.S. competitiveness in the textile industry also improved substantially during the period of 1971-92. The U.S. textile industry had a comparative "dis"advantage over all countries in 1971, but a comparative advantage over 7 out of 12 countries by 1992.

The wage effect during this period remained unchanged and strong in both periods; the comparative advantage in the wage effect was over 8 out of 12 countries in both 1971 and 1992. What induced the substantial improvement in the 1980s was, therefore, improvements in productivity.

As in the case of the food industry, the improvement in the productivity effect was due to an improvement in relative technology.

5.5. Paper

U.S. competitiveness in the paper industry did not change much over the period 1971-92.

5.6. Chemical Products

As in the case of the food and textile industries, the chemical industry also saw a substantial improvement in competitiveness; the comparative advantage was over only 3 out of 12 countries in 1971, but was over 8 countries in 1992.

The wage effect remained rather moderate; the comparative advantage was over 4 countries in 1971 and 3 in 1992. The main source of the stronger competitiveness was, therefore, due to improvement in relative productivity. The comparative advantage in relative productivity was over 6 countries in 1971 and 9 in 1992.

The key player in the productivity effect was the endowment effect. In other words, the effective endowment of labor inputs with machineries played an important role. The US chemical industry had a comparative advantage over 8 countries in both 1971 and 1992. The technology effect comparison, however, showed that the U.S. had a comparative advantage over 7 countries in 1971 and 6 in 1992.

5.7. Non-Metallic Products

The U.S. non-metallic products industry was not competitive in either period, 1971 or 1992; the comparative "dis"advantage was over all countries except Belgium in 1971, and over all countries in 1992.

The key determinant of the comparative advantage in this industry was again the productivity effect, which hampered the comparative advantage.

5.8. Basic Metal

The U.S. basic metal industry was very strong in 1971, but had lost its competitiveness by 1992. The comparative advantage was over 10 out of 12 countries in 1971 but over only 6 countries in 1992.

The main source of the loss in competitiveness was again in the productivity effect. The comparative advantage in terms of the productivity (or labor requirement) effect fell from over 8 countries to 5 countries during this period.

The fall in the productivity effect was mainly caused by a fall in the technology effect. The U.S. basic metal industry had a comparative advantage in the technology effect over 9 countries in 1971, but only over 4 countries in 1992. This seems to be in contrast with the rest of the industries, most of which were improving relative technology. This might be due to the fact that other countries, such as West Germany, Italy and Japan, had improved their relative productivity to a greater extent than the improvement in the U.S.

5.9. Machinery and Equipment

The comparative advantage in this industry did not change much between 1971 and 1992; the comparative advantage was over 4 countries in both periods. The U.S. had a rather strong position in productivity in both periods: the comparative advantage was over 6 countries in 1971 and 7 in 1992.

The wage effect, however, seemed to have hampered the overall competitiveness: the comparative "dis"advantage in the wage effect in 1971 and 1992 was over 11 countries and 10 countries, respectively). This is quite the opposite of what was observed in the agriculture or food industries, where the wage effect was favorable.

5.10. Other Manufacturing Products

U.S. competitiveness in other manufacturing products improved over the period of 1971-92. The stronger competitiveness in the U.S., particularly driven by a comparative advantage in technology, was probably in medical machinery and equipment, which was a rapidly growing product in this industry.

Here, too, the technology effect played an important role in improving the productivity effect. The comparative advantage in the technology effect improved from being over 4 countries to being over 9 countries between 1971 and 1992.

6. Comments on Other Trade Theories

The comparative advantage index decomposition provides fruitful insight for the Ricardian theory of trade and the traditional Heckscher-Ohlin theorem with no capital mobility. First, the Ricardian model claims that the relative labor requirements are the key determinant of comparative advantage. The empirical evidence could only confirm this claim for the 1970s. In the 1980s, the sector-specific wage rates (relative to those in other sectors in a country) began to play a much more important role as the determinant of comparative advantage of each country. Second, one of the main sources of the poor performance of the Heckscher-Ohlin theorem is widely agreed to be in cross-country differences in relative labor requirements. The decomposition of relative labor requirements into two sub-components indicates that such differences are highly correlated with (i) cross-country differences in relative rates of technical progress in light industries and (ii) cross-country differences in relative capital requirements in heavy industries.

6.1. Ricardian Theory of Trade

The Ricardian theory of trade explains comparative advantage simply by relative labor productivity. This study finds strong evidence to support the Ricardian theory of trade in 1971, as in the case of MacDougall et al. (1962), Stern (1962) and Balassa (1963).[11] In contrast to their studies, which only looked at the UK-US data, this paper found a high correlation between the comparative advantage index (CAI) and the productivity effect for all OECD countries for all industries.[12] This evidence changes during the sample period, however. The correlation between the comparative

---

[11] See Deardorff (1984) for more details.

[12] Here, CAI is implicitly assumed to reflect the patterns of trade fully. This is probably not the case. Factors such as different preferences (e.g., home good bias) and transaction costs (e.g., transportation costs) are likely to be causing a lot of noise between the patterns of comparative advantage and the actual pattern of trade. This is discussed in Saito (1999).

advantage index and the productivity effect fell substantially in some sectors, such as non-metallic products, basic metal products and machinery and equipment industries.

Table 5 presents the correlation coefficients between the comparative advantage index (CAI) and each of the four components of the decomposition for 1971 and 1992 for each industry. An asterisk next to a correlation coefficient indicates that it is statistically significant at the 5 percent level. For instance, the correlation coefficient between the CAI and the productivity effect for 1971 in agriculture, 0.930, is computed from the sample of all 91 country combinations (e.g., Japan vs. the U.S., can be found in the first row of Table 3, -0.014 (CAI) and -0.608 (the productivity effect)).

In 1971 (see the non-shaded columns of Table 5), the CAI and the productivity effect have a high correlation in all industries, ranging from 0.834 and 0.982. This implies that the size and sign of the CAI are predominantly determined by the productivity effect. It is to be noted that the correlation coefficient represents simply the general tendency (or the summary of numerous observations), while individual figures for each industry and for each combination of countries stand for individual facts.

It is important to note, however, that the high correlation is not necessarily the case in 1992. The shaded area of Table 5 presents the relationship between the CAI and its components in 1992. It must be stressed that, in contrast to 1971, the strong relationship between the CAI and the productivity effect was no longer the case, particularly in TEX (0.640), CHE (0.686), MNM (0.252), BMI (0.297) and MEQ (0.245). On the other hand, the relationship between the CAI and the wage effect increased, particularly in those that lost the strong relationship between the CAI and the productivity effect, TEX (0.776), MNM (0.902), BMI (0.564) and MEQ (0.585).

These findings lead us to believe that competition in relative labor cost shares, which was definitely competition over relative productivity (or a labor requirement) in 1971, was moving toward competition over relative wage rates. In other words, keeping wage rates low relative to the rest of the economy in each country became much more important issue than reducing the costs through technical progress. This may be a result of convergence of differences in labor productivity across countries, particularly in heavy industries.

6.2. Poor Performance of Heckscher-Ohlin Theorem

The poor performance of the Heckscher-Ohlin theorem in data is a well discussed issue, since Leontief (1953), Leamer (1980), Bowen et al. (1987) and others. There are two standard explanations of the poor performance of the theorem. They are, the differences in production technologies and factor prices across countries.

Firstly, relaxing the assumption of "universal technology" has been questioned and discussed thoroughly by various people in the empirical H-O literature; see Trefler (1995), Maskus and Webster (1995), Harrigan (1997), and others. This literature tends to assume that differences in factor requirements are due to differences in technologies. This is equivalent to assume that factor prices are equalized and hence there is neither endowment effect nor wage effect.

Secondly, relaxing the assumption of factor price equalization across sectors and across countries has also been explored; see Davis et al. (1997) and others. Davis et al. assume that factor prices are equalized and technologies are the same within a country, but not across countries. Using a regional data on Japan, they show that the H-O theorem holds well for the regional data. They, in contrast to Trefler (1995) and others, assume that there is no differences in technology when factor prices are equalized.

The evidence in this paper shows that these two explanations have different importance in different industries.

Table 6 presents the correlation coefficients between the productivity effect and its two components, the endowment effect and the technology effect, for 1971 and 1992. Again, the non-shaded area is for 1971 and the shaded area is for 1992. There are two important points to note. First, it is clear that in both periods the light industries, such as the food (FOD) and textile (TEX) industries show very little correlation between the productivity effect and the endowment effect, but very high correlation between the productivity effect and the technology effect. For instance, for the food industry (FOD), the correlation with the endowment effect in 1971 and 1992 is 0:022 and 0:295, respectively, while that with the technology effect is 0:774 and 0:797, respectively. This indicates that the labor requirement in light industries is predominantly determined by the technology effect in these industries (or we could also say that the endowment effect is not large enough to reverse the comparative advantage).

The second point relates to the heavy industries, which are in great contrast to the light industries. In the case of heavy industries, such as the chemical products (CHE), non-metallic products (MNM), basic metal (BMI) and machinery and equipments (MEQ) industries, the correlation between the productivity effect and the endowment effect tended to go up from 1971 to 1992, while that with the technology effect tended to go down. For instance, in the case of the non-metallic products industry (MNM), the correlation with the endowment effect went up from 0:434 to 0:749, while that with the technology effect went down from 0:882 to 0:628: These findings indicate that in the heavy industries, particularly in early 1990s, the labor productivity (and consequently the comparative advantage) is closely related to the choice of the capital-labor ratio, rather than the rate of technical progress. The importance of the choice of capital-labor ratio may reflect the importance of factors that are outside the traditional Heckscher-Ohlin models, for instance the degree of market power and price setting behavior associated with increasing-returns-to-scale production technology.

7. Conclusion

Under the assumption of differences in technologies and perfect capital mobility, this paper has examined the determinants of the comparative advantage in international trade, using every combination of 14 OECD countries and 10 traded industries for 1970-92. The main findings as follows.

First, the comparative advantage between Japan and U.S. was examined. The changes in the industrial structure in Japan during the 1970s and the 1980s were well-reflected in the shift of comparative advantage from light to heavy industries.

Second, the comparative advantage of the U.S. with respect to the rest of the world for each industry was discussed. Improvement in labor productivity was evident, particularly in the food, textile, chemical products and other manufacturing products industries. The main factor in explaining the changes in labor productivity was improvement in technology.

Third, the Ricardian model focused on the relative labor requirement (or the relative labor productivity). The empirical findings showed that this approach would undermine the relatively large impact of less than perfect labor mobility (and hence wage rate differentials) across sectors within a country, particularly in early 1990s.

Finally, this study indicated that differences in relative labor productivity was closely related to (i) differences in relative rate of technical progress in light industries and (ii) differences in relative capital-labor ratio in heavy industries.

8. Appendix

8.1. Estimation Method: 3SLS

For each industry, I simultaneously estimate the system of equations of (15) and the elasticity equation (16) for all 14 OECD countries, using time series data for 1970-1992. The 28-equation system is as follows (industry subscripts are dropped here):

$$\text{¢} \ln x_t^1 = \pm_{11} + \pm_{12}\,\text{¢} \ln \frac{k_t^1}{l_t^1} + \pm_{13}\,\text{¢} \ln K_t + \pm_{14}\frac{\text{¢} (\ln \frac{k_t^1}{l_t^1})^2}{2} + \pm_{15}\frac{\text{¢} (\ln K_t)^2}{2} + \pm_{16}\,\text{¢} \ln \frac{k_t^1}{l_t^1} \ln K_t;;$$

$$''^{1}_{kt} = \pm_{12} + \pm_{14} \ln \frac{k_t^1}{l_t^1} + \pm_{16} \ln K_t;$$

$$\text{¢} \ln x_t^2 = \pm_{21} + \pm_{22}\,\text{¢} \ln \frac{k_t^2}{l_t^2} + \pm_{23}\,\text{¢} \ln K_t + \pm_{24}\frac{\text{¢} (\ln \frac{k_t^2}{l_t^2})^2}{2} + \pm_{25}\frac{\text{¢} (\ln K_t)^2}{2} + \pm_{26}\,\text{¢} \ln \frac{k_t^2}{l_t^2} \ln K_t;$$

$$''^{2}_{kt} = \pm_{22} + \pm_{24} \ln \frac{k_t^2}{l_t^2} + \pm_{26} \ln K_t;$$

$$\vdots$$

$$\text{¢} \ln x_t^{14} = \pm_{141} + \pm_{142}\,\text{¢} \ln \frac{k_t^{14}}{l_t^{14}} + \pm_{143}\,\text{¢} \ln K_t + \pm_{144}\frac{\text{¢} (\ln \frac{k_t^{14}}{l_t^{14}})^2}{2} + \pm_{145}\frac{\text{¢} (\ln K_t)^2}{2} + \pm_{146}\,\text{¢} \ln \frac{k_{14t}}{l_{14t}} \ln K_t;$$

$$''^{14}_{kt} = \pm_{142} + \pm_{144} \ln \frac{k_t^{14}}{l_t^{14}} + \pm_{146} \ln K_t:$$

The instrumental variables are taken from Baskin and Lau (1992).

8.2. Data

The industry-level output, X_{it}^m, capital, k_{it}^m; labor, l_{it}^m; labor share, $\frac{w_{it}^m l_{it}^m}{X_{it}^m}$; and industry aggregate capital stock, K_{it}; for each industry i; country, m, and time, t; are directly taken or computed from International Sectoral Data Base 97. The variables used are as follows:

$GDPD_{it}^m$: Value added at market prices, at 1990 prices and 1990 PPPs (US$);

$KTVD_{it}^m$: Gross capital stock, at 1990 prices and 1990 PPPs (US$);

EE^m_{it} : Number of employees;

$WSSS^m_{it}$:Compensation of employees, at current prices, national currency;

GDP^m_{it} : Value added at market prices, current prices, national currency.

The variables in this paper, X^m_{it}, k^m_{it} and l^m_{it} correspond to $GDPD^m_{it}, KTVD^m_{it}$ and EE^m_{it}, respectively. $\frac{w^m_{it} l^m_{it}}{X^m_{it}}$ and K_{it} are computed as follows: $\frac{w^m_{it} l^m_{it}}{X^m_{it}} = \frac{WSSS^m_{it}}{GDP^m_{it}}$ and $K_{it} = \sum_{m=1} KTVD^m_{it}.$

8.3. Test for a Unit Root

The unit root test in this paper follows Dickey and Fuller (1981) closely. The model used is

$$y_t = \mu + \beta t + \gamma y_{t-1} + \phi(y_{t-1} - y_{t-2}) + \varepsilon_t,$$

where y_t is real GDP for the U.S. The test is carried out by testing the joint hypothesis that both β and γ^* are zero in the model

$$(y_t - y_{t-1}) = \mu + \beta t + \gamma^* y_{t-1} + \phi(y_{t-1} - y_{t-2}) + \varepsilon_t.$$

The results for the U.S. data show that in all 10 traded good sectors, except for PAP, a unit root hypothesis cannot be rejected.

References

[1] Balassa, B., 1963, An Empirical Demonstration of Classical Comparative Cost Theory, Review of Economics and Statistics 45.

[2] Boskin, M. J. and L. J. Lau, 1992, Capital, Technology, and Economic Growth, in: N. Rosenberg, R. Landau and D. C. Mowery, eds., Technology and the Wealth of Nations (Stanford University Press).

[3] Bowen, H. P., E. E. Leamer and L. Sveikauskas, 1987, Multicountry, Mutifactor Test of the Factor Abundance Theory, American Economic Review 77 (5), 791 - 809.

[4] Christensen, L. R., D. W. Jorgenson and L. J. Lau, 1973, Transcendental Logarithmic Production Frontiers, Review of Economics and Statistics 55, 28-45.

[5] Davis, D. R., D. E. Weinstein, S. C. Bradford and K. Shimpo, 1997, Using International and Japanese Regional Data to Determine When the Factor Abundance Theory of Trade Works, American Economic Review 87, 421-446.

[6] Deardor¤, A. 1984. Testing Trade Theories and Predicting Trade Flows, in: R. W. Jones and P. B. Kenen, eds., Handbook of International Economics, vol. I, (North-Holland, Amsterdam).

[7] Dunkin, J. T. and M. Krygier, 1998, Comparative Advantage and the Pattern of Trade Within Industries, Review of International Economics 6(2), 292-306.

[8] Gagnon J. E. and A. K. Rose, 1991, How Pervasive Is the Product Cycle? The Empirical Dynamics of American and Japanese Trade Flows, International Finance Discussion Papers 410.

[9] Harrigan, J. 1997, Technology, Factor Supplies, and International Specialization: Estimating the Neoclassical Model, American Economic Review 87, 475-494.

[10] Hayami, Y. and V. W. Ruttan. 1985, Agricultural Productivity Differences Among Countries, American Economic Review 60, 895-911.

[11] Heckscher, E. F., 1919, The Effect of Foreign Trade on the Distribution of National Income, Ekonomisk Tidskrift 21; reprinted in Ellis and Metzler, Readings in the Theory of International Trade (Blakiston, Philadelphia).

[12] Hickman, B. G., 1992, International Productivity and Competitiveness (Oxford University Press, Oxford).

[13] Jones, R. W., 1967, International Capital Movements and the Theory of Tariffs and Trade, Quarterly Journal of Economics 81, 1-38.

[14] Jones, R. W. and R. J. Ruffin, 1975, Trade Patterns with Capital Mobility in M. Parkin and A. R. Nobay, eds., Current Economics Problems; reprinted as Production Patterns with Capital Mobility in R. W. Jones, International Trade: Essays in Theory (North-Holland, Amsterdam).

[15] Kemp, M. C., 1966, The Gain from International Trade and Investment : A Neo-Heckscher-Ohlin Approach, American Economic Review 56, 788-809.

[16] Komiya, R., 1990, The Japanese Economy: Trade, Industry and Government, University of Tokyo Press, Tokyo).

[17] Komiya, R. and M. Irino, 1992, Japan's Economic and Industrial Policy in the 1980's, in: M. Baldassarri, eds., Keynes and the Economic Policies of the 1980s (St. Martin's Press, Rome).

[18] Lau, L. J. and P. A. Yotopoulos, 1990, Intercountry Differences in Agricultural Productivity: An Application of the Meta-Production Function, Working paper, Stanford University (mimeographed).

[19] Leamer, E. E., 1980, The Leontief Paradox, Reconsidered, Journal of Political Economy 88, 495-503.

[20] Leontief, W., 1953, Domestic Production and Foreign Trade: The American Capital Position Re-examined, Proceedings of the American Philosophical Society, 97, 332-349, reprinted in: R. E. Caves and H. G. Johnson, 1968, eds., Readings in International Economics (Allen and Unwin, London).

[21] MacDougall, G.D.A., M. Dowley, P. Fox and S. Pugh, 1962, British and American Productivity, Prices and Exports: An Addendum, Oxford Economic Papers, 14.

[22] Madsen, J. B., 1996, Tests of Factor Price Equalization Theorem, Journal of Economic Integration 11 (2), 146-159.

[23] Marshall, A., 1890, Principles of Economics, 8th edition (Macmillan, London).

[24] Maskus, K. E. and A. Webster, 1995, Factor Specialization in U.S. and U.K. Trade: Simple Departures from the Factor-content Theory, Swiss Journal of Economics and Statistics 131 (3), 419-439.

[25] OECD, 1997, International Sectoral Data Base.

[26] Ohlin, B., 1933, Interregional and International Trade (Harvard University Press, Cambridge).

[27] Ricardo, D., 1817, The Principles of Political Economy and Taxation (reprinted, J. M. Dent & Sons Ltd., London).

[28] Ruffin R. J., 1984, International Factor Movements, in: R. W. Jones and P. B. Kenen, eds., Handbook of International Economics, vol. I, (North-Holland, Amsterdam).

[29] Saito, M., 1998, The Determinant of FDI: The case of Baltics, mimeo.

[30] Saito, M., 1999, The Imperfect Substitution of Goods Traded Among OECD Countries, mimeo.

[31] Stern, R., 1962, British and American Productivity and Comparative Costs in International Trade, Oxford Economic Papers 14.

[32] Trefler, D., 1995, The Case of the Missing Trade and Other Mysteries, American Economic Review 85, 1029-1046.

Table 1 (a): Industries

1.AGR	agriculture, hunting, forestry and fishing
2.MID	mining and quarrying
3.FOD	manufacturing of food, beverages and tobacco
4.TEX	textiles, wearing apparel and leather industries
5.PAP	manufacturing of paper, paper products, printing and publishing
6.CHE	manufacturing of chemicals and of chemical petroleum, coal, rubber and plastic rubber
7.MNM	manufacturing of non-metallic products, except products of petroleum and coal
8.BMI	basic metal industries
9.MEQ	manufacturing of fabricated metal products, machinery and equipment
10.MOT	other manufacturing industries

Table 1 (b): Countries

1.AUS	Australia
2.BEL	Belgium
3.CAN	Canada
4.DNK	Denmark
5.FRA	France
6.FIN	Finland
7.DEU	West Germany
8.ITA	Italy
9.JPN	Japan
10.NLD	Netherland
11.NOR	Norway
12.SWE	Sweden
13.GBR	United Kingdom
14.USA	United States

Table 1 (c): Country Combination Index

m\n	1.AUS	2.BEL	3.CAN	4.DNK	5.FRA	6.FIN	7.DEU	8.ITA	9.JPN	10.NLD	11.NOR	12.SWE	13.GBR	14.USA
1.AUS		1	2	3	4	5	6	7	8	9	10	11	12	13
2.BEL			14	15	16	17	18	19	20	21	22	23	24	25
3.CAN				26	27	28	29	30	31	32	33	34	35	36
4.DNK					37	38	39	40	41	42	43	44	45	46
5.FRA						47	48	49	50	51	52	53	54	55
6.FIN							56	57	58	59	60	61	62	63
7.DEU								64	65	66	67	68	69	70
8.ITA									71	72	73	74	75	76
9.JPN										77	78	79	80	81
10.NLD											82	83	84	85
11.NOR												86	87	88
12.SWE													89	90
13.GBR														91
14.USA														

Table 1 (d): Industry Combination Index

i \ j	1.AGR	2.MID	3.FOD	4.TEX	5.PAP	6.CHE	7.MNM	8.BMI	9.MEQ	10.MOT
1.AGR		1	2	3	4	5	6	7	8	9
2.MID	-1		10	11	12	13	14	15	16	17
3.FOD	-2	-10		18	19	20	21	22	23	24
4.TEX	-3	-11	-18		25	26	27	28	29	30
5.PAP	-4	-12	-19	-25		31	32	33	34	35
6.CHE	-5	-13	-20	-26	-31		36	37	38	39
7.MNM	-6	-14	-21	-27	-32	-36		40	41	42
8.BMI	-7	-15	-22	-28	-33	-37	-40		43	44
9.MEQ	-8	-16	-23	-29	-34	-38	-41	-43		45
10.MOT	-9	-17	-24	-30	-35	-39	-42	-44	-45	

Table 2: Structural Parameters

		Industry									
		1.AGR	2.MID	3.FOD	4.TEX	5.PAP	6.CHE	7.MNM	8.BMI	9.MEQ	10.MOT
Lamda by Country (*1)	14.USA	0.037 *	-0.015	0.005	0.061 *	-0.022 *	0.008	-0.024 *	-0.021	-0.019 *	-0.057 *
	1.AUS	-0.010	0.008								
	2.BEL	0.000		-0.002	0.019	0.013	0.126 *	0.028 *	0.016	0.027 *	0.054 *
	3.CAN	0.024	-0.125 *	-0.008	0.095 *	-0.034 *	0.001	-0.025	-0.015	-0.018	-0.054 *
	4.DNK	0.006		0.022	0.008	-0.004	0.069 *	-0.005	-0.014	0.002	-0.056 *
	5.FRA	-0.009	-0.021	-0.005	-0.040 *	-0.025 *	-0.008	0.024 *	-0.001	-0.013 *	
	6.FIN	-0.008	0.010	0.002	0.000	0.003	0.052 *	0.007	-0.049 *	0.022 *	-0.002
	7.DEU	0.004	-0.049 *	-0.005	0.030 *	-0.011	-0.014	-0.014	0.009	-0.018 *	-0.045 *
	8.ITA	-0.022		-0.002	0.023 *		0.035 *	0.000	-0.016	-0.013	-0.007
	9.JPN	-0.057 *	-0.041 *	-0.036 *	-0.011	-0.025	-0.027	0.024	-0.025	0.005	-0.072 *
	10.NLD	0.002	-0.024								
	11.NOR	-0.026		-0.023	0.009	-0.004	0.052 *		-0.022	0.005	
	12.SWE	-0.007	-0.007	-0.007	0.007	0.003	0.062 *	0.010	-0.021	0.015 *	0.111 *
	13.GBR	0.015	-0.007	0.008	-0.027 *	-0.003	0.009	0.012	0.020	-0.004	-0.008
Alfak (*1)	G7	0.530 *	2.324 *	0.085	0.393 *	-2.436 *	1.068 *	-0.309 *	0.038	-1.494 *	0.115 *
	non G7	1.532 *	3.643 *	0.296 *	0.128	-1.578 *	0.993 *	1.602 *	6.588 *	0.464 *	-1.800 *
AlfaK	G7	0.470 *	-1.324 *	0.915 *	0.607 *	3.436 *	-0.068	1.309 *	0.962 *	2.494 *	0.885 *
	non G7	-0.532 *	-2.643 *	0.704 *	0.872 *	2.578 *	0.007	.	-5.588 *	.	.
Betakk	G7	-0.017 *	0.101 *	-0.004	0.010 *	-0.181 *	0.041 *	-0.037 *	-0.013	-0.102 *	0.025 *
	non G7	0.052 *	0.205 *	0.000	-0.002	-0.144 *	-0.049 *	-0.125 *	0.411 *	-0.025 *	0.199 *
BetaKK	G7	-0.017 *	0.101 *	-0.033	0.010 *	-0.181 *	0.041 *	-0.037 *	-0.013	-0.102 *	0.025 *
	non G7	0.052 *	0.205 *	-0.017	-0.002	-0.144 *	-0.049 *	.	0.411 *	.	.
BetakK	G7	0.017 *	-0.108 *	0.016	-0.010 *	0.181 *	-0.041 *	0.037 *	0.013	0.102 *	.
	non G7	-0.052 *	-0.205 *	.	0.002	0.134 *	.	.	-0.411 *	.	.
lnA by Country (*2)	14.USA	-6.781	9.990	-7.369	-11.503	-31.590	-4.783	-15.907	-13.879	-27.692	-22.898
	1.AUS	-6.888	9.803	.	.	.	.	.	.	.	.
	2.BEL	1.151	.	-5.482	-14.333	-20.511	18.585	-0.166	35.755	6.476	17.899
	3.CAN	-6.871	9.845	-7.228	-11.519	-31.885	-5.228	-15.569	-14.203	-27.976	-23.131
	4.DNK	-0.189	.	-6.248	-14.417	-20.433	19.384	0.211	35.360	6.387	18.133
	5.FRA	-6.166	10.692	-7.515	-11.183	-31.700	-4.874	-16.042	-14.551	-27.970	.
	6.FIN	0.544	14.550	-5.929	-14.493	-20.989	19.523	-0.097	35.586	6.152	17.816
	7.DEU	-7.389	9.876	-7.433	-11.421	-32.037	-4.691	-16.026	-14.489	-27.873	-22.915
	8.ITA	-6.691	.	-7.521	-11.349	.	-5.934	-16.360	-14.159	-28.220	-24.440
	9.JPN	-6.088	9.820	-6.984	-11.767	-32.428	-4.406	-15.946	-14.096	-28.552	-22.814
	10.NLD	0.866	19.861	.	.	.	.	.	.	.	.
	11.NOR	0.438	.	-5.654	-14.403	-20.580	19.188	.	35.430	6.584	.
	12.SWE	0.638	18.307	-5.520	-14.171	-20.777	19.748	0.076	35.471	6.370	16.196
	13.GBR	-6.650	9.384	-7.700	-11.526	-31.825	-5.159	-15.946	-13.980	-28.333	-23.343

* The estimate is significant at the 5 percent level.

(*1) Lamda for each country, alfak, alfaK, betakk, betaKK and betakK, are estimated for G7 and non G7 countries separately.

(*2) lnA for each country is computed so that the residuals for each country are zero for the initial period, 1970.

Table 3: Japan vs. the U.S. (1971, 1992)

Industry	Comparative		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
1. AGR	**-0.014**	0.066	0.594	0.091	**-0.608**	**-0.025**	0.161	**-0.586**	**-0.785**	0.590
2. MID	1.523	0.439	**-0.046**	**-0.380**	1.570	0.819	1.534	1.201	0.099	**-0.352**
3. FOD	**-0.660**	0.072	**-0.306**	**-0.085**	**-0.355**	0.157	0.136	0.272	-0.500	0.036
4. TEX	**-0.128**	0.290	0.037	**-0.143**	**-0.165**	0.432	**-0.405**	**-0.187**	0.255	0.655
5. PAP	0.173	**-0.096**	**-0.191**	**-0.015**	0.364	**-0.081**	**-0.439**	**-0.334**	0.815	0.172
6. CHE	**-0.684**	**-0.467**	0.216	0.371	**-0.900**	**-0.838**	**-0.315**	**-0.298**	**-0.498**	**-0.380**
7. MNM	**-0.464**	**-0.033**	**-0.203**	0.095	**-0.261**	**-0.128**	**-0.172**	**-0.106**	**-0.129**	**-0.216**
8. BMI	**-0.146**	**-0.433**	0.072	0.105	**-0.218**	**-0.537**	**-0.332**	**-0.098**	0.126	**-0.550**
9. MEQ	0.540	**-0.135**	**-0.194**	**-0.091**	0.734	**-0.044**	**-0.149**	0.030	0.810	**-0.130**
10. MOT	**-0.141**	0.298	0.020	0.051	**-0.161**	0.246	**-0.020**	0.106	**-0.194**	0.175

☐	The observation for 1971.
▨	The observation for 1992.
Bold	Japan has a comparative advantage over the U.S.

Table 5: CAI and Its Components (1971, 1992)

Industry	Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992
1. AGR	0.019	0.178	0.930 *	0.928 *	0.496 *	0.721 *	0.686 *	0.657 *
2. MID	0.010	-0.516 *	0.982 *	0.973 *	0.457 *	0.832 *	0.696 *	0.618 *
3. FOD	0.619 *	0.897 *	0.837 *	0.870 *	-0.277 *	0.086	0.821 *	0.851 *
4. TEX	-0.197	0.776 *	0.934 *	0.640 *	0.426 *	-0.109	0.719 *	0.606 *
5. PAP	-0.288 *	0.302 *	0.905 *	0.927 *	0.015	0.759 *	0.563 *	-0.478
6. CHE	0.171	0.294 *	0.942 *	0.686 *	0.503 *	0.786 *	0.886 *	0.105
7. MNM	-0.146	0.902 *	0.834 *	0.252	0.161	-0.300 *	0.831 *	0.660 *
8. BMI	-0.309 *	0.564 *	0.935 *	0.297 *	0.142	0.502 *	0.868 *	-0.108
9. MEQ	-0.055	0.585 *	0.882 *	0.245 *	0.085	0.471 *	0.739 *	-0.197
10. MOT	-0.420 *	-0.350 *	0.922 *	0.907 *	0.463 *	0.213	0.519 *	0.732 *

* The correlation coefficients are significant at the 5 percent level.

Table 6: PE and Its Components (1971, 1992)

Industry	Endowment Effect		Technology Effect		Residuals	
	1971	1992	1971	1992	1971	1992
1. AGR	0.630 *	0.764 *	0.682 *	0.695 *	0.419 *	-0.036
2. MID	0.508 *	0.886 *	0.685 *	0.550 *	0.564 *	-0.267
3. FOD	0.022	0.295 *	0.774 *	0.797 *	0.313 *	-0.296 *
4. TEX	0.433 *	0.319 *	0.837 *	0.742 *	0.644 *	-0.001
5. PAP	-0.098	0.790 *	0.717 *	-0.424 *	-0.428 *	0.698 *
6. CHE	0.560 *	0.662 *	0.961 *	0.645 *	0.479 *	0.790 *
7. MNM	0.434 *	0.749 *	0.882 *	0.628 *	0.117	-0.503 *
8. BMI	0.281 *	0.439 *	0.916 *	0.675 *	0.131	-0.148
9. MEQ	0.029	0.568 *	0.917 *	0.774 *	0.270 *	0.013
10. MOT	0.543 *	0.570 *	0.555 *	0.445 *	0.787 *	0.497 *

* The correlation coefficients are significant at the 5 percent level.

Table 4: U.S. Competitiveness: ARG (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	-0.434	**0.053**	-0.073	**0.013**	-0.361	**0.040**	-0.257	-0.242	-0.011	**0.400**
25. BEL	-1.322	-1.213	**0.648**	**0.230**	-1.970	-1.443	-0.700	-0.801	-1.147	-0.442
36.CAN	**0.121**	**0.405**	**0.161**	**0.105**	-0.040	**0.300**	**0.058**	**0.231**	-0.048	-0.048
46. DNK	-0.194	**0.080**	**0.309**	**0.339**	-0.503	-0.259	-0.285	-0.645	**0.191**	**0.088**
55. FRA	-0.379	-0.468	-0.135	**0.355**	-0.244	-0.824	**0.455**	-0.341	-0.628	-0.440
63. FIN	-0.312	-0.231	**0.550**	**0.371**	-0.861	-0.602	-0.003	-0.630	-0.729	-0.101
70. DEU	**0.167**	-0.375	**0.488**	**0.182**	-0.321	-0.557	-0.670	-0.935	**0.484**	**0.431**
76. ITA	**0.247**	**1.029**	-0.123	**0.585**	**0.370**	**0.444**	**1.022**	**0.020**	-0.586	**0.503**
81. JPN	-0.014	**0.066**	**0.594**	**0.091**	-0.608	-0.025	**0.161**	-0.586	-0.785	**0.590**
85. NLD	**1.022**	**1.132**	**0.449**	**0.129**	**0.573**	**1.003**	**0.042**	**0.287**	**0.486**	**0.673**
88. NOR	-0.918	-0.710	-0.163	-0.385	-0.755	-0.325	-0.121	-0.558	-0.493	**0.041**
90. SWE	**0.285**	-0.142	**0.510**	**0.335**	-0.225	-0.477	**0.624**	-0.373	-0.758	-0.242
91. GBR	**0.448**	**0.218**	**0.214**	**0.125**	**0.234**	**0.093**	**0.730**	**0.411**	-0.410	-0.217

Table 4: U.S. Competitiveness: MID (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	**0.434**	-0.053	**0.073**	-0.013	**0.361**	-0.040	**0.257**	**0.242**	**0.011**	-0.400
25. BEL	.	.	.	.	.	.	.	.	.	.
36.CAN	**0.243**	**0.047**	-0.016	-0.066	**0.259**	**0.113**	**0.226**	-0.076	**0.120**	**0.486**
46. DNK	**2.910**	-1.465	-0.001	**0.058**	**2.912**	-1.523	**0.503**	-0.571	.	.
55. FRA	**1.344**	**0.757**	-0.243	-0.356	**1.587**	**1.114**	**2.291**	**1.808**	-0.771	-0.458
63. FIN	**1.801**	**0.482**	-0.177	-0.222	**1.979**	**0.704**	**1.018**	**0.735**	**0.746**	-0.102
70. DEU	**1.334**	**1.380**	**0.073**	**0.038**	**1.261**	**1.343**	**1.296**	**1.056**	-0.063	**0.455**
76. ITA	.	.	.	.	.	.	.	.	.	.
81. JPN	**1.523**	**0.439**	-0.046	-0.380	**1.570**	**0.819**	**1.534**	**1.201**	**0.099**	-0.352
85. NLD	-1.022	-1.132	-0.449	-0.129	-0.573	-1.003	-0.042	-0.287	-0.486	-0.673
88. NOR	**1.354**	-1.140	**0.121**	**0.604**	**1.233**	-1.744	**0.905**	-0.820	.	.
90. SWE	**0.525**	**0.500**	-0.084	-0.124	**0.609**	**0.625**	**0.898**	**0.816**	-0.179	-0.151
91. GBR	**1.217**	-0.043	-0.275	-0.006	**1.492**	-0.037	**1.178**	**0.171**	**0.375**	-0.130

Table 4: U.S. Competitiveness: FOD (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	-0.258	**0.129**	-0.156	-0.041	-0.102	0.170	**0.154**	**0.181**	-0.257	**0.141**
36.CAN	-0.252	-0.079	-0.084	**0.010**	-0.168	-0.089	**0.103**	**0.183**	-0.304	-0.161
46. DNK	**0.165**	**0.173**	**0.038**	**0.021**	**0.127**	**0.152**	-0.141	**0.130**	**0.467**	**0.101**
55. FRA	-0.224	**0.097**	**0.104**	**0.066**	-0.327	**0.031**	-0.484	-0.230	**0.188**	**0.329**
63. FIN	-0.242	**0.184**	-0.093	**0.071**	-0.149	**0.113**	-0.133	**0.000**	**0.027**	**0.273**
70. DEU	-0.417	-0.251	-0.115	-0.179	-0.302	-0.072	-0.167	**0.062**	-0.144	-0.106
76. ITA	-0.190	-1.078	**0.078**	-0.787	-0.268	-0.291	**0.085**	**0.145**	-0.368	-0.294
81. JPN	-0.660	**0.072**	-0.306	-0.085	-0.355	**0.157**	**0.136**	**0.272**	-0.500	**0.036**
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	-0.205	**0.620**	**0.081**	**0.055**	-0.286	**0.565**	-0.203	**0.225**	-0.138	**0.384**
90. SWE	-0.540	-0.198	-0.074	**0.022**	-0.465	-0.219	-0.169	-0.033	-0.320	-0.023
91. GBR	-0.213	**0.056**	-0.178	-0.037	-0.035	**0.093**	-0.143	**0.041**	**0.076**	**0.182**

Table 4: U.S. Competitiveness: TEX (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	-0.363	**0.110**	-0.009	**0.048**	-0.354	**0.062**	-0.010	-0.020	-0.271	**0.188**
36.CAN	-0.228	-0.079	-0.023	**0.045**	-0.205	-0.125	-0.040	**0.007**	-0.183	-0.372
46. DNK	-0.700	**0.225**	**0.048**	**0.191**	-0.748	**0.034**	-0.130	**0.000**	-0.335	-0.084
55. FRA	-0.645	**0.032**	**0.175**	**0.260**	-0.820	-0.228	-0.427	-0.336	-0.234	**0.245**
63. FIN	-0.529	**0.108**	**0.043**	**0.145**	-0.572	-0.037	-0.121	-0.114	-0.342	**0.163**
70. DEU	-0.570	-0.111	**0.044**	**0.205**	-0.613	-0.316	-0.260	-0.271	-0.285	-0.083
76. ITA	-0.606	-1.235	**0.189**	-0.853	-0.795	-0.382	-0.068	**0.063**	-0.683	-0.415
81. JPN	-0.128	**0.290**	**0.037**	-0.143	-0.165	**0.432**	-0.405	-0.187	**0.255**	**0.655**
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	-0.306	**0.298**	**0.276**	**0.285**	-0.582	**0.013**	-0.158	**0.040**	-0.359	-0.095
90. SWE	-0.791	-0.266	**0.229**	**0.298**	-1.020	-0.564	-0.308	-0.343	-0.553	-0.109
91. GBR	-0.725	**0.035**	-0.091	-0.060	-0.634	**0.095**	-0.281	-0.104	-0.166	**0.311**

Table 4: U.S. Competitiveness: PAP (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	**0.282**	**0.336**	-0.035	**0.020**	**0.317**	**0.315**	**0.199**	**0.098**	**0.074**	**0.169**
36.CAN	-0.028	-0.080	-0.103	-0.011	**0.075**	-0.069	-0.162	-0.214	**0.179**	**0.106**
46. DNK	-0.341	**0.398**	**0.048**	**0.171**	-0.388	**0.227**	-0.035	**0.207**	-0.157	-0.127
55. FRA	**0.021**	**0.176**	**0.126**	**0.097**	-0.105	**0.080**	-0.259	-0.148	**0.139**	**0.142**
63. FIN	**0.061**	-0.020	**0.041**	**0.131**	**0.020**	-0.151	-0.328	-0.189	**0.302**	**0.055**
70. DEU	**0.183**	-0.057	-0.119	-0.082	**0.303**	**0.026**	-0.001	-0.005	**0.256**	-0.013
76. ITA	.	.	.	.	.	.	.	.	.	.
81. JPN	**0.173**	-0.096	-0.191	-0.015	**0.364**	-0.081	-0.439	-0.334	**0.815**	**0.172**
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	-0.073	**0.330**	-0.007	-0.002	-0.065	**0.333**	-0.113	**0.231**	**0.021**	-0.132
90. SWE	-0.212	-0.318	-0.111	**0.037**	-0.101	-0.355	-0.421	-0.339	**0.254**	**0.072**
91. GBR	-0.037	**0.000**	-0.054	-0.072	**0.017**	**0.072**	**0.010**	**0.151**	-0.051	-0.112

Table 4: U.S. Competitiveness: CHE (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	**1.326**	**0.309**	**0.001**	-0.005	**1.326**	**0.315**	**0.125**	**0.157**	**1.176**	**0.118**
36.CAN	**0.214**	**0.017**	-0.086	-0.107	**0.300**	**0.124**	-0.070	-0.100	**0.341**	**0.307**
46. DNK	-0.062	**0.278**	-0.096	-0.158	**0.034**	**0.436**	**0.093**	**0.388**	**0.189**	-0.050
55. FRA	-0.218	-0.122	-0.011	-0.133	-0.207	**0.010**	-0.353	-0.107	**0.133**	**0.113**
63. FIN	-0.177	**0.027**	-0.088	-0.134	-0.089	**0.161**	**0.010**	**0.076**	-0.062	**0.110**
70. DEU	-0.249	**0.068**	**0.008**	**0.003**	-0.257	**0.065**	**0.062**	**0.217**	-0.306	-0.166
76. ITA	**1.223**	**0.922**	**0.122**	**0.608**	**1.101**	**0.315**	**0.283**	**0.540**	**0.734**	-0.259
81. JPN	-0.684	-0.467	**0.216**	**0.371**	-0.900	-0.838	-0.315	-0.298	-0.498	-0.380
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	-0.304	**0.208**	-0.499	-0.546	**0.195**	**0.754**	-0.072	**0.303**	**0.452**	**0.236**
90. SWE	-0.419	-0.371	-0.216	-0.077	-0.203	-0.295	-0.024	**0.035**	-0.148	-0.204
91. GBR	-0.010	**0.031**	-0.172	-0.137	**0.161**	**0.168**	**0.004**	**0.183**	**0.128**	**0.077**

Table 4: U.S. Competitiveness: MNM (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	**0.018**	-0.037	-0.129	**0.003**	**0.146**	-0.041	**0.121**	**0.099**	-0.003	-0.182
36.CAN	-0.499	-0.256	**0.358**	**0.061**	-0.857	-0.317	-0.213	-0.087	-0.538	-0.347
46. DNK	-0.815	-0.025	**0.015**	-0.016	-0.830	-0.009	-0.115	-0.028	-0.543	-0.105
55. FRA	-0.245	-0.225	**0.100**	**0.203**	-0.346	-0.428	-0.489	-0.341	**0.110**	-0.269
63. FIN	-0.481	-0.222	-0.042	-0.076	-0.439	-0.146	-0.056	-0.014	-0.317	-0.307
70. DEU	-0.238	-0.284	**0.007**	**0.059**	-0.246	-0.343	-0.109	-0.097	-0.107	-0.327
76. ITA	-0.113	-1.266	-0.115	-1.118	**0.002**	-0.148	**0.109**	**0.191**	-0.061	-0.462
81. JPN	-0.464	-0.033	-0.203	**0.095**	-0.261	-0.128	-0.172	-0.106	-0.129	-0.216
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	.	.	.	.	.	.	.	.	.	.
90. SWE	-0.386	-0.238	**0.177**	**0.080**	-0.563	-0.318	-0.223	-0.172	-0.353	-0.394
91. GBR	-0.345	-0.210	-0.149	-0.309	-0.196	**0.099**	**0.105**	**0.223**	-0.287	-0.245

Table 4: U.S. Competitiveness: BMI (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	**0.722**	**0.145**	-0.082	**0.105**	**0.805**	**0.041**	**0.149**	**0.223**	**0.508**	-0.384
36.CAN	**0.333**	**0.028**	**0.218**	**0.135**	**0.115**	-0.107	-0.142	-0.087	**0.190**	**0.063**
46. DNK	**0.411**	**0.182**	-0.085	-0.267	**0.496**	**0.449**	**0.022**	**0.169**	**0.811**	**0.001**
55. FRA	**0.542**	-0.217	**0.025**	-0.409	**0.516**	**0.193**	-0.355	-0.140	**0.746**	**0.170**
63. FIN	**0.380**	-0.238	-0.145	-0.073	**0.525**	-0.165	-0.126	**0.071**	**0.482**	-0.160
70. DEU	**0.406**	-0.132	-0.114	-0.143	**0.520**	**0.011**	**0.006**	**0.158**	**0.416**	-0.252
76. ITA	-0.041	**0.516**	**0.123**	**0.594**	-0.165	-0.078	**0.023**	**0.237**	-0.238	-0.369
81. JPN	-0.146	-0.433	**0.072**	**0.105**	-0.218	-0.537	-0.332	-0.098	**0.126**	-0.550
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	**0.705**	**0.063**	**0.095**	-0.004	**0.610**	**0.067**	-0.158	**0.261**	**0.800**	-0.303
90. SWE	**0.523**	-0.287	-0.004	-0.114	**0.527**	-0.173	-0.280	-0.155	**0.760**	**0.006**
91. GBR	**0.044**	**0.017**	**0.331**	**0.597**	-0.286	-0.579	-0.222	-0.034	-0.223	-0.863

Table 4: U.S. Competitiveness: MEQ (1971, 1992)

Country Comb Index	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	**0.024**	**0.173**	-0.150	-0.190	**0.174**	**0.362**	**0.138**	**0.212**	-0.031	**0.088**
36.CAN	**0.076**	-0.152	-0.079	-0.059	**0.155**	-0.093	**0.024**	**0.040**	**0.150**	-0.153
46. DNK	-0.545	**0.229**	-0.178	-0.274	-0.367	**0.504**	-0.044	**0.258**	-0.057	**0.119**
55. FRA	-0.194	-0.031	-0.141	-0.083	-0.054	**0.052**	-0.379	-0.163	**0.318**	**0.166**
63. FIN	-0.157	-0.171	-0.158	-0.172	**0.002**	**0.000**	-0.090	**0.137**	**0.089**	-0.151
70. DEU	-0.200	-0.056	-0.128	-0.033	-0.072	-0.023	-0.075	**0.021**	-0.029	-0.079
76. ITA	**0.081**	**0.545**	-0.081	**0.497**	**0.162**	**0.047**	**0.038**	**0.226**	**0.046**	-0.200
81. JPN	**0.540**	-0.135	-0.194	-0.091	**0.734**	-0.044	-0.149	**0.030**	**0.810**	-0.130
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	-0.253	**0.332**	**0.096**	-0.006	-0.349	**0.338**	-0.079	**0.318**	-0.283	-0.131
90. SWE	-0.286	-0.217	-0.094	-0.139	-0.192	-0.078	-0.223	-0.065	**0.000**	-0.027
91. GBR	-0.105	-0.161	-0.485	-0.801	**0.380**	**0.639**	-0.059	**0.161**	**0.406**	**0.471**

Table 4: U.S. Competitiveness: MOT (1971, 1992)

Country Comb	Comparative Advantage Index		Wage Effect		Productivity Effect		Endowment Effect		Technology Effect	
Index	1971	1992	1971	1992	1971	1992	1971	1992	1971	1992
13. AUS	.	.	.	.	.	.	.	.	.	.
25. BEL	-0.429	**0.049**	-0.088	-0.170	-0.341	**0.219**	-0.177	-0.149	-0.050	**0.304**
36.CAN	**0.019**	**0.149**	-0.348	-0.114	**0.366**	**0.263**	**0.217**	**0.103**	**0.093**	**0.120**
46. DNK	-0.830	-0.075	-0.097	-0.064	-0.733	-0.011	**0.131**	**0.092**	-0.566	**0.056**
55. FRA	.	.	.	.	.	.	.	.	.	.
63. FIN	-0.345	**0.080**	**0.070**	-0.041	-0.415	**0.121**	-0.171	-0.074	-0.197	**0.221**
70. DEU	-0.416	-0.183	-0.144	-0.050	-0.272	-0.133	-0.080	-0.205	-0.222	**0.141**
76. ITA	-0.600	**0.568**	-0.193	**0.475**	-0.408	**0.093**	-1.491	-1.422	**1.155**	**1.497**
81. JPN	-0.141	**0.298**	**0.020**	**0.051**	-0.161	**0.246**	-0.020	**0.106**	-0.194	**0.175**
85. NLD	.	.	.	.	.	.	.	.	.	.
88. NOR	.	.	.	.	.	.	.	.	.	.
90. SWE	**1.302**	**1.537**	-0.331	-0.317	**1.633**	**1.854**	**0.125**	**0.629**	**1.298**	**1.072**
91. GBR	-0.274	**0.055**	**0.858**	**0.700**	-1.132	-0.645	-1.321	-1.203	**0.151**	**0.525**

☐	The observation for 1971.
▨	The observation for 1992.
Bold	The U.S. has a comparative advantage over other countries.

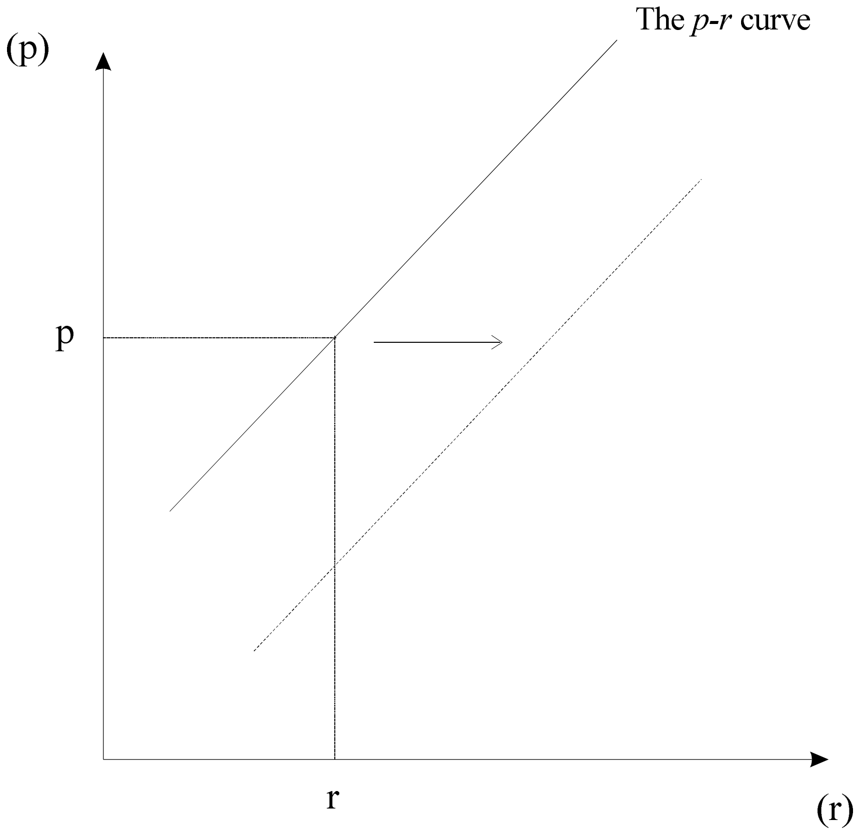

Figure 1. The *p-r* Curve and Technical Progress

The upward sloping *p-r* curve will shift to the right, for instance if there is technical progress in the capital-intensive good sector.

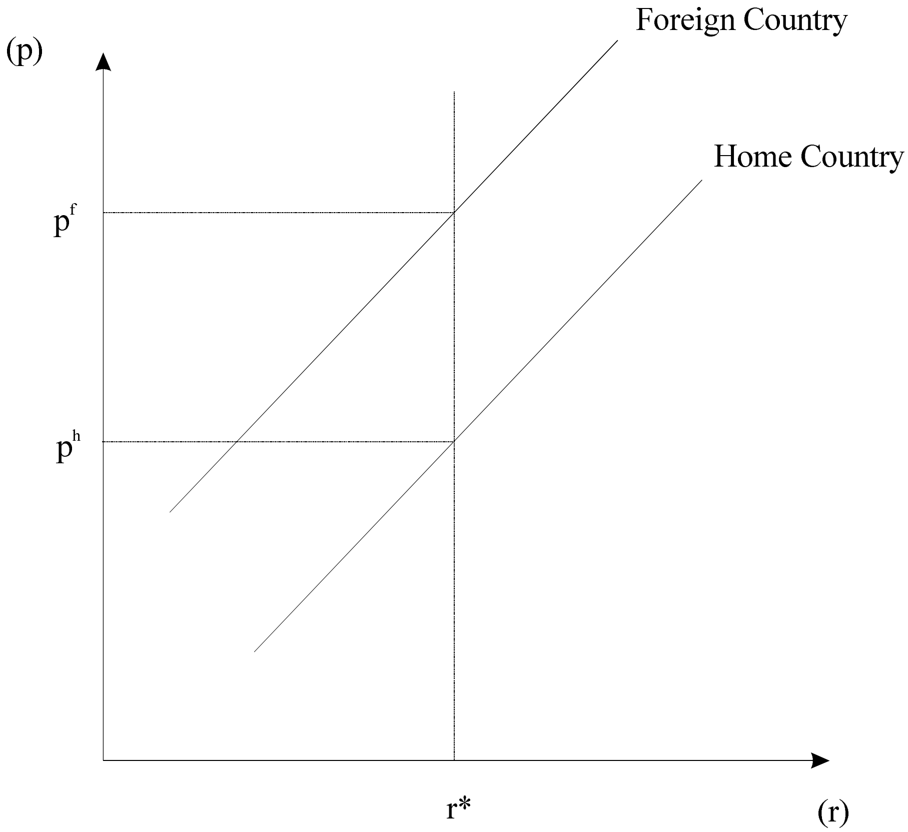

Figure 2. Two-Country Case with Perfect Capital Mobility

If two countries, home and foreign, face the same rental rate r*, then the comparative advantage in the production of the capital-intensive good is in home country whose *p-r* curve lies below that of foreign country.

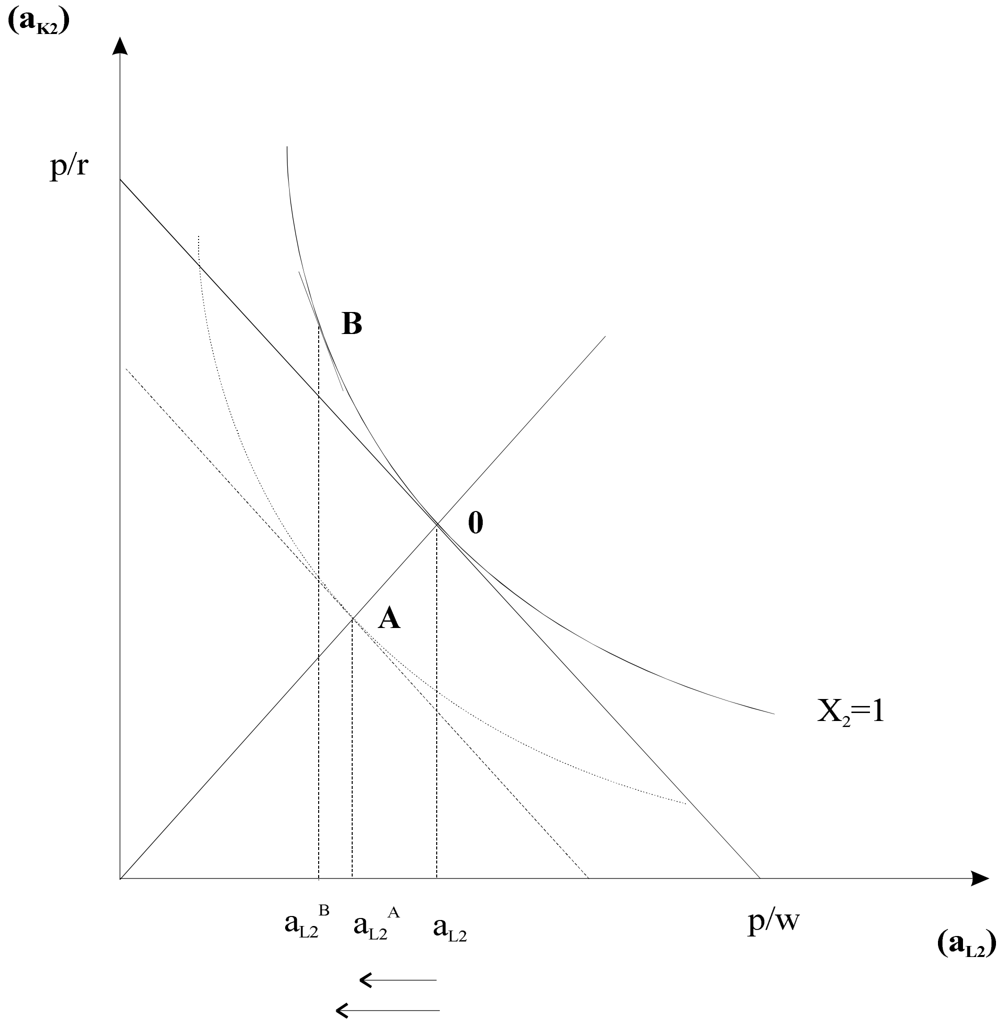

Figure 3. The Unit Labor Cost of the Capital-Intensive Good Sector

- The unit labor cost at initial point **0** is $a_{L2}w$.
- The unit labor cost at **A** (with technical progress) is $a_{L2}^A w$.
- The unit labor cost at **B** (with possible labor market distortions) is $a_{L2}^B w^B$.

The reduction in unit labor cost could be identical in case **A** and **B**. In such a case, we cannot distinguish if improvements in comparative advantage is a result of **A** or **B**, by simply looking at the unit labor costs. The Comparative Advantage Index (CAI) Decomposition of this paper allows us to distinguish the two.