# Productivity and International Competitiveness of European Union and United States Agriculture, 1973-2002

**Abstract**: The United States faces a growing imbalance in agricultural trade with the European Union. Explanations for this trade imbalance must include variations in exchange rates, changes in relative prices of factors of production, and the relative growth of total factor productivity in European and United States agriculture. We analyze the role of each of these factors in explaining the rise in competitiveness of European Union agriculture relative to its United States counterpart.

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The Doha Round of trade negotiations has stagnated, with the European Union and the United States at an impasse over the level of support for agriculture and the need for increased market access. These disputes over trade issues have accompanied the rapid expansion of European exports to the United States.[1] Explanations for the resulting trade imbalance must include variations in exchange rates, changes in the relative prices of factors of production, and the relative growth of productivity.[2] We analyze the role of each of these factors in explaining the rise in competitiveness of European Union agriculture relative to its United States counterpart.

At the outset it is necessary to define a measure of international competitiveness. Our measure of international competitiveness is the price of agricultural output in a given country relative to the price in the United States. We calculate relative output prices for eleven member countries of the European Union. In order to explain changes in international competitiveness, we must account for changes in the determinants of this relative price.

The starting point for our analysis of the competitiveness of European Union and United States agriculture is the exchange rate between each national currency and the dollar. Variations in exchange rates are easy to document and are often used to characterize movements in relative prices among countries. However, movements in these relative prices of goods and services do not coincide with variations in exchange rates. To account for changes in international competitiveness a measure of the relative prices of specific goods and services is required.

Relative prices among countries can be summarized by means of purchasing power parities. The purchasing power parity for an industry's output is the number of units of a given currency required to purchase an amount of the industry's output that would cost one dollar in the United States. The dimensions of the purchasing power parities are the same as the exchange rate. However, the purchasing power parities reflect the relative prices of the goods and services that make up industry output in each country.[3]

In this study, we estimate purchasing power parities for agriculture in the eleven European countries and the United States for the period 1973-2002. These are relative prices of agricultural output in each country expressed in terms of national currencies per dollar. We divide the relative price of output by the exchange rate to translate the purchasing power parities into relative prices in dollars. We employ relative prices in dollars as our measure of international competitiveness. Variations in exchange rates are reflected in the relative prices of output in all twelve countries.

To account for changes in international competitiveness among the European countries and the United States, we calculate purchasing power parities for the inputs employed in agriculture. By analogy with output, the purchasing power parities for inputs are based on the relative prices of the goods and services that make up the inputs. We disaggregate inputs among capital, land, labor and intermediate goods. We then translate purchasing power parities for inputs into relative prices in dollars by dividing by the exchange rate.

The final step in accounting for changes in international competitiveness is to measure relative levels of productivity for all countries in the comparison. We employ a multilateral model of production. This model enables us to express the price of output in each country as a function of the prices of inputs and the level of productivity in that country. We can account for the relative prices of output among countries by allowing input prices and levels of productivity to differ among countries. We have compiled data on relative productivity levels in the eleven European countries and the United States for the period 1973-2002. For this purpose, we have revised and extended the estimates for 1973-1993 reported by Ball et al. (2001).

The methodology for this study was originated by Jorgenson and Nishimizu (1978). They provided a theoretical framework for productivity comparisons based on a bilateral production function. They employed this framework in comparing output, input, and productivity at the aggregate level for Japan and the United States. The methodology was extended to the industry level by Jorgenson and Nishimizu (1981). The industry level approach introduced models of production for individual industries based on bilateral production functions for each industry. We provide a brief discussion of the theoretical framework for international comparisons in next section of this paper.

In subsequent sections, we describe the product and factor accounts for the European Union countries and the United States. These accounts underpin our estimates of relative output and input prices and relative levels of total factor productivity. We employ changes in relative productivity levels and relative prices of inputs in accounting for changes in international competitiveness. The final section provides a summary of results and conclusions.

**Theoretical Framework**

Under competitive conditions, we can represent technology by a price function that is dual to a production function for all twelve countries:[4, 5]

$$(1) \qquad \ln P = \sum_i a_i \ln W_i + a_t T + \sum_d a_d D_d + \frac{1}{2}\sum_i \sum_j b_{ij} \ln W_i \ln W_j + \sum_i b_{it} \ln W_i T$$

$$+ \sum_i \sum_d b_{id} \ln W_i D_d + \frac{1}{2} b_{tt} T^2 + \sum_d b_{td} T D_d + \frac{1}{2}\sum_d b_{dd} D_d^{\,2},$$

where $P$ is the price of agricultural output in each country,[6] the $W_i$ are input prices, $T$ is time, $D_d$ is a dummy variable equal to one for the corresponding country and zero otherwise, and $d$ is an index of countries, running over Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, the Netherlands, Sweden, and the United Kingdom.[7] Since we express levels of output and input prices and levels of productivity relative to the United States, we omit a dummy variable for the United States from the price function. Since $T$ and $D_d$ interact with input prices, differences in levels of productivity across time and across countries are permitted to be non-neutral.

In examining the differences in production patterns among countries, we combine the price function with the demand functions for inputs. We can express these functions as equalities between the share of each input in the value of output and the elasticity of the output price with respect to the price of that input:

(2) $$v_{X_i} = \frac{\partial \ln P}{\partial \ln W_i} = a_i + \sum_j b_{ij} \ln W_j + b_{it} T + b_{id} D_d .$$

The sum of the elasticities with respect to all inputs equals unity, so that the value shares also sum to unity.[8]

We can define the rate of productivity growth, say $v_T$, as the negative of the rate of growth of the output price with respect to time, holding input prices and the country dummy variables constant:[9]

(3) $$-v_T = \frac{\partial \ln P}{\partial T} = a_t + \sum_i b_{it} \ln W_i + b_{tt} T + b_{td} D_d .$$

Similarly, we can define the difference in technology between any country and the United States, say $v_d$, as the negative of the rate of growth of the price of output with respect to the dummy variable, holding input prices and time constant:

(4) $$-v_d = \frac{\partial \ln P}{\partial D_d} = a_d + b_{id} \ln W_i + b_{td} T + b_{dd} D_d .$$

The price of output, the prices of inputs, and the value shares for all four inputs are observable for each year in each country. The rates of productivity growth are not directly observable, but the average rate of productivity growth between two points of time, say $T$ and $T-1$, can be expressed as the difference between a weighted average of growth rates of input prices and the growth rate of the price of output:

$$(5) \qquad -\bar{v}_T = \ln P(T) - \ln P(T-1) - \sum_i \bar{v}_{X_i} [\ln W_i(T) - \ln W_i(T-1)],$$

where the average rate of technical change is

$$\bar{v}_T = \frac{1}{2}[v_T(T) + v_T(T-1)],$$

and the weights are given by the average value shares

$$\bar{v}_{X_i} = \frac{1}{2}[v_{X_i}(T) + v_{X_i}(T-1)].$$

The index number in (5) is referred to as the translog price index of productivity growth.[10] It was introduced by Jorgenson and Griliches (1967). Diewert (1976) showed that the index is exact for the translog price function.

Similarly, the differences in productivity $v_d$ are not directly observable. However, the average of these differences can be expressed as weighted averages of the differences between logarithms of the input prices for each country and the geometric mean of input prices for all twelve countries, less the difference between logarithms of the output price. Expressing differences in productivity relative to the United States:

$$(6) \qquad -\hat{v}_d = \ln P(d) - \ln P(US) - \sum_i \hat{v}_{X_i}(d)[\ln W_i(d) - \overline{\ln W_i}] + \sum_i \hat{v}_{X_i}(US)[\ln W_i(US) - \overline{\ln W_i}],$$

where

$$\hat{v}_{X_i}(d) = \frac{1}{2}[v_{X_i}(d) + \frac{1}{N}\sum_d v_{X_i}(d)],$$

and a bar indicates the average over all $N$ countries.

The translog multilateral index of productivity differences (6) was introduced by Caves, Christensen, and Diewert (1982). Its use for making bilateral comparisons results in transitive multilateral comparisons that retain a high degree of characteristicity.[11]

To complete our methodology for comparing levels of output and input prices and levels of productivity among countries, we require specific forms for the functions defining the price of output and the prices of capital, land, labor, and intermediate inputs. We specify the price of agricultural output as a linearly homogeneous translog function of the prices of its components for all twelve countries:

$$(7) \qquad \ln P = \sum_i a_i \ln P_i + \frac{1}{2}\sum_i \sum_j b_{ij} \ln P_i \ln P_j \ .$$

The share of each component in the value of total agricultural output can be expressed as:

$$(8) \qquad v_{Y_i} = \frac{\partial \ln P}{\partial \ln P_i} = a_i + \sum_j b_{ij} \ln P_j \ .$$

Since the price of agricultural output is a translog function of the prices of its components, the difference between successive logarithms of the price of agricultural output can be expressed as a weighted average of differences between logarithms of individual prices with weights given by the average value shares:

$$(9) \qquad \ln P(T) - \ln P(T-1) = \sum_i \bar{v}_{Y_i}[\ln P_i(T) - \ln P_i(T-1)],$$

where

$$\bar{v}_{Y_i} = \frac{1}{2}[v_{Y_i}(T) + v_{Y_i}(T-1)].$$

Considering data for all twelve countries at a given point of time, the difference between logarithms of the price of agricultural output for any two countries can be expressed as weighted averages of the differences between logarithms of the individual output prices and the geometric average of output prices for the twelve countries. Expressing the differences in output prices relative to the United States:

$$(10) \qquad \ln P(d) - \ln P(US) = \sum_i \hat{v}_{Y_i}(d)[\ln P_i(d) - \overline{\ln P_i}] - \sum_i \hat{v}_{Y_i}(US)[\ln P_i(US) - \overline{\ln P_i}],$$

where

$$\hat{v}_{Y_i}(d) = \frac{1}{2}[v_{Y_i}(d) + \frac{1}{N}\sum_d v_{Y_i}(d)],$$

and

$$\overline{\ln P_i} = \frac{1}{N}\sum_d \ln P_i(d).$$

The price index in (10) represents the purchasing power parity between the currencies of the two countries expressed in terms of agricultural output.

Similar, if the input prices are translog functions of their components for all twelve countries we can express the differences between successive logarithms of input prices for a given country as:

$$(11) \qquad \ln W_i(T) - \ln W_i(T-1) = \sum_j \bar{v}_{X_{ij}}[\ln W_{ij}(T) - \ln W_{ij}(T-1)],$$

where

$$\bar{v}_{X_{ij}} = \frac{1}{2}[v_{X_{ij}}(T) + v_{X_{ij}}(T-1)],$$

and $v_{X_{ij}}$ are the shares of the components in the value of the input aggregates.

Finally, we can express the differences between logarithms of input prices relative to the United States as:

$$(12) \qquad \ln W_i(d) - \ln W_i(US) = \sum_j \hat{v}_{X_{ij}}(d)[\ln W_{ij}(d) - \overline{\ln W_{ij}}] - \sum_j \hat{v}_{X_{ij}}(US)[\ln W_{ij}(US) - \overline{\ln W_{ij}}],$$

where

$$\hat{v}_{X_{ij}}(d) = \frac{1}{2}[v_{X_{ij}}(d) + \frac{1}{N}\sum_d v_{X_{ij}}(d)].$$

The price indexes in (12) represent the purchasing power parities expressed in terms of the inputs employed in agriculture.

**Data**

We assume that data on production patterns in the eleven European countries and the United States are generated by a gross output model of production.[12] Output is defined as gross production leaving the farm, as opposed to real value added. Inputs are not limited to labor and capital, but include intermediate inputs as well. The text in this section provides an overview of the sources and methods used to construct the product and factor accounts for the period 1973-2002 for each of the twelve countries.

*Output and intermediate input*. Our measure of agricultural output includes deliveries to final demand and to intermediate demand in the non-farm sector. We also include deliveries to intermediate farm demand so long as these deliveries are intended for different production activities (*e.g.*, crop production intended for use in animal feeding).

One unconventional aspect of our measure of output is the inclusion of goods and services from certain non-agricultural or secondary activities. These activities are defined as activities closely linked to agricultural production for which information on output and input use cannot be separately observed. Two types of secondary activities are distinguished. The first represents a continuation of the agricultural activity, such as the processing and packaging of agricultural products on the farm, while services relating to agricultural production, such as machine services for hire, are typical of the second.

The total output of the sector represents the sum of output of agricultural goods and the output of goods and services from secondary activities. We evaluate industry output from the point of view of the producer; that is, subsidies are added and indirect taxes are subtracted from market values. In those countries where a forfeit system prevails, the difference between payments and refunds of the tax on value added (or VAT) is also included in the value of output.

Intermediate input consists of all goods and services consumed during the accounting period, excluding consumption of fixed capital. Those goods and services that are produced and consumed within the industry are included in intermediate input so long as they also enter the farm output accounts. The value of intermediate input includes taxes (other than the deductible VAT) less subsidies, whether paid to suppliers of intermediate goods or to agricultural producers.

*Capital input*. The measurement of capital input in agriculture begins with data on the stock of capital for each component of capital input. We employ the perpetual inventory method to estimate capital stock from data on investment in constant prices.[13] In this method, the stock of capital at each point of time, say $K(T)$, is the sum of past investments, say $I(T-t)$, weighted by the relative efficiencies of capital goods of each age $t$, say $S(t)$:

$$(13) \qquad K(T) = \sum_{t=0}^{\infty} S(t) I(T-t) .$$

In equation (13), we normalize initial efficiency $S(0)$ at unity and assume that relative efficiency decreases so that:

(14) $$S(0) = 1, S(t) - S(t-1) \leq 0, \quad (t = 0,1,\ldots,T).$$

We also assume that every capital good is eventually retired or scrapped so that relative efficiency declines to zero:

(15) $$\lim_{t \to \infty} S(t) = 0.$$

The decline in efficiency of capital goods gives rise to needs for replacement in order to maintain the productive capacity of the capital stock. The proportion of an investment to be replaced at age t, say $m(t)$, is equal to the decline in efficiency from age $t$ - $1$ to age $t$ :

(16) $$m(t) = -[S(t) - S(t-1)], \qquad (t = 1,2,\ldots,L).$$

These proportions represent mortality rates for capital goods of different ages.

Replacement requirements at each point of time, say $R(T)$, can be expressed as a weighted sum of past investments, where the weights are the mortality rates $m(t)$:

(17) $$R(T) = \sum_{t=1}^{\infty} m(t) I(T-t).$$

Taking first differences of the expression for capital stock, and substituting (16) and (17), we can write:

(18) $$K(T) - K(T-1) = I(T) - R(T).$$

The change in capital stock in any period is equal to the acquisition of investment goods less replacement requirements.

To estimate replacement, we must introduce an explicit description of the decline in efficiency. This function, $S(t)$, may be expressed in terms of two parameters, the service life of the asset $L$ and a curvature or decay parameter ß. Initially, we hold the value of $L$ constant and evaluate the efficiency function for various values of ß. One possible form for the efficiency function is given by:

$$(19) \qquad \begin{aligned} S(t) &= (L-t)/(L-bt), && (0 \leq t \leq L), \\ S(t) &= 0, && (t > L). \end{aligned}$$

This function is a form of a rectangular hyperbola that provides a general model incorporating several types of depreciation as special cases.

The value of ß in (19) is restricted only to values less than or equal to one. Values greater than one yield results outside the bounds established by restrictions on $S(t)$. For values of ß greater than zero, the function $S(t)$ approaches zero at an increasing rate. For values less than zero, $S(t)$ approaches zero at a decreasing rate.

Little empirical evidence is available to suggest a precise value for ß. However, two studies (Penson, Hughes, and Nelson, 1977; Romain, Penson, and Lambert, 1987) provide evidence that efficiency decay occurs more rapidly in the later years of service, corresponding to a value of ß in the zero-one interval. It was assumed that the efficiency of a structure declines very slowly over most of its service life until a point is reached where the cost of repairs exceeds the increased service flows derived from the repairs, at which point the structure is allowed to depreciate rapidly. The decay parameter for machinery and transportation equipment assumes that the decline in efficiency is more uniformly distributed over the asset's service life. Given these assumptions, the final ß values chosen were 0.75 for structures and 0.5 for machinery and equipment.

The other critical variable in the efficiency function (19) is the asset lifetime $L$. For each asset type, there exists some mean service life $\overline{L}$ around which there exists a distribution of actual service lives. In order to determine the amount of capital available for production, the actual service lives and the relative frequency of assets with these service lives must be determined. It is assumed that this distribution may be accurately depicted by the normal distribution truncated at points two standard deviations before and after the mean service life.[14]

Once the frequency of a true service life $L$ is known, the decay function for that particular service life is calculated using the assumed value of ß. This process is repeated for all other possible values of $L$. The replacement function $R$ is then constructed as a weighted sum of the individual decay functions using as weights the frequency of occurrence. This function not only reflects changes in efficiency, but also the discard distribution around the mean service life.

Firms will add to the capital stock so long as the present value of the net revenue generated by an additional unit of capital exceeds the purchase price of the asset. This result can be stated algebraically as:

$$(20) \qquad \sum_{t=1}^{\infty} \left( P \frac{\partial Y}{\partial K} - W_K \frac{\partial R_t}{\partial K} \right) (1+r)^{-t} > W_K \, ,$$

where $P$ is the price of output, $W_K$ is the price of investment goods, and $r$ is the real discount rate.

To maximize net present value, firms will continue to add to capital stock until this equation holds as an equality. This requires that:

$$(21) \qquad P \frac{\partial Y}{\partial K} = r W_K + r \sum_{t=1}^{\infty} W_K \frac{\partial R_t}{\partial K} (1+r)^{-t} = c.$$

The expression for $c$ is the implicit rental price of capital corresponding to the mortality distribution $m$. The rental price consists of two components. The first term, $rW_K$, represents the opportunity cost associated with the initial investment. The second term, $r\sum_{t=1}^{\infty} W_K \frac{\partial R_t}{\partial K}(1+r)^{-t}$, is the present value of the cost of all future replacements required to maintain the productive capacity of the capital stock.

Let $F$ denote the present value of the stream of capacity depreciation on one unit of capital according to the mortality distribution $m(t)$:

(22) $$F = \sum_{t=1}^{\infty} m(t)\,(1+r)^{-t}.$$

It can be shown that:

(23) $$\sum_{t=1}^{\infty} \frac{\partial R_t}{\partial K}(1+r)^{-t} = \frac{F}{(1-F)},$$

so that

(24) $$c = \frac{r\,W_K}{(1-F)}.$$ [15]

The real rate of return $r$ in expression (24) is calculated as the nominal yield on government bonds less the rate of inflation as measured by the implicit deflator for gross domestic product.[16] An *ex ante* rate is obtained by expressing observed real rates as an ARIMA process.[17] We then calculate $F$ holding the required real rate of return constant for that vintage of capital goods. In this way, implicit rental prices $c$ are calculated for each asset type.

Although we estimate the decline in efficiency of capital goods for each component of capital input separately for all twelve countries, we assume that the relative efficiency of new capital goods is the same in each country. The appropriate purchasing power parity for new capital goods is the purchasing power parity for the corresponding component of investment goods output (OECD, p. 162). To obtain the purchasing power parity for capital input, we multiply the purchasing power parity for investment goods for any country by the ratio of the price of capital input in that country relative to the United States.

*Land input*. To estimate the stock of land in each country, we construct translog price indexes of land in farms. The stock of land is then constructed implicitly as the ratio of the value of land in farms to the translog price index. The rental price of land is obtained using (24), assuming zero replacement.

Spatial differences in land characteristics or quality prevent the direct comparison of observed prices. To account for these differences, indexes of relative prices of land are constructed using hedonic regression methods in which a commodity (or service) is viewed as a bundle of characteristics which contribute to the productivity or utility derived from its use. According to the hedonic framework the price of a commodity represents the valuation of the characteristics "that are bundled in it", and each characteristic is valued by its "implicit" price (Rosen, 1974). Implicit prices for characteristics exhibit many of the properties of ordinary prices, but these prices are not observed directly and must be estimated from the hedonic price function. Griliches (1964) notes that if we can observe different "quality combinations" selling at different prices, it is possible to estimate, at the margin, the prices of these characteristics.

A hedonic price function expresses the price of a good or service as a function of the quantities of the characteristics it embodies. Thus, the hedonic price function for land may be expressed as $W_L = W(X, D)$, where $W_L$ represents the price of land, $X$ is a vector of characteristics, and $D$ is a vector of other variables. In the hedonic framework, we regard different parcels of land as alternative combinations or "bundles" of a smaller number of characteristics that reflect quality.

The World Soil Resources Office of the U.S. Department of Agriculture's Natural Resource Conservation Service has compiled data on characteristics that capture differences in land quality.[18] These characteristics include soil acidity, salinity, and moisture stress, among others. We measure the "level" of each characteristic as the percentage of the land area in a given region that is subject to stress.[19]

In areas with moisture stress, agriculture is not possible without irrigation. Hence irrigation (*i.e.*, the percentage of the cropland that is irrigated) is included as a separate variable. Because irrigation mitigates the negative impact of acidity on plant growth, the interaction between irrigation and soil acidity is included in the vector of characteristics.

In addition to environmental attributes, we also include a "population accessibility" score for each region in each country. These indexes are constructed using a gravity model of urban development, which provides a measure of accessibility to population concentrations (Shi, Phipps, and Colyer, 1997). A gravity index accounts for both population density and distance from that population. The index increases as population increases and/or distance from the population center decreases.

Other variables (denoted by $D$) are also included in the hedonic equation, and their selection depends not only on the underlying theory but also on the objectives of the study. If the main objective of the study is to obtain price indexes adjusted for quality, as in our case, the only variables that should be included in $D$ are country dummy variables, which will capture all price effects other than quality. After allowing for differences in the levels of the characteristics, the part of the price difference not accounted for by the included characteristics will be reflected in the country dummy coefficients.

Finally, economic theory places few if any restrictions on the functional form of the hedonic price function. In this study, we adopt a generalized linear form, where the dependent variable and each of the continuous independent variables is represented by the Box-Cox transformation. This is a mathematical expression that assumes a different functional form depending on the transformation parameter, and which can assume both linear and logarithmic forms, as well as intermediate non-linear functional forms.

Thus the general functional form of our model is given by:

$$(25)\qquad W_L(l_0) = \sum_n a_n X_n(l_n) + \sum_d g_d D_d + e,$$

where $W_L(l_0)$ is the Box-Cox transformation of the dependent price variable, $W_L > 0$; that is,

$$(26)\qquad W_L(l_0) = \begin{cases} \dfrac{W_L^{\,l_0} - 1}{l_0}, l_0 \neq 0, \\ \ln W_L, l_0 = 0. \end{cases}$$

Similarly, $X_n(l_n)$ is the Box-Cox transformation of the continuous quality variable $X_n$ where $X_n(l_n) = (X_n^{\,l_n} - 1)/l_n$ if $l_n \neq 0$ and $X_n(l_n) = \ln X_n$ if $l_n = 0$. Variables represented by *D* are country dummy variables, not subject to transformation; ?, a, and ? are unknown parameter vectors, and e is a stochastic disturbance.[20]

*Labor input*. Data on labor input in agriculture consist of hours worked disaggregated by hired and self-employed and unpaid family workers. Compensation of hired farm workers is defined as the average hourly wage plus the value of perquisites and employer contributions to social insurance.

The compensation of self-employed workers is not directly observable. These data are derived using the accounting identity where the value of total product is equal to total factor outlay.

**Purchasing Power Parities**

We estimate purchasing power parities for agricultural output in 1996 for the eleven European countries and the United States using equation (10) above. Equation (12) yields purchasing power parities for capital, land, labor, and materials inputs. These are relative prices expressed in terms of national currencies per dollar. We translate the purchasing power parities into relative prices in dollars by dividing by the exchange rate. These relative prices are shown in Table 1.

According to Table 1, the levels of output prices in the eleven European countries in 1996 were well above the United States price level. The relative price of output was highest in Sweden at 1.629, or some sixty percent above the United States price. The Netherlands had the lowest output price relative to the United States in 1996 at 1.338.

The European countries also faced higher prices for intermediate inputs in 1996. Relative prices ranged from 1.35 in Denmark to 1.055 in Ireland. The cost of capital input, other than land, exceeded that in the United States in all of the European countries except Germany, Ireland, and Italy. Among the eleven European countries, only Sweden had a lower price of land input in 1996. By contrast, the purchasing power parities for labor input in 1996 represent substantially lower costs of labor input in the European countries relative to the United States. In 1996, hourly earnings in the eleven European countries averaged slightly more than 50 percent of United States hourly earnings. This result is consistent with the observation by Ball et al. (2001) that agriculture in the European countries is relatively labor intensive.

We have estimated purchasing power parities between the eleven European currencies and the dollar in 1996. We have also compiled price indexes for output and inputs in each country for the period 1973-2002. We obtain indexes of output and input prices in each country relative to those in the United States for each year by linking these time-series price indexes with estimates of relative prices for the base period. Table 2 presents indexes of relative output prices in the eleven European countries and the United States for the period 1973-2002, with a base equal to one in the United States in 1996.

According to the results presented in Table 2, the price deflator for agricultural output in Ireland was 0.574 in 1973, while that in the United States was 0.637. This implies that the Irish aggregate output price index in 1973 was only 90 percent of that in the United States. In that same year, the ratio of the output price index in the United Kingdom to the United States price index was 95 percent. These results imply that Ireland and the United Kingdom had a competitive advantage relative to the United States in 1973.

Output prices in the other countries in the comparison were well above the level in the United States. The price index in Belgium in 1973 was 0.719. This was nearly 13 percent above the United States price index. In France, the index of output prices was 0.749, or 18 percent above the United States level. The price gap widens further when the comparison is between Sweden and the United States. The index of output prices in Sweden in 1973 was 1.362, or more than double the United States price index.

The levels of output prices in the eleven European countries increased relative to the United States during the 1970s. This was a consequence of more rapid inflation in most European countries and an appreciation of the European currencies relative to the dollar through 1980. The competitiveness of United States agriculture reached a temporary peak in that year.

The situation changed in the early 1980s. By then the European countries and the United States were vigorously pursuing policies to combat inflation. The change to restrictive monetary policy initiated by the Federal Reserve pushed up interest rates sharply. The dollar appreciated on foreign exchange markets, and world export prices started to fall.[21] By 1984 the price level in most European countries was well below the United States price. This had the short-run effect of restoring the competitiveness of European agriculture.[22]

The United States inflation rate slowed between 1981 and 1986. This was followed by a rapid depreciation of the dollar. By 1986 the level of prices in the European countries, denominated in dollars, once again exceeded the United States price. The continued weakness of the dollar through the early 1990s resulted in a further deterioration of the international competitiveness of European agriculture. By 1995 prices in most European countries were at their highest levels relative to the United States. But a strengthening dollar between 1996 and 2001 eroded much of the competitive advantage of the United States.[23, 24]

According to the international comparison of materials input prices shown in Table 3, the price of materials in the European countries in 1973 exceeded that in the United States. These relative prices trend higher during the 1970s, but the rapid appreciation of the dollar in the early 1980s reversed this trend. By 1984 the price of materials input in the European countries had fallen below the level in the United States. The price of materials increased relative to the United States after 1984, a consequence of the depreciation of dollar. Relative materials prices reached a peak in the early 1990s. But the subsequent appreciation of the dollar resulted in a decline in relative prices. By 2001 the relative cost of materials in most European countries was again below that in the United States.

A comparison of capital input prices is provided in Table 4. The patterns of change for relative capital input prices are similar to those for relative output and materials input prices. Initially, the cost of capital in a number of the European countries was below that in the United States but rose to well above the United States level by 1979. The rapid increase in the cost of capital in the United States during the early 1980s and the appreciation of the dollar resulted in a decline in this relative price. By 1984 the price of capital in the European countries had fallen to its lowest level relative to the United States. The subsequent weakness of the dollar and declining capital costs in the United States resulted in an increase in the cost of capital in the European countries relative to the United States. The appreciation of the dollar after 1995 reversed this trend.

As can be seen in Table 5, the differences in relative land input prices in 1973 were much larger than differences in relative capital input prices. The price of land input in the Netherlands in 1973 was more than six times the level of prices in the United States. In Sweden this relative price was less than one-half the United States price. The differences in relative prices had narrowed substantially by the early 1980s. This was a result of rapid increases in the price of land input in the United States and the appreciation of the dollar. But the farm debt crisis of the 1980s and the ensuing collapse of land prices in the United States raised relative prices in the European countries. By 1992 the price of land input in the Netherlands was twelve times the United States price. The recovery of land prices in the United States during mid-1990s and the appreciation of the dollar resulted in some narrowing of the differences in relative land input prices, but price levels in the European countries remained well above the level in the United States.

Finally, a comparison of labor input prices appears in Table 6. The patterns of change in relative wage rates bear little resemblance to those for relative materials and capital input prices. Rapid wage increases in the European countries during the 1970s and the appreciation of their currencies raised wages rates in the European countries above the United States level. The subsequent appreciation of the dollar resulted in a decline in European wage rates relative to the United States. By 2002 the wage rate in Belgium had fallen to 67 percent of the United States wage rate. The relative wage in Ireland in 2002 was only 33 percent of the United States level.

Our international comparisons of relative output and input prices show, first, that United States agriculture has been more competitive than its European counterparts throughout the period 1973-2002, except for the years 1973-1974 and 1983-1985. Second, lower costs of materials, capital, and land inputs contributed to United States international competitiveness for most of this period.

**Relative Productivity Levels**

In this section we estimate relative levels of productivity in agriculture for the eleven European countries and the United States for the period 1973-2002. Ball et al. (2001) have reported relative productivity levels for nine of the eleven European countries and the United States for the period 1973-1993. In 1973, six European countries had higher levels of productivity than the United States. The United States closed the productivity gap with two of these countries during the sample period. However, differences in productivity levels between four of the European countries—Belgium, Denmark, France, and the Netherlands—and the United States remained at the end of the period in 1993.

In order to extend the observations through 2002 we must take note of the following revisions of the data. First, the measure of output in the present study includes the value of services. While accounting for a relatively small share of total output this series exhibits very rapid growth. Second, our measure of capital input reflects subsidies on purchases of new capital goods. We used this information to improve our estimates of the user cost of capital. Finally, we have compiled regionally disaggregated data on land values and characteristics that reflect land quality. These data allow us to estimate hedonic price indexes for land that reflect differences in land quality across countries.

The revisions of the data have resulted in substantial changes in the rank ordering of countries from that presented in Ball et al. (2001). As can be seen in Table 7, only two countries—Belgium and the Netherlands—had higher levels of productivity than the United States in 1973. Moreover, the United States had closed the gaps in productivity by the early 1990s.

Sweden and Spain were the only European countries to achieve faster rates of productivity growth in agriculture than the United States. Most remarkable was the performance of Spain. Spain began the period in 1973 with the second lowest relative level of total factor productivity of any European country, but had overtaken Greece by 1977, Ireland by 1978, Italy by 1979, France by 1984, Germany and the United Kingdom by 1985, and Belgium and Denmark by 2002.

There are several likely explanations for Spain's rapid productivity growth. The first is technological "catch-up" by initially backward countries. The idea is that imitation is less costly than innovation, so that countries initially lagging behind the technology leaders experience faster improvements in technology than do the leaders. Furthermore, the rate of catch-up should accelerate as these countries become more integrated with the rest of Europe. A second factor is capital deepening. Of the eleven European countries, only Denmark, France, and Ireland had faster rates of growth of capital per unit of labor than did Spain. Ball et al. (2001) find this to be an important factor in determining the speed of convergence of productivity. Thirdly, it can be argued that integration in the European Union has lead to increased specialization in production of goods that are competitive in export markets. Mora and San Juan (2004) find that those regions initially specializing in production for export have increased their share of total output since Spain's joining of the European Union.[25]

Finally, we turn to international competitiveness of European and United States agriculture. We can account for movements in relative prices of output in the twelve countries by changes in relative input prices and changes in relative productivity levels. Figure 1 shows the relative price of output in the eleven European countries expressed in dollars. We have expressed these prices in logarithmic form so that a negative difference implies that the output price in the comparison country is below the United States price.

In the 1970s output prices in the European countries were above the United States price level, due primarily to lower levels of productivity. Although lower labor costs in the European countries helped to reduce relative prices of output, they were totally offset by lower levels of productivity in all the European countries except Belgium and the Netherlands. Belgium and the Netherlands had higher levels of productivity than the United States in the 1970s, but these countries faced substantially higher capital and land input prices.

The international competitiveness of European agriculture improved during the early 1980s in spite of productivity gains in the United States. This was because of more rapid increases in the costs of capital and land inputs in the United States and the appreciation of the dollar since 1980.

Output prices in the European countries increased relative to the United States after 1984. A weaker dollar resulted in higher prices of materials, capital, and land inputs in the European countries. Slower growth of productivity in the European countries further eroded their international competitiveness.

The upward trend in relative output prices was reversed after 1995, notwithstanding the increasing United States productivity advantage. More rapid increases in the prices of capital and materials inputs and the appreciation of the dollar pushed output prices in the United States higher.

**Summary and Conclusions**

The United States faces a growing imbalance in agricultural trade with the European Union. Explanations for this trade imbalance must include variations in exchange rates, changes in relative prices of factors of production, and the relative growth of total factor productivity. We analyze the role of each of these factors in explaining the rise in competitiveness of European Union agriculture relative to the United States.

At the outset it is necessary to define a measure of international competitiveness. We employ relative output prices denominated in dollars as our measure of international competitiveness. In order to explain changes in international competitiveness, we must account for changes in this relative price.

We summarize relative output prices by means of purchasing power parities. These are relative prices in each country expressed in terms of national currency per dollar. We divide the relative price of output by the exchange rate to translate the purchasing power parity into relative prices in dollars. Variations in exchange rates are reflected in the relative prices.

To account for changes in competitiveness, we calculate purchasing power parities for the inputs employed in agriculture. We then translate the purchasing power parities for inputs into relative prices in dollars by dividing by the exchange rate.

The final step in accounting for competitiveness is to measure relative levels of productivity. For this purpose we represent technology by the dual price function. This approach allows us to express the price of output in each country as a function of prices of inputs and the level of productivity in that country. We account for differences in relative prices of output among countries by allowing input prices and levels of productivity to differ across countries.

Only two countries—Belgium and the Netherlands—were more productive than the United States at the beginning of the period in 1973. Moreover, the United States had closed the gaps in productivity levels by the early 1990s.

We also find that the United States was more competitive than its European counterparts throughout the period 1973-2002, except for the years 1973-1974 and 1983-1985. We conclude that the main factor behind changes in international competitiveness is the gap in relative levels of productivity. However, changes in international competitiveness over time are strongly influenced by variations in exchange rates through their impact on relative input prices. During the periods 1979-1984 and 1996-2001, the strengthening dollar helped the European countries improve their competitive position, even as their relative productivity performance lagged.

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## Notes

[1] The United States agricultural trade surplus with the European Union reached $10 billion in 1981. But the rapid expansion in European exports—increasing from $238 million in 1981 to nearly $2 billion in 2005—reduced this surplus to $2.5 billion in 2005. If the value of trade in processed items is included, the $2.5 billion surplus becomes a $5 billion trade deficit (Source: U.S. Department of Commerce, Bureau of the Census).

[2] There may be macroeconomic explanations as well. The United States has grown faster than the European Union for much of the study period, and with growth in income we would expect to see growth in demand for imports.

[3] The most familiar application of the notion of purchasing power parity is to the relative prices of such aggregates as gross domestic product. This application was the focus of the landmark studies of Summers and Heston (1991) and Heston, Summers, and Aten (2002).

[4] Equivalently, the expression in (1) could be interpreted as the unit cost function.

[5] Representing technology by the price (equivalently, the unit cost) function implies that the structure of production exhibits constant returns to scale. Here we appeal to Diewert (1981). He shows that if there is free entry into an industry where producers competitively minimize cost, and if the minimum average cost of firm output is small relative to total industry output, then the industry total cost function will be approximated by a cost function which is linear in output as in (1). This industry cost function is dual to a well behaved constant returns to scale production function.

[6] We suppress the county subscripts in order to simplify the notation.

[7] Portugal, Austria, and Finland are excluded from the analysis because the production accounts are incomplete for the full 1973-2002 period for these countries.

[8] This follows from the application of Euler's theorem to a linearly homogeneous function.

[9] An alternatively interpretation of (3) is that of the rate of cost diminution.

[10] This measure of productivity change requires that revenues equal costs. Diewert (1992) has shown that if revenues equal costs then the price index of productivity change equals the more familiar quantity index of productivity growth.

[11] The term characteristicity appears to have been introduced by Drechsler (1973). It indicates the degree to which index number weights reflect the economic conditions that are specific to the two countries being compared.

[12] The accounting framework is that proposed in *Manual on the Economic Accounts for Agriculture and Forestry* (Eurostat, 2000). This approach ensures consistency of the accounts across countries and, hence, facilitates international comparisons.

[13] Data on investment in constant prices are from *Capital Stock Data for the European Union* (Beutel, 1997) and from *Fixed Reproducible Tangible Wealth in the United States* (U.S. Dept. of Commerce).

[14] Very little data exist on the form of the distribution around the mean life. The only study available was conducted by Winfrey (1935) detailing actual service lives of a group of assets. Winfrey's S-3 distribution had a bell-shaped appearance somewhat akin to the normal distribution. No rigorous tests were performed to determine if the distribution was, in fact, a normal distribution, but based on this admittedly sparse evidence it is assumed that there exists a normal distribution about the mean life of a particular type of asset. This assumption is used mostly for convenience since tables of values for the normal distribution are readily available.

[15] A number of European countries offer subsidies on purchases of new capital goods at the rate $s$ of their price, in which case the rental price falls to:

$$c = [rW_K /(1 - F)](1 - s).$$

Hence, the cost of capital services falls by $s$.

To fully realize the reduction in capital costs made possible by the subsidy, the firm would have to sell its existing capital stock and replace it with new units of capital which are eligible for the subsidy. In a simple model with no adjustment costs and perfect resale markets, this would be possible. The subsidy would create a one-time capital loss on existing capital. The prices of used capital goods would have to decline to keep services from them competitive with the lower cost of services available from subsidized, new capital goods.

[16] The nominal rate was taken to be the average annual yield over all maturities.

[17] Ex ante real rates are expressed as an AR(1) process. We use this specification after examining the correlation coefficients for autocorrelation, partial and inverse autocorrelation, and performing the unit root and while noise tests. We centered each time series by subtracting its sample mean. The analysis was performed on the centered data.

[18] See Eswaren, Beinroth, and Reich (2003). They develop a procedure for evaluating inherent land quality and use this procedure to assess land resources on a global scale. Given the Eswaren, Beinroth, and Reich database, we use GIS to overlay country and regional boundaries. The result of the overlay gives us the proportion of land area of each region that is in each of soil stress categories.

[19] A number of characteristics are common to only a few regions. In this case, we indicate environmental stress by a dummy variable equal to unity if more than 10 percent of the land area is affected and zero otherwise.

[20] We use the PROC QLIM procedure in SAS 9.1 to estimate the Box-Cox parameters. The estimation results are available from the authors on request.

[21] Prices in the United States remained at or near record levels long after the momentum of inflation was broken in the early 1980s. An explanation for this can be found in the Agricultural and Food Act of 1981. In the 1981 Act the tie between target prices and rates of inflation was broken and specific levels of price support were mandated for each year between 1982 and 1985 on the assumption that high rates of inflation would continue.

[22] Furthermore, the European Union, under its Common Agricultural Policy (CAP), embarked on a program of subsidized grain sales to increase its market share of world exports. This came largely at the expense of the United States. The United States share of world grain trade fell from 40.4 percent in 1974-76 to 35.6 percent in 1983-85 (Timms and Shane, 1987).

[23] Another factor contributing to the decline in relative prices in the European countries was a series of reforms of the CAP that culminated in the so-called MacSharry reforms of 1992. The package of reforms lowered intervention prices for grains, oilseeds, and protein crops and for beef and sheepmeat. The grain price support was reduced by 29 percent to be phased in over three years beginning with the 1993 crop year. Guaranteed minimum prices for oilseeds and protein crops were eliminated. To compensate for the revenue loss farmers would receive direct payments based in part on historical yields and planted area. Beef prices were lowered 15 percent over three years, while sheepmeat prices were frozen at existing levels. Again, transfer payments would compensate farmers for lower prices.

[24] A motivation for reform of the CAP was the explosive rise in export “restitutions.” With the narrowing of the gap between domestic and world market prices, export restitutions fell from €10 billion in 1992 to €2 billion in 2002 (Source: L’agriculture, nouveaux d’efis – edition 2007. INSEE. Paris).

[25] Spain's impressive productivity performance was not limited to agriculture. Looking at rates of productivity growth across sectors for the 1960-2000 period, Caselli and Tenreyro (2005) find that labor productivity convergence in Spain was driven both by a reallocation of labor from agriculture to more productive sectors and by catching-up of labor productivity within sectors. In contrast, convergence of labor productivity in the other lagging countries was mainly due to the reallocation of labor across sectors, while the contribution of within-industry catch-up to overall labor productivity convergence was actually negative.

Table 1. Output and input prices relative to the United States, 1996

| | Belgium | Denmark | Germany | Greece | Spain | France | Ireland | Italy | Nether-lands | Sweden | United Kingdom |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Output | 1.3551 | 1.4402 | 1.4711 | 1.5046 | 1.3520 | 1.4907 | 1.4273 | 1.4973 | 1.3381 | 1.6300 | 1.6020 |
| Materials | 1.1623 | 1.3498 | 1.3087 | 1.1894 | 1.1886 | 1.2846 | 1.0550 | 1.3448 | 1.2356 | 1.3475 | 1.1729 |
| Capital | 1.2399 | 1.5483 | 0.8577 | 1.0143 | 1.1585 | 1.2051 | 0.8242 | 0.8577 | 1.5246 | 1.1211 | 1.2432 |
| Land | 3.2487 | 1.0169 | 2.2333 | 4.9054 | 4.6744 | 1.9533 | 4.1060 | 2.9146 | 8.1226 | 0.5692 | 2.2617 |
| Labor | 0.7923 | 0.8452 | 0.5308 | 0.3235 | 0.4221 | 0.5601 | 0.2896 | 0.4217 | 0.7048 | 0.4701 | 0.3971 |

Table 2. Output price relative to the 1996 level for the United States

| Year | Belgium | Denmark | Germany | Greece | Spain | France | Ireland | Italy | Nether-lands | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1973 | 0.7189 | 0.8414 | 0.8690 | 0.8749 | 0.7579 | 0.7493 | 0.5742 | 0.7218 | 0.7702 | 1.3616 | 0.6032 | 0.6373 |
| 1974 | 0.6849 | 0.7823 | 0.8499 | 0.8619 | 0.7454 | 0.7638 | 0.5920 | 0.7182 | 0.6830 | 1.1678 | 0.6449 | 0.7159 |
| 1975 | 0.8470 | 0.9294 | 1.0029 | 0.9108 | 0.7809 | 0.9432 | 0.7229 | 0.7992 | 0.7789 | 1.3487 | 0.7414 | 0.6720 |
| 1976 | 0.9550 | 0.9645 | 1.0532 | 0.8432 | 0.7470 | 0.9159 | 0.7220 | 0.7519 | 0.8381 | 1.3768 | 0.7594 | 0.6790 |
| 1977 | 0.9108 | 0.9524 | 1.0751 | 0.8848 | 0.8051 | 0.9080 | 0.8317 | 0.8665 | 0.9061 | 1.4044 | 0.7834 | 0.6612 |
| 1978 | 1.0226 | 1.1408 | 1.1852 | 0.9902 | 0.8892 | 1.0236 | 1.0159 | 0.9874 | 0.9657 | 1.4626 | 0.8645 | 0.7418 |
| 1979 | 1.1408 | 1.2120 | 1.3361 | 1.1751 | 1.0657 | 1.1384 | 1.1499 | 1.1418 | 1.0751 | 1.5833 | 1.0603 | 0.8220 |
| 1980 | 1.2443 | 1.2635 | 1.3525 | 1.2180 | 1.0405 | 1.2306 | 1.1435 | 1.2313 | 1.0960 | 1.7706 | 1.2525 | 0.8629 |
| 1981 | 1.0567 | 1.1106 | 1.1422 | 1.1143 | 0.9446 | 1.0741 | 1.0503 | 1.0524 | 0.9942 | 1.6078 | 1.2041 | 0.8828 |
| 1982 | 0.9471 | 1.0255 | 1.0720 | 1.1078 | 0.8990 | 0.9877 | 0.9912 | 1.0124 | 0.9255 | 1.3877 | 1.1172 | 0.8589 |
| 1983 | 0.9305 | 1.0077 | 1.0159 | 1.0179 | 0.7462 | 0.9282 | 0.9440 | 0.9645 | 0.8926 | 1.2011 | 1.0228 | 0.9684 |
| 1984 | 0.8343 | 0.8826 | 0.8990 | 0.9505 | 0.7236 | 0.8241 | 0.8360 | 0.8984 | 0.8244 | 1.1364 | 0.9002 | 0.9236 |
| 1985 | 0.8083 | 0.8434 | 0.8508 | 0.9226 | 0.6893 | 0.8173 | 0.8104 | 0.8659 | 0.7742 | 1.0898 | 0.8569 | 0.8416 |
| 1986 | 0.9995 | 1.0873 | 1.0911 | 1.0122 | 0.9700 | 1.0618 | 1.0391 | 1.1093 | 0.9850 | 1.3683 | 0.9908 | 0.8338 |
| 1987 | 1.1779 | 1.2426 | 1.2683 | 1.1486 | 1.0594 | 1.1975 | 1.2007 | 1.2818 | 1.1576 | 1.6381 | 1.1380 | 0.8458 |
| 1988 | 1.1893 | 1.2409 | 1.2943 | 1.2242 | 1.1314 | 1.2225 | 1.3346 | 1.3319 | 1.1696 | 1.7758 | 1.2602 | 0.9174 |
| 1989 | 1.2298 | 1.2062 | 1.2890 | 1.2039 | 1.2147 | 1.2347 | 1.3560 | 1.3491 | 1.1497 | 1.7435 | 1.2372 | 0.9432 |
| 1990 | 1.3653 | 1.3490 | 1.4065 | 1.5071 | 1.3944 | 1.4426 | 1.3259 | 1.6194 | 1.2828 | 1.9501 | 1.3796 | 0.9505 |
| 1991 | 1.2883 | 1.2880 | 1.3487 | 1.5173 | 1.4009 | 1.3694 | 1.2575 | 1.6000 | 1.2604 | 1.9202 | 1.3832 | 0.9158 |
| 1992 | 1.3016 | 1.3680 | 1.4151 | 1.4773 | 1.3376 | 1.3870 | 1.3570 | 1.6014 | 1.3069 | 1.9932 | 1.4226 | 0.9025 |
| 1993 | 1.1619 | 1.1900 | 1.3151 | 1.2884 | 1.1778 | 1.2860 | 1.2654 | 1.2815 | 1.1539 | 1.4620 | 1.3541 | 0.9359 |
| 1994 | 1.2436 | 1.2474 | 1.3681 | 1.3371 | 1.2698 | 1.3678 | 1.3055 | 1.2842 | 1.2084 | 1.5008 | 1.4115 | 0.9143 |
| 1995 | 1.3525 | 1.4619 | 1.5540 | 1.5204 | 1.5182 | 1.5526 | 1.4647 | 1.3659 | 1.3789 | 1.5905 | 1.5900 | 0.9456 |
| 1996 | 1.3551 | 1.4402 | 1.4711 | 1.5046 | 1.3520 | 1.4907 | 1.4273 | 1.4973 | 1.3381 | 1.6300 | 1.6020 | 1.0000 |
| 1997 | 1.1990 | 1.2572 | 1.2808 | 1.3574 | 1.1549 | 1.3154 | 1.3066 | 1.3619 | 1.1790 | 1.4150 | 1.4870 | 0.9635 |
| 1998 | 1.1010 | 1.1035 | 1.1886 | 1.2530 | 1.1282 | 1.2871 | 1.2223 | 1.3171 | 1.1277 | 1.3959 | 1.3762 | 0.9196 |
| 1999 | 0.9919 | 1.0398 | 1.0679 | 1.2069 | 1.1245 | 1.1894 | 1.1436 | 1.2168 | 1.0219 | 1.2833 | 1.2892 | 0.8856 |
| 2000 | 0.9161 | 0.9693 | 0.9910 | 1.0503 | 0.9578 | 1.0508 | 1.0393 | 1.0735 | 0.9268 | 1.1717 | 1.1778 | 0.8966 |
| 2001 | 0.9698 | 1.0146 | 0.9935 | 1.0594 | 0.9665 | 1.0759 | 1.0173 | 1.0877 | 0.9664 | 1.1038 | 1.2060 | 0.9053 |
| 2002 | 0.9459 | 0.9784 | 1.0061 | 1.1319 | 0.9924 | 1.0945 | 1.0406 | 1.1689 | 1.0126 | 1.1560 | 1.2141 | 0.8733 |

Table 3. Materials price relative to the 1996 level for the United States

| Year | Belgium | Denmark | Germany | Greece | Spain | France | Ireland | Italy | Nether-lands | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1973 | 0.7097 | 0.6968 | 0.7468 | 0.7168 | 0.3821 | 0.6495 | 0.4187 | 0.7122 | 0.6033 | 0.6904 | 0.4491 | 0.4339 |
| 1974 | 0.6591 | 0.7687 | 0.7665 | 0.6856 | 0.4237 | 0.6449 | 0.4622 | 0.7191 | 0.5808 | 0.6047 | 0.5590 | 0.5420 |
| 1975 | 0.7225 | 0.8348 | 0.7996 | 0.6532 | 0.4608 | 0.8047 | 0.5198 | 0.8217 | 0.6284 | 0.6417 | 0.6040 | 0.5546 |
| 1976 | 0.7681 | 0.8504 | 0.8595 | 0.5810 | 0.4476 | 0.7337 | 0.5102 | 0.7651 | 0.6481 | 0.6666 | 0.5731 | 0.5605 |
| 1977 | 0.8385 | 0.9106 | 0.9616 | 0.5633 | 0.4845 | 0.6921 | 0.5964 | 0.8139 | 0.7213 | 0.7021 | 0.6324 | 0.5697 |
| 1978 | 0.9161 | 0.9724 | 1.0237 | 0.5945 | 0.5869 | 0.7738 | 0.6832 | 0.9032 | 0.8024 | 0.7606 | 0.7163 | 0.5773 |
| 1979 | 1.0347 | 1.0737 | 1.1687 | 0.7455 | 0.7035 | 0.8757 | 0.7697 | 1.0162 | 0.9112 | 0.8620 | 0.8832 | 0.6459 |
| 1980 | 1.1387 | 1.1530 | 1.2125 | 0.8357 | 0.7897 | 0.9836 | 0.8641 | 1.3044 | 0.9735 | 1.0110 | 1.0931 | 0.7202 |
| 1981 | 0.9678 | 1.0565 | 1.0657 | 0.7797 | 0.7341 | 0.8682 | 0.7675 | 1.1205 | 0.8405 | 0.9595 | 1.0376 | 0.7747 |
| 1982 | 0.8648 | 0.9949 | 1.0066 | 0.7459 | 0.6998 | 0.8188 | 0.7434 | 1.0531 | 0.8197 | 0.8694 | 0.9502 | 0.7716 |
| 1983 | 0.8375 | 0.9696 | 0.9756 | 0.6965 | 0.7247 | 0.7783 | 0.7005 | 1.0369 | 0.7831 | 0.7839 | 0.8882 | 0.8193 |
| 1984 | 0.8006 | 0.9005 | 0.8829 | 0.6487 | 0.7215 | 0.7193 | 0.6557 | 0.9597 | 0.7375 | 0.7798 | 0.8031 | 0.8024 |
| 1985 | 0.7658 | 0.8404 | 0.8075 | 0.6289 | 0.7143 | 0.7188 | 0.6512 | 0.8972 | 0.6936 | 0.7930 | 0.7723 | 0.7444 |
| 1986 | 0.9203 | 1.0461 | 1.0043 | 0.7060 | 0.9489 | 0.9169 | 0.7928 | 1.0959 | 0.8532 | 0.9657 | 0.8580 | 0.6868 |
| 1987 | 1.0539 | 1.1800 | 1.1297 | 0.8123 | 1.1190 | 1.0338 | 0.8545 | 1.2567 | 0.9654 | 1.0967 | 0.9561 | 0.6858 |
| 1988 | 1.0563 | 1.2483 | 1.1613 | 0.8789 | 1.1703 | 1.0637 | 0.9009 | 1.2457 | 0.9920 | 1.2012 | 1.0390 | 0.8014 |
| 1989 | 1.0189 | 1.1764 | 1.1086 | 0.8373 | 1.1203 | 1.0341 | 0.8590 | 1.2168 | 0.9434 | 1.2369 | 1.0175 | 0.8387 |
| 1990 | 1.1945 | 1.2899 | 1.2413 | 1.0275 | 1.3025 | 1.1948 | 1.0041 | 1.4141 | 1.0720 | 1.4044 | 1.1439 | 0.8266 |
| 1991 | 1.0957 | 1.2521 | 1.2148 | 1.0650 | 1.2986 | 1.1471 | 0.9741 | 1.4297 | 1.0669 | 1.4020 | 1.1569 | 0.8247 |
| 1992 | 1.1948 | 1.3232 | 1.3047 | 1.1512 | 1.3232 | 1.1951 | 1.0481 | 1.4349 | 1.1457 | 1.4817 | 1.1598 | 0.8223 |
| 1993 | 1.0550 | 1.2194 | 1.1762 | 1.0158 | 1.0663 | 1.0914 | 0.9106 | 1.1811 | 1.0781 | 1.0961 | 1.0220 | 0.8520 |
| 1994 | 1.0407 | 1.2166 | 1.2062 | 1.0790 | 1.0774 | 1.1193 | 0.9378 | 1.1448 | 1.1063 | 1.0975 | 1.0438 | 0.8719 |
| 1995 | 1.1512 | 1.3693 | 1.3715 | 1.1614 | 1.1721 | 1.2799 | 1.0217 | 1.2211 | 1.2621 | 1.2180 | 1.1261 | 0.9092 |
| 1996 | 1.1623 | 1.3498 | 1.3087 | 1.1894 | 1.1886 | 1.2846 | 1.0550 | 1.3448 | 1.2356 | 1.3475 | 1.1729 | 1.0000 |
| 1997 | 1.0119 | 1.1987 | 1.1492 | 1.0672 | 1.0524 | 1.1285 | 0.9926 | 1.2104 | 1.0782 | 1.1925 | 1.1666 | 0.9726 |
| 1998 | 0.9561 | 1.1574 | 1.0619 | 0.9870 | 1.0462 | 1.0797 | 0.9170 | 1.1632 | 1.0536 | 1.1466 | 1.1160 | 0.9120 |
| 1999 | 0.9000 | 1.0997 | 0.9975 | 0.9681 | 0.9539 | 1.0191 | 0.8777 | 1.1263 | 1.0030 | 1.1078 | 1.0782 | 0.8685 |
| 2000 | 0.8286 | 0.9652 | 0.8824 | 0.8736 | 0.8413 | 0.9033 | 0.8011 | 1.0084 | 0.9009 | 1.0205 | 1.0338 | 0.9054 |
| 2001 | 0.8288 | 0.9869 | 0.8117 | 0.8463 | 0.8435 | 0.9190 | 0.8141 | 1.0309 | 0.9329 | 0.9595 | 1.0154 | 0.9501 |
| 2002 | 0.8839 | 1.0452 | 0.9106 | 0.9029 | 0.9963 | 0.9687 | 0.8788 | 1.0874 | 1.0030 | 1.0268 | 1.0574 | 0.9578 |

Table 4. Capital price relative to the 1996 level for the United States

| Year | Belgium | Denmark | Germany | Greece | Spain | France | Ireland | Italy | Nether-lands | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1973 | 0.3716 | 0.2517 | 0.2113 | 0.1734 | 0.1982 | 0.2447 | 0.1597 | 0.2827 | 0.3003 | 0.3556 | 0.3145 | 0.2737 |
| 1974 | 0.4216 | 0.3428 | 0.2414 | 0.1998 | 0.2322 | 0.2869 | 0.1948 | 0.3501 | 0.3515 | 0.3986 | 0.3811 | 0.2942 |
| 1975 | 0.4362 | 0.3240 | 0.2671 | 0.2091 | 0.2581 | 0.3448 | 0.2109 | 0.3423 | 0.3798 | 0.4784 | 0.4314 | 0.3225 |
| 1976 | 0.4415 | 0.3397 | 0.2611 | 0.2111 | 0.2440 | 0.3270 | 0.2044 | 0.3221 | 0.3891 | 0.4927 | 0.4213 | 0.3402 |
| 1977 | 0.5138 | 0.3899 | 0.2878 | 0.2349 | 0.2546 | 0.3616 | 0.2357 | 0.3840 | 0.4734 | 0.5090 | 0.4654 | 0.3752 |
| 1978 | 0.6248 | 0.5253 | 0.3477 | 0.2753 | 0.2987 | 0.4454 | 0.2897 | 0.4960 | 0.5801 | 0.5361 | 0.5582 | 0.4217 |
| 1979 | 0.7146 | 0.6116 | 0.4450 | 0.3268 | 0.4057 | 0.5024 | 0.3118 | 0.6781 | 0.6922 | 0.6096 | 0.7171 | 0.4850 |
| 1980 | 0.8420 | 0.6444 | 0.4721 | 0.3738 | 0.4585 | 0.5748 | 0.3545 | 0.3783 | 0.8165 | 0.7717 | 0.8645 | 0.5739 |
| 1981 | 0.8121 | 0.5912 | 0.4453 | 0.4091 | 0.4683 | 0.5853 | 0.3443 | 0.3674 | 0.7898 | 0.7476 | 0.8610 | 0.7229 |
| 1982 | 0.6985 | 0.6171 | 0.4206 | 0.4323 | 0.4839 | 0.6160 | 0.3342 | 0.3529 | 0.7296 | 0.6687 | 0.8175 | 0.7490 |
| 1983 | 0.6174 | 0.5495 | 0.3922 | 0.3926 | 0.4252 | 0.5551 | 0.3465 | 0.3527 | 0.6011 | 0.6123 | 0.7677 | 0.8189 |
| 1984 | 0.5699 | 0.4527 | 0.3643 | 0.3363 | 0.4650 | 0.4345 | 0.3291 | 0.3270 | 0.5224 | 0.5774 | 0.7269 | 0.9273 |
| 1985 | 0.5502 | 0.4427 | 0.3520 | 0.3035 | 0.4139 | 0.4478 | 0.3910 | 0.3217 | 0.5055 | 0.6113 | 0.7024 | 0.8568 |
| 1986 | 0.6818 | 0.6066 | 0.4698 | 0.3815 | 0.5722 | 0.6120 | 0.5160 | 0.4427 | 0.6639 | 0.7607 | 0.6864 | 0.7532 |
| 1987 | 0.7887 | 0.8423 | 0.5752 | 0.4302 | 0.6953 | 0.7245 | 0.6126 | 0.5524 | 0.8758 | 0.9020 | 0.8636 | 0.8016 |
| 1988 | 0.8574 | 0.9869 | 0.6159 | 0.5179 | 0.9160 | 0.8377 | 0.7574 | 0.6033 | 0.9938 | 1.0233 | 1.0550 | 0.8373 |
| 1989 | 0.8779 | 0.9338 | 0.6315 | 0.5855 | 1.0154 | 0.8571 | 0.6956 | 0.6349 | 1.0555 | 1.0330 | 1.0165 | 0.8531 |
| 1990 | 1.0603 | 1.2977 | 0.8195 | 0.7719 | 1.3405 | 1.1254 | 0.7369 | 0.7986 | 1.4497 | 1.2844 | 1.1575 | 0.8790 |
| 1991 | 1.1189 | 1.3335 | 0.7651 | 0.9180 | 1.4161 | 1.1168 | 0.7082 | 0.8912 | 1.4772 | 1.2882 | 1.1558 | 0.8662 |
| 1992 | 1.1981 | 1.3562 | 0.8495 | 0.9803 | 1.3493 | 1.1972 | 0.7972 | 0.8977 | 1.5405 | 1.2877 | 1.2976 | 0.8575 |
| 1993 | 1.0386 | 1.1536 | 0.7311 | 0.9631 | 0.9621 | 0.9988 | 0.6791 | 0.7191 | 1.3364 | 0.9620 | 1.2480 | 0.8659 |
| 1994 | 1.0875 | 1.2803 | 0.7776 | 0.9179 | 0.9503 | 1.1042 | 0.6326 | 0.7326 | 1.4340 | 0.9413 | 1.3018 | 0.9303 |
| 1995 | 1.3093 | 1.6696 | 0.9796 | 1.0049 | 1.1815 | 1.2772 | 0.9090 | 0.7821 | 1.6589 | 1.1103 | 1.3563 | 0.9795 |
| 1996 | 1.2399 | 1.5483 | 0.8577 | 1.0143 | 1.1585 | 1.2051 | 0.8242 | 0.8577 | 1.5246 | 1.1211 | 1.2432 | 1.0000 |
| 1997 | 1.0855 | 1.2046 | 0.7172 | 0.8291 | 0.9516 | 1.0283 | 0.7563 | 0.7877 | 1.3631 | 0.9471 | 1.1899 | 1.0295 |
| 1998 | 1.0289 | 1.0290 | 0.7018 | 0.8810 | 0.9498 | 0.9730 | 0.6125 | 0.7646 | 1.2836 | 0.8922 | 1.1543 | 0.9902 |
| 1999 | 0.9809 | 1.0658 | 0.6775 | 0.8359 | 0.8955 | 0.9534 | 0.5603 | 0.7603 | 1.2689 | 0.8702 | 1.0714 | 1.0669 |
| 2000 | 0.9091 | 1.0311 | 0.6481 | 0.6449 | 0.8111 | 0.8796 | 0.5424 | 0.6555 | 1.1911 | 0.7709 | 1.0067 | 1.0908 |
| 2001 | 0.8786 | 0.9727 | 0.6552 | 0.6860 | 0.7461 | 0.8551 | 0.5512 | 0.6624 | 1.1471 | 0.7055 | 0.9380 | 1.0165 |
| 2002 | 0.9138 | 0.9849 | 0.6611 | 0.7411 | 0.7726 | 0.8467 | 0.5572 | 0.6867 | 1.1616 | 0.8341 | 0.9811 | 0.9994 |

Table 5. Land price relative to the 1996 level for the United States

| Year | Belgium | Denmark | Germany | Greece | Spain | France | Ireland | Italy | Nether-lands | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1973 | 0.7476 | 0.1406 | 0.7791 | 1.6116 | 1.0369 | 0.5136 | 0.2370 | 0.3005 | 1.7234 | 0.1077 | 0.3327 | 0.2628 |
| 1974 | 0.7331 | 0.2983 | 0.8246 | 1.5700 | 0.9639 | 0.7068 | 0.5083 | 0.4767 | 2.6926 | 0.1038 | 0.2439 | 0.2347 |
| 1975 | 0.4299 | 0.1669 | 0.6506 | 1.0085 | 0.7287 | 0.7322 | 0.3427 | 0.2964 | 1.3595 | 0.1309 | 0.0993 | 0.1870 |
| 1976 | 0.5564 | 0.2614 | 0.3995 | 0.7937 | 0.5020 | 0.4886 | 0.4899 | 0.2375 | 0.9472 | 0.1038 | 0.0913 | 0.1786 |
| 1977 | 0.9868 | 0.4459 | 0.3768 | 0.7386 | 0.3953 | 0.3653 | 0.7561 | 0.2180 | 1.9883 | 0.0691 | 0.0897 | 0.2574 |
| 1978 | 1.8310 | 0.9723 | 0.5799 | 0.7027 | 0.3490 | 0.3403 | 0.7729 | 0.2706 | 3.1814 | 0.0433 | 0.1312 | 0.3954 |
| 1979 | 2.3771 | 1.1048 | 1.8706 | 0.8153 | 0.3919 | 0.3143 | 0.8262 | 0.4633 | 4.0613 | 0.0383 | 0.3463 | 0.5880 |
| 1980 | 4.2142 | 0.8900 | 2.3255 | 1.1903 | 0.5018 | 0.4865 | 0.5640 | 0.6403 | 3.9482 | 0.0875 | 0.4108 | 0.8714 |
| 1981 | 4.4137 | 0.3562 | 3.6310 | 2.2548 | 0.6498 | 1.0723 | 0.7781 | 1.1652 | 3.0703 | 0.1548 | 0.3782 | 1.4552 |
| 1982 | 2.8306 | 0.2170 | 2.9133 | 3.3564 | 0.8629 | 1.2170 | 0.5838 | 0.8287 | 2.3024 | 0.1694 | 0.5438 | 1.3201 |
| 1983 | 2.0442 | 0.2456 | 2.5110 | 3.0519 | 0.7694 | 0.8464 | 0.9452 | 0.7133 | 2.0477 | 0.1612 | 0.5734 | 1.5105 |
| 1984 | 2.0379 | 0.1634 | 2.5738 | 2.2900 | 1.0894 | 0.5391 | 0.7308 | 0.5458 | 2.4152 | 0.1629 | 0.6335 | 1.8294 |
| 1985 | 1.9121 | 0.2619 | 2.2268 | 1.6729 | 0.8711 | 0.5251 | 1.3317 | 0.4500 | 2.9347 | 0.2295 | 0.4965 | 1.3250 |
| 1986 | 2.0398 | 0.3803 | 2.5510 | 1.3360 | 1.8781 | 0.8163 | 1.9531 | 0.7226 | 5.4748 | 0.2913 | 0.6897 | 0.7463 |
| 1987 | 2.3424 | 0.6753 | 3.0895 | 1.7515 | 3.0838 | 1.4638 | 2.1547 | 1.2559 | 6.6694 | 0.4063 | 0.9191 | 0.8502 |
| 1988 | 3.0165 | 0.9391 | 3.2448 | 2.1800 | 6.1029 | 1.9889 | 2.9627 | 1.8939 | 9.5227 | 0.5723 | 1.4137 | 0.8892 |
| 1989 | 3.7179 | 0.8978 | 3.7953 | 3.1121 | 7.5286 | 1.9941 | 3.3163 | 2.5015 | 9.7868 | 0.7143 | 1.5104 | 0.8417 |
| 1990 | 4.3123 | 1.4749 | 5.7303 | 4.5986 | 9.1538 | 2.9397 | 3.5645 | 3.3281 | 10.4906 | 1.1580 | 1.5540 | 0.8944 |
| 1991 | 4.5418 | 1.4058 | 4.1079 | 4.7887 | 7.5596 | 2.6846 | 2.8606 | 4.3389 | 9.3810 | 1.1142 | 1.1647 | 0.8102 |
| 1992 | 4.5395 | 0.9871 | 3.7840 | 6.3217 | 5.3179 | 2.5337 | 2.9251 | 3.4712 | 9.0047 | 0.8318 | 0.9174 | 0.7335 |
| 1993 | 2.7524 | 0.5184 | 1.8923 | 5.2007 | 3.2569 | 1.7596 | 2.1784 | 2.4442 | 6.6270 | 0.3426 | 1.1274 | 0.7166 |
| 1994 | 2.6834 | 0.7136 | 2.2536 | 5.7715 | 3.3266 | 1.9139 | 1.6486 | 2.6045 | 5.7365 | 0.4976 | 1.3942 | 0.8802 |
| 1995 | 3.8427 | 1.2129 | 3.9673 | 6.0218 | 4.7560 | 2.3241 | 4.4059 | 3.0330 | 8.8239 | 0.6479 | 2.2077 | 0.9605 |
| 1996 | 3.2487 | 1.0169 | 2.2333 | 4.9054 | 4.6744 | 1.9533 | 4.1060 | 2.9146 | 8.1226 | 0.5692 | 2.2617 | 1.0000 |
| 1997 | 2.6307 | 0.6778 | 1.7461 | 4.1281 | 4.4010 | 1.4864 | 4.4092 | 2.3513 | 7.6223 | 0.4543 | 1.5207 | 1.0979 |
| 1998 | 2.1162 | 0.4125 | 1.5562 | 3.4279 | 4.7489 | 1.2974 | 2.6765 | 2.2096 | 8.0486 | 0.4867 | 1.2129 | 0.9085 |
| 1999 | 2.0724 | 0.6391 | 1.4925 | 4.5035 | 4.7363 | 1.3400 | 2.2223 | 2.4576 | 5.4840 | 0.5377 | 0.9530 | 1.1808 |
| 2000 | 2.4700 | 0.7612 | 1.8154 | 3.3819 | 3.5680 | 1.4991 | 3.6493 | 1.9878 | 4.8812 | 0.4952 | 1.0887 | 1.2241 |
| 2001 | 2.2189 | 0.8439 | 1.9399 | 2.3662 | 2.7856 | 1.4077 | 4.1153 | 2.2206 | 4.4436 | 0.5818 | 0.8530 | 0.8209 |
| 2002 | 2.0984 | 0.7877 | 1.6661 | 2.4435 | 2.4160 | 1.2550 | 2.2444 | 2.0184 | 4.9510 | 0.7267 | 0.7602 | 0.6918 |

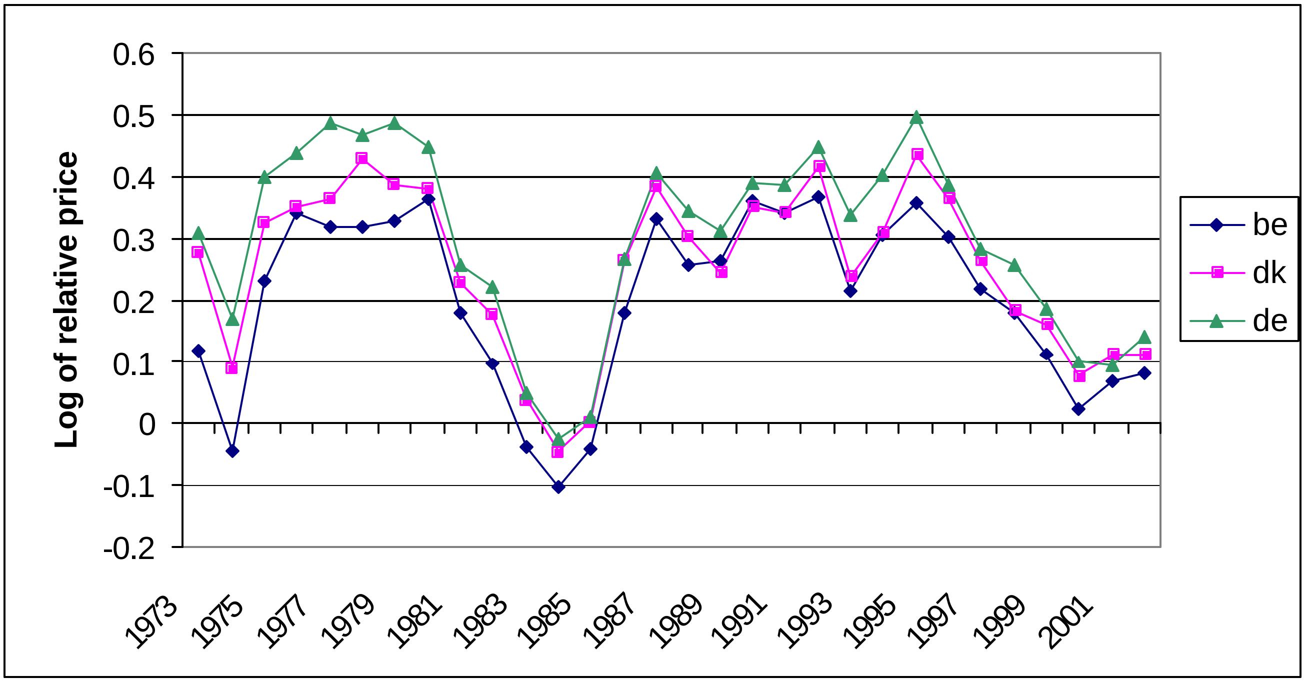
Table 6. Labor price relative to the 1996 level for the United States

| Year | Belgium | Denmark | Germany | Greece | Spain | France | Ireland | Italy | Nether-lands | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1973 | 0.2345 | 0.2172 | 0.2029 | 0.0848 | 0.0934 | 0.1477 | 0.0663 | 0.1163 | 0.4627 | 0.1699 | 0.1202 | 0.3125 |
| 1974 | 0.2473 | 0.2286 | 0.1966 | 0.0995 | 0.0890 | 0.1421 | 0.0654 | 0.0935 | 0.3809 | 0.1756 | 0.1158 | 0.3079 |
| 1975 | 0.3165 | 0.2280 | 0.2287 | 0.1195 | 0.1005 | 0.1670 | 0.1056 | 0.1268 | 0.4378 | 0.2141 | 0.1685 | 0.3103 |
| 1976 | 0.3269 | 0.1909 | 0.3071 | 0.1139 | 0.1105 | 0.1798 | 0.0937 | 0.0990 | 0.4777 | 0.2259 | 0.1805 | 0.2972 |
| 1977 | 0.3002 | 0.1999 | 0.3416 | 0.1184 | 0.1315 | 0.1873 | 0.1224 | 0.1264 | 0.4638 | 0.2513 | 0.2005 | 0.3133 |
| 1978 | 0.3544 | 0.2643 | 0.4092 | 0.1511 | 0.1586 | 0.2443 | 0.1589 | 0.1412 | 0.4228 | 0.2785 | 0.2286 | 0.3585 |
| 1979 | 0.3391 | 0.1956 | 0.3894 | 0.1665 | 0.2041 | 0.3092 | 0.1602 | 0.1581 | 0.4226 | 0.2853 | 0.2508 | 0.4162 |
| 1980 | 0.2661 | 0.1805 | 0.3366 | 0.1653 | 0.2237 | 0.3060 | 0.1535 | 0.1872 | 0.3138 | 0.3148 | 0.3138 | 0.2562 |
| 1981 | 0.1682 | 0.2227 | 0.1646 | 0.1141 | 0.1486 | 0.2207 | 0.1286 | 0.1336 | 0.3919 | 0.3201 | 0.3109 | 0.2361 |
| 1982 | 0.2123 | 0.2654 | 0.2580 | 0.1281 | 0.1510 | 0.2299 | 0.1455 | 0.1453 | 0.3782 | 0.3186 | 0.2809 | 0.2633 |
| 1983 | 0.2698 | 0.2193 | 0.2508 | 0.1226 | 0.1180 | 0.2137 | 0.1329 | 0.1592 | 0.4420 | 0.2275 | 0.2141 | 0.1159 |
| 1984 | 0.2463 | 0.3651 | 0.2226 | 0.1456 | 0.1320 | 0.2200 | 0.1425 | 0.1397 | 0.3836 | 0.2975 | 0.2187 | 0.2382 |
| 1985 | 0.2560 | 0.3404 | 0.2083 | 0.1657 | 0.1575 | 0.2279 | 0.1032 | 0.1481 | 0.3108 | 0.2183 | 0.1916 | 0.3756 |
| 1986 | 0.4026 | 0.5292 | 0.3295 | 0.1869 | 0.1682 | 0.3092 | 0.1136 | 0.2034 | 0.5099 | 0.3221 | 0.2484 | 0.5781 |
| 1987 | 0.4722 | 0.4427 | 0.3371 | 0.2114 | 0.2012 | 0.3438 | 0.1810 | 0.2348 | 0.5707 | 0.3519 | 0.2761 | 0.6276 |
| 1988 | 0.4920 | 0.4522 | 0.3284 | 0.2270 | 0.1818 | 0.3142 | 0.2069 | 0.2052 | 0.5382 | 0.3977 | 0.2536 | 0.5579 |
| 1989 | 0.5894 | 0.6113 | 0.3381 | 0.2228 | 0.1610 | 0.3447 | 0.2034 | 0.2248 | 0.5857 | 0.4545 | 0.2909 | 0.7505 |
| 1990 | 0.6465 | 0.6382 | 0.4304 | 0.2248 | 0.1631 | 0.3908 | 0.2154 | 0.2261 | 0.6436 | 0.5681 | 0.3196 | 0.8216 |
| 1991 | 0.6046 | 0.5696 | 0.2467 | 0.2989 | 0.1793 | 0.3154 | 0.2129 | 0.2380 | 0.6410 | 0.4646 | 0.3740 | 0.7644 |
| 1992 | 0.6635 | 0.5525 | 0.2907 | 0.2631 | 0.1935 | 0.3851 | 0.2748 | 0.2555 | 0.6508 | 0.4091 | 0.4155 | 0.9477 |
| 1993 | 0.7023 | 0.5901 | 0.4037 | 0.1952 | 0.2767 | 0.4065 | 0.2737 | 0.2275 | 0.5543 | 0.4026 | 0.3674 | 0.8883 |
| 1994 | 0.7719 | 0.6520 | 0.4405 | 0.2522 | 0.3352 | 0.4621 | 0.3146 | 0.2690 | 0.6758 | 0.4294 | 0.3782 | 0.9697 |
| 1995 | 0.7100 | 0.7963 | 0.3904 | 0.3332 | 0.3256 | 0.5366 | 0.2536 | 0.3245 | 0.7173 | 0.4377 | 0.3839 | 0.7872 |
| 1996 | 0.7923 | 0.8452 | 0.5308 | 0.3235 | 0.4221 | 0.5601 | 0.2896 | 0.4217 | 0.7048 | 0.4701 | 0.3971 | 1.0000 |
| 1997 | 0.7608 | 0.8067 | 0.5017 | 0.3258 | 0.4042 | 0.5438 | 0.2569 | 0.4280 | 0.5424 | 0.4614 | 0.3882 | 0.9153 |
| 1998 | 0.7724 | 0.6580 | 0.4957 | 0.2889 | 0.3873 | 0.6046 | 0.3194 | 0.4659 | 0.5993 | 0.4464 | 0.3814 | 0.9392 |
| 1999 | 0.6798 | 0.5775 | 0.4562 | 0.3010 | 0.3667 | 0.5491 | 0.3010 | 0.4574 | 0.5694 | 0.3362 | 0.4258 | 0.8095 |
| 2000 | 0.5898 | 0.6051 | 0.3489 | 0.2858 | 0.3910 | 0.4348 | 0.2680 | 0.3917 | 0.5261 | 0.3575 | 0.3633 | 0.8753 |
| 2001 | 0.6424 | 0.7454 | 0.3349 | 0.2967 | 0.4698 | 0.4326 | 0.2298 | 0.3827 | 0.5585 | 0.3290 | 0.4047 | 0.9379 |
| 2002 | 0.5940 | 0.5604 | 0.3481 | 0.3199 | 0.5249 | 0.4884 | 0.2883 | 0.4177 | 0.5366 | 0.3176 | 0.5153 | 0.8838 |

Table 7. Total factor productivity relative to the 1996 level for the United States

| Year | Belgium | Denmark | Germany | Greece | Spain | France | Ireland | Italy | Nether-lands | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1973 | 0.6802 | 0.5343 | 0.4609 | 0.3469 | 0.3259 | 0.4806 | 0.3609 | 0.4712 | 0.7476 | 0.2916 | 0.4710 | 0.5730 |
| 1974 | 0.7018 | 0.6380 | 0.4865 | 0.3643 | 0.3323 | 0.4759 | 0.3900 | 0.4539 | 0.7850 | 0.3235 | 0.5014 | 0.5601 |
| 1975 | 0.6461 | 0.5558 | 0.4437 | 0.3769 | 0.3447 | 0.4664 | 0.4053 | 0.4740 | 0.7433 | 0.3162 | 0.4864 | 0.6047 |
| 1976 | 0.6037 | 0.5212 | 0.4730 | 0.3779 | 0.3707 | 0.4609 | 0.3835 | 0.4287 | 0.7243 | 0.3222 | 0.4673 | 0.5944 |
| 1977 | 0.6662 | 0.5696 | 0.5136 | 0.3655 | 0.3889 | 0.4583 | 0.4113 | 0.4340 | 0.7285 | 0.3363 | 0.4959 | 0.6434 |
| 1978 | 0.6837 | 0.5525 | 0.5306 | 0.3939 | 0.4190 | 0.4846 | 0.4091 | 0.4336 | 0.7312 | 0.3499 | 0.5161 | 0.6275 |
| 1979 | 0.6705 | 0.5391 | 0.5496 | 0.3873 | 0.4422 | 0.5139 | 0.3825 | 0.4393 | 0.7361 | 0.3556 | 0.5189 | 0.6569 |
| 1980 | 0.6707 | 0.5407 | 0.5456 | 0.4294 | 0.5063 | 0.5127 | 0.4015 | 0.4519 | 0.7297 | 0.3722 | 0.5444 | 0.6232 |
| 1981 | 0.6838 | 0.5818 | 0.5524 | 0.4284 | 0.4516 | 0.5144 | 0.3937 | 0.4386 | 0.7653 | 0.3996 | 0.5485 | 0.6974 |
| 1982 | 0.6916 | 0.6236 | 0.5920 | 0.4457 | 0.4857 | 0.5598 | 0.4229 | 0.4478 | 0.7851 | 0.4304 | 0.5617 | 0.7203 |
| 1983 | 0.6865 | 0.5935 | 0.5868 | 0.4222 | 0.5170 | 0.5462 | 0.4310 | 0.4805 | 0.7915 | 0.4229 | 0.5507 | 0.6200 |
| 1984 | 0.7202 | 0.6954 | 0.6036 | 0.4411 | 0.5759 | 0.5654 | 0.4743 | 0.4618 | 0.7891 | 0.4725 | 0.5954 | 0.7389 |
| 1985 | 0.7169 | 0.6834 | 0.5845 | 0.4552 | 0.6087 | 0.5760 | 0.4671 | 0.4716 | 0.7776 | 0.4655 | 0.5731 | 0.7894 |
| 1986 | 0.7332 | 0.7071 | 0.5951 | 0.4667 | 0.5462 | 0.5834 | 0.4424 | 0.4833 | 0.8181 | 0.4731 | 0.5720 | 0.7864 |
| 1987 | 0.7138 | 0.6720 | 0.5758 | 0.4716 | 0.6066 | 0.5961 | 0.4673 | 0.4925 | 0.8041 | 0.4483 | 0.5714 | 0.8132 |
| 1988 | 0.7313 | 0.7219 | 0.5836 | 0.4944 | 0.6422 | 0.5991 | 0.4777 | 0.4613 | 0.8302 | 0.4600 | 0.5631 | 0.7832 |
| 1989 | 0.7394 | 0.7571 | 0.5921 | 0.5112 | 0.6057 | 0.6040 | 0.4505 | 0.4794 | 0.8502 | 0.4939 | 0.5780 | 0.8535 |
| 1990 | 0.7704 | 0.7722 | 0.6718 | 0.4516 | 0.6331 | 0.6206 | 0.5079 | 0.4504 | 0.8858 | 0.5244 | 0.5795 | 0.8769 |
| 1991 | 0.7748 | 0.7801 | 0.5960 | 0.5503 | 0.6320 | 0.6059 | 0.5160 | 0.4886 | 0.8961 | 0.5079 | 0.5873 | 0.8774 |
| 1992 | 0.8339 | 0.7520 | 0.6202 | 0.5378 | 0.6412 | 0.6468 | 0.5485 | 0.4944 | 0.9061 | 0.4895 | 0.5951 | 0.9550 |
| 1993 | 0.8408 | 0.8017 | 0.6204 | 0.5157 | 0.6453 | 0.6378 | 0.5254 | 0.5154 | 0.9142 | 0.5225 | 0.5792 | 0.9126 |
| 1994 | 0.8025 | 0.7998 | 0.6337 | 0.5593 | 0.6418 | 0.6444 | 0.5239 | 0.5467 | 0.9349 | 0.5181 | 0.5810 | 0.9969 |
| 1995 | 0.8010 | 0.8124 | 0.6460 | 0.5750 | 0.5966 | 0.6569 | 0.5258 | 0.5788 | 0.9395 | 0.5394 | 0.5681 | 0.9276 |
| 1996 | 0.8135 | 0.8135 | 0.6570 | 0.5704 | 0.7310 | 0.6799 | 0.5483 | 0.6139 | 0.9312 | 0.5676 | 0.5637 | 1.0000 |
| 1997 | 0.8176 | 0.8168 | 0.6660 | 0.5903 | 0.7734 | 0.6874 | 0.5548 | 0.6358 | 0.9029 | 0.5865 | 0.5679 | 1.0048 |
| 1998 | 0.8481 | 0.8407 | 0.6804 | 0.6134 | 0.7744 | 0.6984 | 0.5543 | 0.6659 | 0.9417 | 0.5710 | 0.5791 | 1.0085 |
| 1999 | 0.8712 | 0.8512 | 0.7140 | 0.6294 | 0.7245 | 0.7127 | 0.5498 | 0.7146 | 0.9688 | 0.5731 | 0.5962 | 1.0061 |
| 2000 | 0.8733 | 0.8504 | 0.6936 | 0.6348 | 0.7885 | 0.7085 | 0.5719 | 0.7013 | 0.9736 | 0.5898 | 0.6160 | 1.0449 |
| 2001 | 0.8331 | 0.8536 | 0.6664 | 0.6361 | 0.8163 | 0.6908 | 0.5729 | 0.6991 | 0.9537 | 0.5859 | 0.5920 | 1.0392 |
| 2002 | 0.8720 | 0.8624 | 0.6945 | 0.6351 | 0.8783 | 0.7138 | 0.5924 | 0.6836 | 0.9489 | 0.5989 | 0.6328 | 1.0476 |

Figure 1. Trends of differences in relative output prices denominated in dollars



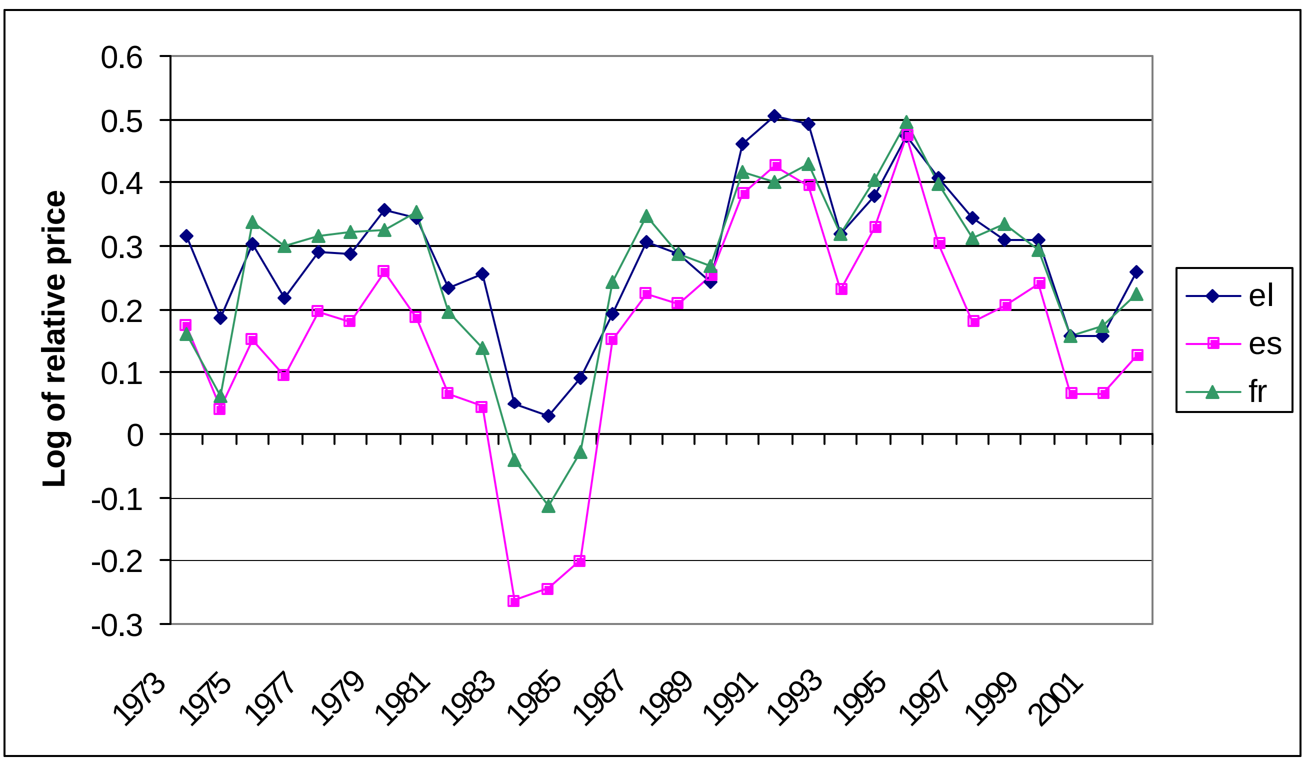



Figure 1 (continued). Trends of differences in relative output prices denominated in dollars