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Comparative Advantage, Exchange Rates, and G-7 Sectoral Trade Balances

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Abstract

This paper uses a Ricardian framework to clarify the role of microeconomic and macroeconomic factors governing the time series and cross-section behavior of sectoral trade balances. Unit labor costs and trade balances are calculated for several sectors for the seven major industrial countries. The time series and cross-section variation in sectoral unit labor costs is decomposed into relative productivity, wage differentials, and exchange rate variations. The main findings are that changes over time in sectoral trade balances, especially for the United States and Japan, are quite well explained by the evolution of unit labor cost, suggesting that trade patterns conform to comparative advantage. The cross-section results are, however, less conclusive.

JEL Classification numbers:
F14, F32

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Summary

This paper investigates the relationship between comparative advantage and sectoral trade balances for the seven major industrial countries (the G-7). It has been motivated in part by the widely-held view that Japan's sectoral trade balances must be "managed" because Japanese trade is not responsive to normal market forces. This paper uses a Ricardian framework to clarify the role of microeconomic and macroeconomic factors in the time series and cross-sectional behavior of sectoral trade balances. The comparative advantage of the United States and Japan relative to the other G-7 countries is evaluated using relative unit labor costs, and an attempt is made to explain sectoral trade balances. The time series and cross-sectional variation in sectoral unit costs is decomposed into relative productivity, wage differentials, and exchange rate variations.

Japanese productivity has grown rapidly relative to other countries, but it has an unusually high dispersion across sectors. For many sectors, Japan's productivity in the late 1980s remained well below that of the United States and the G-7 average, but in a few manufacturing sectors Japan was at the top of the G-7 productivity league. U.S. productivity in agriculture and aggregate manufacturing remained well above that of the other G-7 countries. Relative to the aggregate economy, U.S. manufacturing wages were relatively high, while Japanese manufacturing wages tended to be slightly below average, which enhanced Japan's competitiveness in this sector. Exchange rate changes have played a large role in the medium-term behavior of unit labor costs, especially in the 1980s, when U.S., Japanese, and German competitiveness was strongly influenced by the rise and fall of the dollar.

A statistical analysis finds that changes in the sectoral trade balances are well explained by the evolution of unit labor costs, although the levels of these two variables across countries are sometimes difficult to reconcile because some of the data limitations on trade flows, productivity, and unit labor costs are more acute for assessing levels rather than changes over time. Moreover, it is likely that sectoral nonlabor costs, such as raw materials, vary less over time than across sectors. Except for Canada, the regressions provide some support for the theory of comparative advantage, as sectoral trade balances are usually negatively related to relative unit labor costs. The United States and Japan stand out among the G-7 countries as having sectoral trade balances that are more responsive to sectoral competitiveness over time. Taken together, the regression results indicate that Japan's trading pattern is explained by the Ricardian model better than the patterns of many of the other countries, contrary to the conventional wisdom that Japanese trade is unresponsive to normal market mechanisms.

I. Introduction

Modern mercantilists view international trade as an arena for economic conflict and often call for international agreements to manage trade balances by sector. Japan's manufacturing trade surpluses, in particular, have caused much consternation in Europe and North America and have been widely interpreted as evidence of predatory behavior by Japanese exporters and of a closed Japanese market. Economic theory, however, suggests more benign, although perhaps less easily understood, factors behind sectoral trade surpluses and deficits. This paper investigates the extent to which the fundamental economic principles of comparative and absolute advantage explain sectoral trade balances for the seven major industrial countries (the G-7). Particular attention is devoted to the United States and Japan.

Sectoral trade balances are influenced by both macroeconomic and microeconomic factors. 1/ The overall current account balance is determined by macroeconomic factors, namely the level of aggregate demand in relation to output (or equivalently the relation between saving and investment), as well as the degree of international capital mobility. Shocks to aggregate demand and supply are transmitted to the current account through real exchange rates and relative outputs, although the former operate with a substantial lag. Figures 1a and 1b show the pattern of real exchange rates and net exports of goods and services as a ratio of GDP for the United States and Japan. The real exchange rate is the IMF's real effective exchange rate index, inverted and shown with a two-year lag. There is a strong correlation of net exports to exchange rates, after allowing for the two-year lag.

At the microeconomic level, sectoral trade deficits and surpluses are influenced by comparative advantage: those sectors with particular advantages relative to other industries and other countries--in the form of either higher productivity or lower costs--will tend to be net exporters even when a nation's overall trade balance is zero. Those at a comparative disadvantage will, of course, tend to be net importers. But sectoral trade balances also reflect the macroeconomic factors discussed above, as the overall current account balance must manifest itself in individual sectors. In particular, real exchange rate changes alter absolute advantage--that is, the competitiveness of all sectors is affected equally. For example, if the U.S. dollar appreciates in real terms, industries in which the United States has a comparative advantage will experience declines in their sectoral surpluses, and some may even move into deficit, while sectors where the United States has a comparative disadvantage will suffer greater deficits. The combined effect of these sectoral effects is a larger overall current account deficit.

There have been numerous studies of the macroeconomic influences on the current account and many microeconomic studies of sectoral trade balances using the Heckshe r-Ohlin-Samuelson (HOS) model as a point of departure. Few attempts have been made, however, to provide an integrated perspective and

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1/ See Golub (1993) for a review of the literature on the microeconomic and macroeconomic aspects of trade balances for the United States and Japan.

to assess the relative importance of micro and macro factors. 1/ This paper uses a multi-commodity Ricardian model as a point of departure for a preliminary empirical exercise. The Ricardian model provides a simple framework to analyze both comparative advantage and real exchange rates. The basic idea is that relative unit labor cost--the centerpiece of the Ricardian model--is influenced both by sector-specific variables (productivity and wages) as well as the real exchange rate. On a micro level, the Ricardian model has both advantages and disadvantages compared to the HOS model, in which comparative advantage is derived from factor endowments. The main advantage is that the Ricardian model allows for technological differences between countries, which in practice seem very significant at the sectoral level. There are large and persistent gaps in labor and total factor productivity by industry across countries (Wolff (1993)). Moreover, the HOS model has received only lukewarm empirical support (Bowen, Leamer, and Sveikauskas, (1987)). The main disadvantage of the Ricardian model is that it implies that countries specialize completely. In practice, however, import-competing sectors rarely disappear completely in the face of foreign competition. To allow for incomplete specialization in a Ricardian context, one would have to introduce further assumptions, such as product differentiation. In this sense, the pure Ricardian model can provide only a partial foundation for explaining actual trade patterns. Despite this serious practical problem, previous applications of the Ricardian model have been quite successful, although they are surprisingly few in number. 2/

The analytical framework is spelled out in Section II and is then applied to an empirical analysis of sectoral trade balances of the G-7 countries in Section III. Times series and cross-section regressions of relative unit labor costs on sectoral trade balances are reported in Section IV.

II. Analytical Framework

The starting point is a two-country multi-good Ricardian model, as in Dornbusch, Fischer, and Samuelson (1977), hereafter referred to as DFS. 3/ In the DFS model, comparative advantage is defined by ranking domestic and foreign labor productivities by sector. Let *a* represent factor use per unit

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1/ Ceglowski (1989) examined the responsiveness of U.S. sectoral exports and imports to sector-specific real exchange rates. Stone (1979) provided disaggregated elasticities of export supply and import demand for the United States, the EC, and Japan. Lenz (1991) qualitatively assesses trade balances for various sectors, but lacks on analytical framework.

2/ The most famous of these studies is MacDougall (1951). For a discussion of MacDougall's article and further results, see Deardorff (1985).

3/ The multi-country multi-commodity case was first presented in Jones (1961).

Figure 1a

U.S. Net Exports and Real Exchange Rate Two Years Earlier

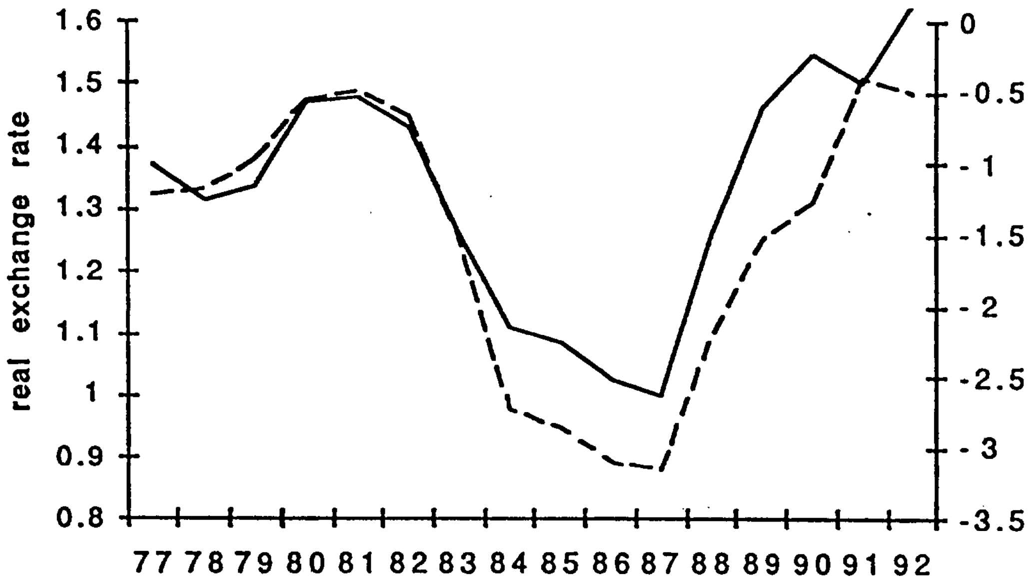
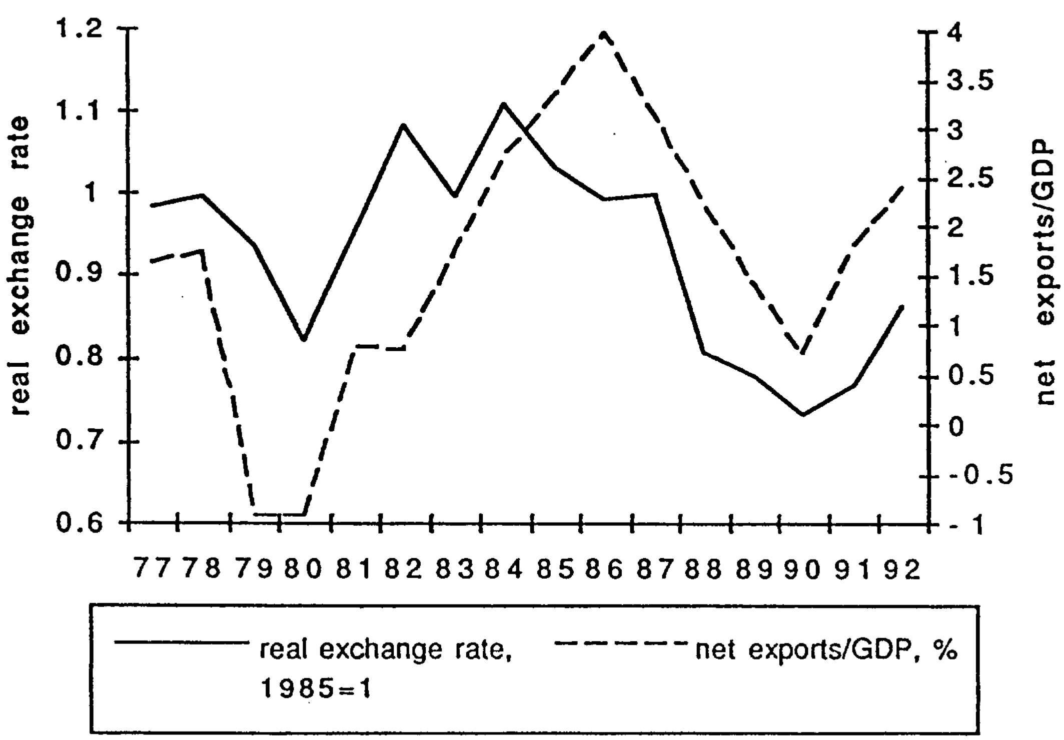


Figure 1b

Japan Net Exports and Real Exchange Rate Two Years Earlier



Source: IMF, International Financial Statistics.

of output (the inverse of productivity), defining it either for labor alone or in relation to labor and capital,

$$a = \frac{L}{Q}, \text{ or} \tag{1a}$$

$$a = \frac{L^{\alpha}K^{1-\alpha}}{Q}, \tag{1b}$$

where Q is value added, L is labor employment, K is capital stock, and d is labor's share of income. Using either measure of factor input, we can obtain a chain of comparative advantage, in order of diminishing home country comparative advantage, where * denotes the foreign country and n is the number of commodities:

$$a_1{*}/a_1 > a_2{*}/a_2 >.....a_i{*}/a_i >...> a_n{*}/a_n.$$

The key question is which goods are produced at home and which abroad, i.e. where the chain of comparative advantage is broken. This also depends on relative wages (w and $w*$) and the exchange rate (e), which determine relative unit labor cost, denoted by c_i, in a common currency:

$$c_i = e.w_i{*}.a_i{*}/w_i.a_i.$$

According to the Ricardian model, the home country will produce and export those goods where c_i is greater than unity and import those goods where c_i is less than unity. The model is closed by adding a condition for market equilibrium (current account balance), which then determines equilibrium relative home to foreign real wages. DFS do not consider capital movements, but these could be introduced. In this case, equilibrium in the goods market would be equivalent to balance-of-payments equilibrium (current account plus the capital account equal to zero) rather than a zero current account, as in DFS.

A few points about c_i should be noted. First, in most versions of the Ricardian model, as in the DFS model, perfect competition and homogenous labor are assumed and wages are equalized across sectors within a country (but not across countries). I allow for sectoral wage disparities to account for differences in education between sectors and imperfections in the labor market. Comparative advantage, therefore, may reflect wage differences as well as productivity differences across sectors and countries. Second, exchange rate changes can alter the competitiveness of all sectors simultaneously and thereby alter where the chain of comparative advantage is cut. The long-run equilibrium exchange rate might be defined as the one which brings about aggregate current account balance. Deviations of the exchange rate from its equilibrium level due to macroeconomic factors, such as savings-investment imbalances, will lead to aggregate external deficits and surpluses. Third, unit labor cost may be an imperfect gauge of competitiveness if quality differences are not measured accurately or if labor is not the only factor of production. Quality differences between foreign and domestic products might imply that the critical value of c_i is different from 1. For example, if Japanese products have superior reliability and service they may still be competitive even if Japanese producers have higher unit costs. The presence of other factors of production implies that one should use total factor productivity rather than just labor productivity--equation (1b) instead of (1a). Both labor and total factor productivity are considered in the empirical work below.

A useful decomposition of relative unit labor cost is:

$$c_i = \frac{a_i^* w_i^* e}{a_i w_i} = \frac{a_i^*}{a_i} \cdot \frac{w_i^*/w^*}{w_i/w} \cdot \frac{w^* PPP}{w} \cdot \frac{e}{PPP}, \tag{3}$$

where PPP is the implicit purchasing-power-parity exchange rate. This decomposition says that relative unit labor costs depend on four factors:

- -Relative labor productivities,
- -Relative sectoral wage divergences from the aggregate wage level,
- -Overall wage ratios compared at PPP exchange rates,
- -The gap between the PPP exchange rate and the market exchange rate.

The first two of these are microeconomic whereas the latter two are macroeconomic. For example, the automobile sector in the United States could be under pressure from Japanese imports because: (i) Japanese automobile productivity is high, (ii) U.S. auto workers earn wages above the average for other traded goods, (iii) overall U.S. wages are out of line with productivity, or (iv) the dollar is overvalued.

III. Data and Method

Most of the data for this study were taken from the OECD International Sectoral Data Base (ISDB) (1993) which contains consistent trade, value-added, factor use (labor and capital) and labor compensation data for most OECD countries disaggregated into about 20 sectors. The ISDB covers the 1960-92 period, but relatively complete data are available only for 1970-89. This period is used for most of the analysis in this paper. Although in principle the data cover the entire economy, there are major gaps for the service sector, so most of the analysis is for goods only. This is a drawback in view of the increasing importance of trade in services and the rising U.S. comparative advantage in this sector. The ISDB permits calculation of sectoral productivities, wage rates, and hence unit factor costs. The ISDB presents a number of variables in U.S. dollars measured at PPP exchange rates, allowing for comparisons of real outputs.

I confined the study to the G-7 countries (United States, Japan, Germany, France, United Kingdom, Italy, and Canada). The Ricardian model was adapted to a multi-country framework by calculating average G-7 unit factor costs and comparing each country to the G-7 average.

With these data, I am able to calculate unit labor costs (and also unit factor costs using total factor productivity), their components (productivity and wages), and the effects of exchange rates. I then relate relative unit labor cost to trade patterns. Jorgenson and Kuroda (1990) present some disaggregated comparisons of international competitiveness for the United States and Japan similar to those in this paper, but they did not use their results to assess trade patterns and did not consider other countries. Although there are consistent trade data on the ISDB, I used trade statistics provided directly by the OECD on diskette, as the ISDB contains no bilateral trade flows. Using this OECD bilateral data, I constructed intra-G7 trade balances, to keep the trade balance data consistent with the unit labor cost calculations.

Table 1a shows the calculated labor productivities for the United States, Japan, and West Germany (as a ratio of the G-7 average), for the whole economy as well as at a more disaggregated level. Labor productivity is calculated as real value added in dollars evaluated at the PPP exchange rate, divided by total employment. 1/ The PPP exchange rate is an aggregate for the entire economy. As Hooper and Larin (1989) stress, for international comparisons of levels of productivity it is desirable to use PPPs appropriate to the comparison in question. It would be preferable, therefore, to use PPPs disaggregated by sector to get more accurate measures of outputs across countries, but they would be difficult to obtain for the sectoral decomposition considered here, and other studies suggest that the

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1/ No adjustment is made for hours worked, as there are no sectoral data on this. Japan's relative productivity would be lowered by such an adjustment because Japanese workers work more hours than those of other G-7 countries (McKinsey (1992)). Allowing for hours worked would not have much effect on comparative advantage to the extent that Japanese workers work longer hours in all industries. In any case, hours worked has a strong cyclical component which could cloud the underlying comparative advantages.

results would not be altered much. 1/ At any rate, this is mainly a problem for the comparison of productivity at a point in time rather than for changes over time.

Table 1a. Sectoral Comparisons of Labor Productivity, Expressed as a Ratio of G-7 Averages, Selected Years

	United States			Japan			Germany		
	1970	1980	1989	1970	1980	1989	1970	1980	1989
Total economy	1.45	1.27	1.19	0.59	0.73	0.82	0.89	0.96	0.94
Manufacturing	1.33	1.21	1.23	0.67	0.84	0.90	1.04	1.01	0.82
Agriculture	2.70	2.01	1.83	0.54	0.52	0.50	0.69	0.90	1.02
Mining	2.29	1.54	1.54	0.24	0.48	0.39	0.51	0.49	0.34
Manufacturing sectors									
Machinery	1.34	1.19	1.28	0.52	0.79	0.94	1.12	1.06	0.76
Textiles	1.14	1.12	1.17	0.54	0.62	0.40	1.10	0.98	1.02
Nonmetallic, minerals	1.40	1.25	1.18	0.78	0.63	0.81	0.95	1.07	0.90
Paper	1.24	1.17	1.07	0.59	0.82	1.06	0.76	0.80	0.76
Basic metals	1.40	1.18	1.08	1.15	1.80	1.43	0.74	0.72	0.68
Chemicals	1.31	1.17	1.16	0.90	1.32	1.73	1.02	0.99	0.76
Food	1.19	1.20	1.24	0.86	0.90	0.84	0.90	0.84	0.77

Source: *OECD International Sectoral Database* and author's calculations as described in the text.

1/ Pilat and Van Ark (1992) develop unit value ratios--essentially sectoral PPPs--by using micro data from the census of manufactures for the United States, Japan, and Germany. However, they do not obtain very different results for productivity for most sectors than Wolff (1993) who uses the same OECD data that I do. Moreover, my results for total manufacturing productivity are very similar to those of Hooper and Larin ((1989), Table 5), suggesting that the precise choice of a PPP index does not make a significant difference.

Total factor productivity, displayed in Table 1b, is defined as in equation (1b) and assuming that labor's share (a) is 0.7 in all industries and all countries, for purposes of international comparisons. 1/

Table 1b. Sectoral Comparisons of Total Factor Productivity, Expressed as a Ratio of G-7 Averages, Selected Years

	United States			Japan			Germany		
	1970	1980	1989	1970	1980	1989	1970	1980	1989
Total economy	1.26	1.16	1.09	0.81	0.85	0.88	0.92	0.96	0.91
Manufacturing	1.25	1.15	1.15	0.82	0.92	0.91	1.13	1.08	0.88
Agriculture	1.93	1.61	1.57	0.76	0.61	0.52	0.59	0.80	0.86
Mining	1.76	1.38	1.39	0.44	0.77	0.65	0.73	0.69	0.52
Manufacturing sectors									
Machinery	1.27	1.15	1.20	0.66	0.89	0.97	1.20	1.12	0.81
Textiles	1.18	1.17	1.15	0.63	0.66	0.37	1.09	0.94	0.90
Nonmetallic, minerals	1.34	1.23	1.16	1.02	0.73	0.80	1.00	1.08	0.87
Paper	1.23	1.18	1.09	0.59	0.68	0.81	0.84	0.85	0.80
Basic metals	1.36	1.16	1.00	1.19	1.68	1.35	0.90	0.87	0.83
Chemicals	1.25	1.12	1.08	0.91	1.19	1.40	1.10	1.08	0.82
Food	1.15	1.15	1.15	1.20	1.10	0.86	0.91	0.85	0.76

Source: *OECD International Sectoral Database* and author's calculations as described in the text.

The results for labor productivity are similar to those reported in Wolff (1993) and Pilat and Van Ark (1992). U.S. productivity remains considerably above that of other G-7 countries throughout the period, for both the overall economy and most sectors. Japan's productivity has been increasing rapidly, but it remains behind the United States in most sectors, and the rate at which it is catching up is decelerating, especially if one considers total factor productivity. (Japan's slower growth of total factor productivity reflects the relatively rapid growth of the Japanese capital stock.) German relative productivity levels have tended to remain slightly below the G-7 average since 1980 after increasing in the 1970s.

As observed by Wolff (1993), there appears to be some convergence of overall productivity levels, but this is much less true in some sectors. For example, U.S. agricultural productivity remains far above that of the G-7 and especially that of Japan, which, at about one-half of the

1/ This way of calculating total factor productivity is similar to Wolff (1993) and Meyer-zu-Schlochtern (1988).

G-7 average, has been little changed in relative terms since 1970. The United States also has an unusually large lead in mining. Manufacturing reveals a mixed picture. The United States remains considerably more productive in manufacturing than Japan and Germany, although Japan's relative productivity has shown major gains, especially in terms of labor productivity. The U.S. level of labor productivity exceeded that of the G-7 average for all categories of manufacturing throughout the period shown in Table 1a, although the degree of U.S. absolute advantage varies. The U.S. advantage in manufacturing is greatest in machinery and equipment, and food, beverages, and tobacco and weakest in basic metals and paper and printing. Japan shows more variation in its relative productivity than the United States does. In chemicals and basic metal products, Japan had a large absolute advantage as of 1989 with respect to the United States. In chemicals, Japan's gains have been very rapid, whereas in basic metals it had a productivity level above the G-7 average for the entire period. On the other hand, Japan's productivity in some manufacturing sectors--for example textiles, nonmetallic minerals, and food and beverages--is well below the G-7 average. Germany does not show much dispersion of its manufacturing productivity, with most sectors declining relative to the G-7 during the 1970-89 period.

Another element of comparative advantage is sectoral relative labor compensation (w_i/w in equation (3)). Labor compensation per employee (hereafter referred to as "wages") was obtained from the ISDB by dividing total compensation of labor by the number of employees. Table 2 presents this information for the same sectors as in Table 1a, with sectoral wages expressed as a ratio of the average wage for the whole economy. Interestingly, wage dispersion is considerable and not always similar across countries. In particular, manufacturing wages in the United States are considerably above the U.S. average, but this is not the case in Japan or Germany. Agricultural wages are below average for all three countries but generally more so for the United States. Mining wages are high in both the United States and Germany, perhaps reflecting strong unions. The same explanation might apply to basic metal products in all three countries. High relative U.S. wages are particularly pronounced in machinery and equipment, and offsets much of the productivity lead the United States has in this sector, particularly vis-à-vis Japan.

Finally, productivity must be combined with relative factor prices and converted to a common currency to determine competitiveness. Since labor and total factor productivities yielded similar patterns, and capital costs are unlikely to differ as much as labor costs between countries, the remaining calculations focus on unit labor cost. Table 3 shows U.S., Japanese, and German unit labor costs expressed as a ratio of the G-7 average in current dollars for selected years. As discussed in the previous section, the critical value of relative unit labor cost is, in theory, unity, but in practice quality differences as well as measurement errors may cloud the picture.

Table 2. Sectoral Wages as a Ratio of Total Economy Wages: United States, Japan, and Germany

(Selected years)

	United States			Japan			Germany		
	1970	1980	1989	1970	1980	1989	1970	1980	1989
Manufacturing	1.10	1.16	1.17	0.98	0.97	1.00	1.00	1.05	1.12
Agriculture	0.52	0.52	0.52	0.87	0.62	0.52	0.74	0.68	0.64
Mining	1.25	1.49	1.46	1.20	0.93	1.06	1.26	1.39	1.36
Manufacturing sectors									
Machinery	1.22	1.27	1.30	1.03	1.01	1.05	1.04	1.12	1.20
Textiles	0.72	0.68	0.68	0.70	0.68	0.55	0.71	0.70	0.77
Nonmetallic minerals	1.10	1.16	1.12	0.96	0.93	1.04	1.05	1.07	1.11
Paper	1.13	1.14	1.13	0.96	1.00	1.05	0.98	1.00	1.01
Basic metals	1.27	1.55	1.40	1.37	1.40	1.31	1.12	1.11	1.13
Chemicals	1.26	1.35	1.36	1.48	1.47	1.80	1.20	1.25	1.34
Food	1.03	1.09	1.05	0.83	0.77	0.83	0.90	0.82	0.81

Source: *OECD International Sectoral Database* and author's calculations as described in the text.

Table 3. Sectoral Relative Unit Labor Costs and Intra-G-7 Trade Balances, Measured in Dollars Expressed as a Ratio of G-7 Averages, Selected Years

	Relative Unit Labor Cost 1/				Trade Balance 2/			
	1970	1980	1985	1989	1972	1982	1987	1991
United States								
Manufacturing	1.32	1.00	1.20	0.93	-3.4	-6.0	-13.0	-6.7
Agriculture	0.62	0.51	0.61	0.56	2.7	3.9	2.3	7.2
Mining	0.75	0.74	0.88	0.75	-3.8	-5.3	-6.7	-8.0
Manufacturing sectors								
Machinery	1.37	1.03	1.21	0.92	-3.3	-8.4	-22.4	-13.0
Textiles	1.47	0.96	1.18	0.93	-5.4	-2.3	-7.8	-1.9
Nonmetallic minerals	1.34	0.97	1.22	0.93	-2.3	-4.8	-7.6	-4.0
Paper	1.22	0.95	1.11	1.02	-3.7	-4.0	-5.2	-2.7
Basic metals	1.24	1.12	1.43	1.14	-10.9	-22.1	-20.2	-9.9
Chemicals	1.24	0.98	1.25	0.96	0.5	-0.6	-4.2	-1.7
Food	1.47	1.06	1.23	0.96	-0.1	0.1	0.4	3.8
Japan								
Manufacturing	0.66	0.85	0.87	1.11	6.4	8.9	10.9	6.3
Agriculture	1.48	1.69	1.70	2.05	-4.9	-16.5	-11.9	-15.4
Mining	1.95	1.04	1.35	2.16	-55.8	-103.0	-58.8	-48.1
Manufacturing sectors								
Machinery	0.84	0.87	0.85	1.04	13.2	24.7	28.3	18.0
Textiles	0.85	1.22	1.39	2.23	10.9	-4.2	-4.2	-17.0
Nonmetallic minerals	0.59	1.10	0.98	1.29	4.4	3.4	2.3	0.5
Paper	0.61	0.84	0.80	0.98	-6.4	-11.6	-7.8	-6.9
Basic metals	0.46	0.47	0.63	0.82	9.4	8.5	3.5	-0.7
Chemicals	0.61	0.67	0.60	0.86	-0.8	-6.0	-1.8	-2.6
Food	0.46	0.71	0.88	1.24	-1.9	-8.0	-6.5	-8.6
Germany								
Manufacturing	0.78	1.13	0.87	1.11	3.3	6.8	10.3	0.8
Agriculture	1.77	1.58	1.10	1.07	-19.1	-7.8	-6.3	-12.2
Mining	1.72	2.30	1.77	2.35	0.9	-65.2	-52.1	-52.0
Manufacturing sectors								
Machinery	0.71	1.08	0.87	1.25	11.9	14.0	19.1	2.6
Textiles	0.76	1.20	0.88	1.06	-21.5	-27.6	-29.0	-33.4
Nonmetallic minerals	0.96	1.11	0.91	1.06	-1.3	0.4	1.8	-2.2
Paper	0.88	1.28	0.84	1.12	-2.4	0.1	3.8	1.7
Basic metals	1.06	1.40	0.99	1.26	3.5	10.9	7.4	4.0
Chemicals	0.78	1.12	0.92	1.26	4.9	4.4	7.5	4.7
Food	0.86	1.19	0.85	1.05	-5.5	1.6	2.8	0.1

Source: OECD International Sectorial Data Base, OECD Trade Statistics, series C, provided on disk by OECD Statistics Department, and author's calculations as described in the text.

1/ Unit labor cost divided by G-7 average unit labor cost.
2/ Intra-G-7 trade balance divided by sectoral value added, in percent.

Table 3 reveals both the effect of comparative advantage and exchange rate movements on unit labor cost. The huge U.S. productivity advantage in agriculture and mining is manifested in low U.S. unit labor cost and high German and Japanese unit labor cost in those sectors, although the relatively high U.S. wages in mining dampen the U.S. advantage. The effects of exchange rate movements are evident for all sectors. For example, U.S. total manufacturing unit labor cost was high in 1970 and 1985, periods where the dollar was greatly overvalued relative to the PPP value, but in 1980 and 1989 the opposite was true. By 1989, U.S. manufacturing unit labor cost was below the G-7 average. German manufacturing unit labor cost moves inversely with that of the U.S, reflecting the importance of the dollar-mark exchange rate. Japan's comparative advantage in manufactures is reflected in unit labor cost below unity until the late 1980s, when the strong yen overwhelms the continuing underlying competitiveness of Japanese manufactures. The dispersion in manufacturing productivity for Japan is evident in the relative unit labor costs. For example, in basic metals and chemicals, the two sectors where Japan's relative productivity is highest, unit labor costs were below unity even in 1989, although they were much higher in that year than earlier. Most U.S. manufacturing competitiveness appears to be dominated by exchange rate movements over the sample period, with the exception of basic metals, where the comparative disadvantage of the United States is sufficiently large that, even in 1989, U.S. unit labor cost is above unity, reflecting relatively weak productivity and relatively high wages.

Table 3 also shows intra-G-7 trade balances for the same sectors and countries. The trade balances have been scaled by sectoral value added, and shown with a two-year lag with respect to the years for which unit labor cost data are shown, to allow for the typical exchange-rate lag uncovered at the aggregate level. The trade balances were deflated by sectoral value added to provide an indicator of the size of the trade balance in relation to the resources allocated to that sector, although this method is not implied by the theory. As noted earlier, the Ricardian model implies complete specialization for tradeable goods, so that the ratios of net exports to domestic production should be either negative infinity or near one. In practice, however, trade balances are usually much smaller in absolute value than the Ricardian theory suggests.

There are two major drawbacks to these data. First, they are nominal flows. It would be desirable to measure trade flows in constant rather than current prices, but no such data are available at a disaggregated level. If sectoral trade balance variations are due to trade prices rather than volumes, the model will perform poorly. This problem is likely to be acute where value added is a small part of the total price and when the price of intermediate inputs varies greatly. For both these reasons, data pertaining to sectors with a high oil content, such as mining (which includes oil) and chemicals, may yield misleading results. The second problem is that the sectors considered here are at the two-digit SIC level of aggregation, and are therefore likely to include a range of very different products. For example, chemicals include a large variety of items such as industrial chemicals, petroleum refining, and pharmaceuticals. Data availability dictated a high level of aggregation, but the results should consequently be interpreted with caution.

Based on Table 3, the sectoral unit labor costs appear to explain some of the time series and cross-sectional variations in sectoral trade balances, but there are also a number of puzzles. The time-series behavior of trade balances (TB) since the late 1970s appears to be well explained by changes in unit labor cost for most sectors. Exchange rate movements clearly underly much of the fluctuations in the 1980s and trade balances responded as expected. For example, U.S. unit labor costs rose sharply between 1980 and 1985 and then declined just as precipitously between 1985 and 1989, whereas Japanese and German unit labor costs followed a mirror image. Correspondingly, the U.S. trade balance deteriorated markedly between 1982 and 1987 and then on average returned to their 1982 level by 1991. This pattern is apparent for agriculture, overall manufacturing, and all sub-sectors of manufacturing. The only exception is mining, which includes petroleum and is therefore heavily influenced by oil prices. Japanese and German trade balances are to a large extent mirror images of the U.S. paths in the 1980s.

The behavior of sectoral trade balances before the late 1970s, on the other hand, is not as easily explained. In the early 1970s there was a tendency for the U.S. deficit in most manufacturing sectors to stay the same or even widen, despite the fact that relative U.S. unit labor costs declined fairly sharply. This puzzle is greatest for machinery and equipment and for chemicals. Conversely the German and Japanese manufacturing trade balances showed surprisingly little adverse reaction to the large decline in their manufacturing competitiveness in the early 1970s, as measured by their unit labor costs. Part of the explanation for this might be that the U.S. manufacturing unit labor cost, although improving through much of the 1970s, remained relatively high until the late 1970s, implying weak competitiveness at a time when world trade expanded greatly. The early 1970s, therefore, may represent a situation of disequilibrium when U.S. relative unit labor costs were too high. In this view, the widening of U.S. manufacturing trade deficits and declining U.S. relative unit labor cost were both the response to a disequilibrium real exchange rate. An alternative explanation is that other dimensions of competitiveness (such as product quality), which cannot readily be quantified, were important and that other countries were gaining ground on the United States in these dimensions in the 1970s.

At the cross-section level, some of the trade balances are puzzling while others appear consistent with relative unit labor costs. The U.S. comparative advantage and Japanese and German disadvantage in agriculture manifested itself in U.S. surpluses and in deficits for the other countries. Similarly, the low Japanese unit labor cost in manufacturing (until the late 1980s) and the generally high U.S. counterpart (with the exceptions of sharp dollar depreciations in the late 1970s and late 1980s) are consistent with Japanese surpluses and U.S. deficits in manufacturing. German manufacturing unit labor cost fluctuated narrowly around unity, so the relatively small German surpluses are not too surprising. At a more disaggregated level, some of the results also make sense. Japan's high unit labor cost in textiles was associated with weak Japanese net exports, whereas low Japanese unit labor cost in other manufacturing industries, such as machinery and equipment and basic metals, were associated with surpluses. On the other hand, Japan also appears to have been a low cost producer of paper and printing, food and beverages, and chemicals, and yet has had sectoral deficits in these industries. Higher raw material costs in Japan than elsewhere may explain these anomalies. The United States has had less dispersion in its sectoral manufacturing unit labor cost than Japan, and correspondingly, the dispersion in its disaggregated manufacturing trade balances has also been less. The area in which the United States had the greatest comparative disadvantage in manufacturing is basic metals and that is also the sector in which the United States had one of its largest deficits. The only major anomaly is food and beverages, where the United States has had trade surpluses without any indication of a cost advantage, again perhaps reflecting the effects of lower raw materials costs. The relationship between Germany's pattern of manufacturing competitiveness and trade patterns within manufacturing appears to be weaker than in the other two countries. Germany has had chronic surpluses in machinery and in equipment, basic metals and chemicals, but based on relative unit labor costs, these are not sectors in which Germany has had unusual comparative advantage. These anomalous cases are likely to reflect the measurement problems discussed above.

Figures 2a-2j plot the intra-G-7 sectoral trade balances and unit labor costs for the United States and Japan relative to the G-7. The unit labor costs are shown with a two-year lag and inverted for ease of visual examination, as in Figure 1. This figure confirms the strong time-series relationship between unit labor costs and trade balances for these two countries for most sectors, especially since the mid-1970s. A notable exception is mining, where changes in oil prices appear to be dominating some of the trade patterns, as noted above. The common influence of the exchange rate is evident for the other sectors, although there is also considerable variation across sectors, especially for Japan. This reflects the large dispersion of Japanese sectoral productivity noted in Table 1a and 1b. Some of the anomalies noted in Table 3 are also evident in Figures 2; the case of Japanese chemicals, for example.

The following section reports a more rigorous statistical analysis of the relationship between relative unit labor costs and sectoral trade balances.

IV. Statistical Analysis of Intra-G-7 Sectoral Trade Balances

In this section, I explore the time-series and cross-section relationships between sectoral trade balances and sectoral relative unit labor costs using regression analysis. Mining was omitted due to the problems discussed above, so the sample covers agriculture and seven manufacturing sectors over the 1970-89 period.

1. Time-series regressions

Net exports relative to sectoral value added are regressed on relative unit labor cost (domestic relative to total G-7 GDP), an activity variable, and a time trend. All variables are in logarithms except for the trade balance. Letting i represent the country and j the sector, TB^{ij} is the sectoral trade balance (intra-G-7) divided by sectoral GDP, C^{ij} is the log of unit labor cost of sector j in country i relative to the G-7 average unit labor cost, Y^i is the log of country i's total GDP divided by total G7 GDP, and T is a time trend. The individual sectoral equations are specified as

$$TB^{ij} = a + b_1 C^{ij} + b_2 C^{ij}_{-1} + b_3 C^{ij}_{-2} + b_4 C^{ij}_{-3} + b_5 Y^i + b6\ T. \qquad (4)$$

with the coefficients on relative unit labor cost estimated by a polynomial distributed lag.

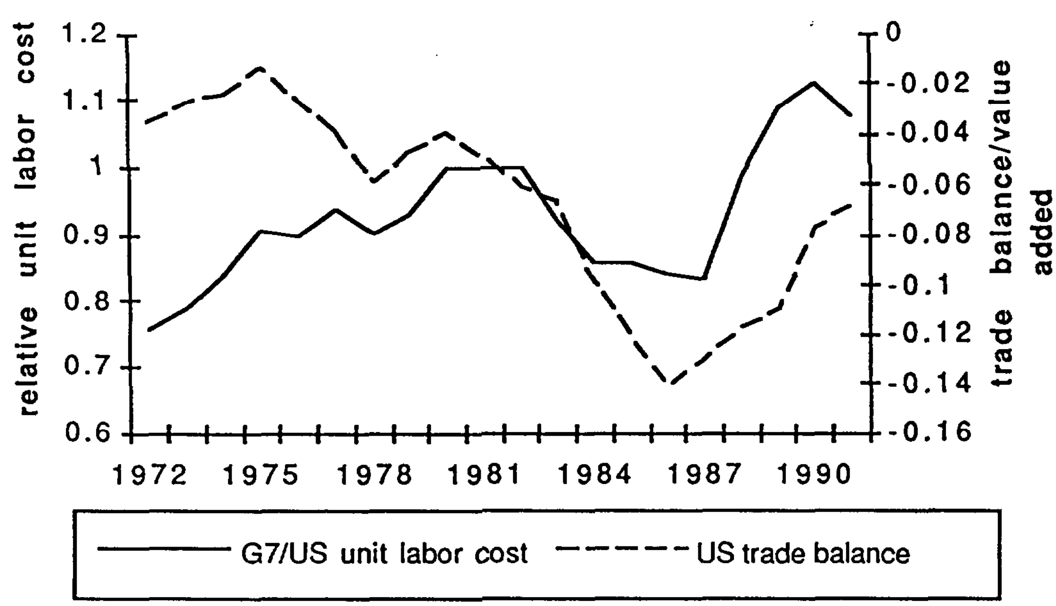
Table 4 reports the sum of the coefficients on the relative unit labor cost variable for each sector and country. More complete reports of the regressions are shown in the Appendix Table 7. The coefficient is the semi-elasticity of the trade balance with respect to relative unit labor costs--that is, an indicator of the extent to which trade responds to changes in underlying competitiveness. The trade balance responds normally when the coefficient is negative. The main result is that the United States and Japan stand out as having the highest responsiveness of trade flows to competitiveness. For total manufacturing and agriculture, the United States and Japan both have relatively large and statistically significant coefficients (at the 1 percent level). Each of these two countries also have statistically significant negative coefficients for most of the manufacturing sectors. Paper and printing is an exception for both countries, as are chemicals for Japan and nonmetallic minerals for the United States. In the case of Japan's deficit in chemicals, however, it is worth noting that Japanese barriers are surely not the explanation for the anomalous result. As shown in Table 3, chemicals is one of the industries in which Japan has both a comparative and absolute advantage. Indeed, for all countries except the United States, the coefficient on unit labor costs for chemicals is insignificant. This may reflect the pricing and aggregation problems discussed above. If we consider agriculture and the seven manufacturing sectors, the number of statistically significant negative coefficients is six for the United States and Japan, four for France, two for Germany and Italy, one for the United Kingdom, and none for Canada. 1/

1/ Italy (paper) and Canada (machinery) each have one statistically significant positive coefficient, although the Canadian equation has high serial correlation and the significance test is therefore unreliable.

Figure 2a
Total Manufacturing

Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

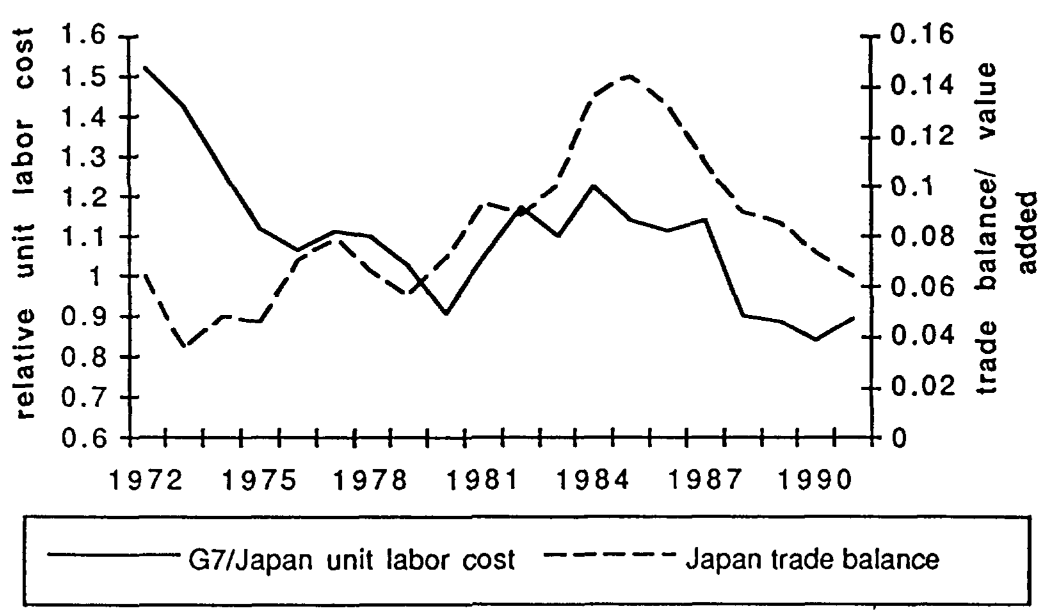
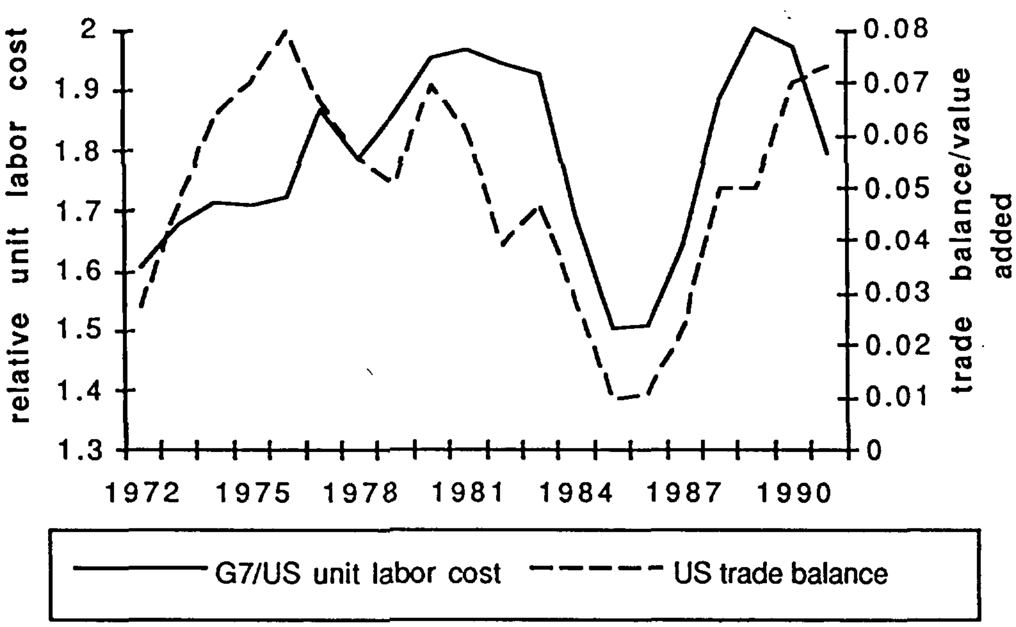


Figure 2b
Agriculture
Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and
G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

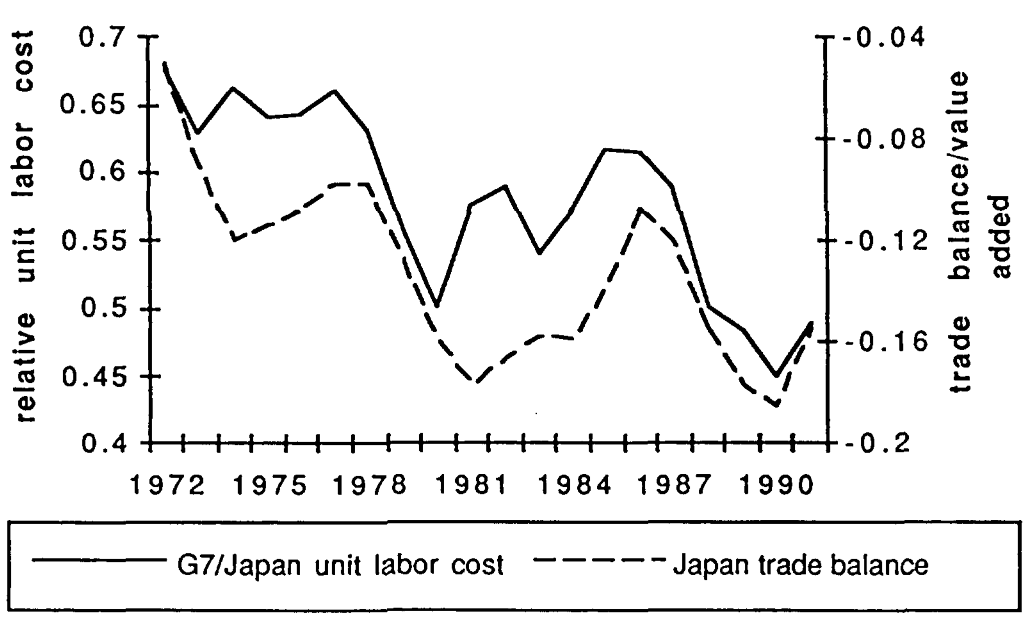
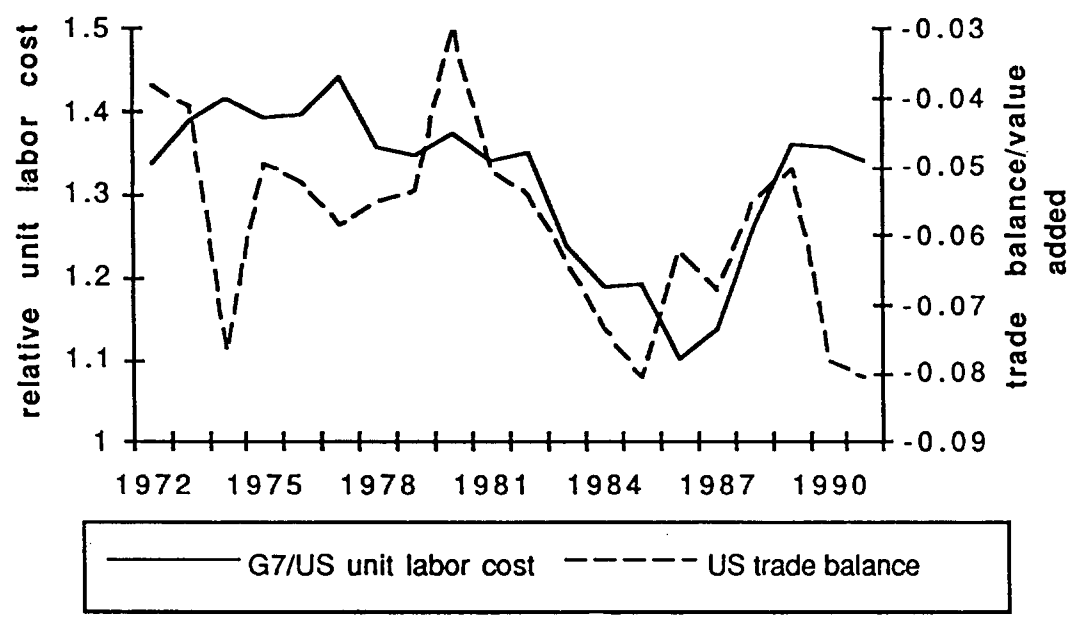


Figure 2c
Mining
Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and
G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

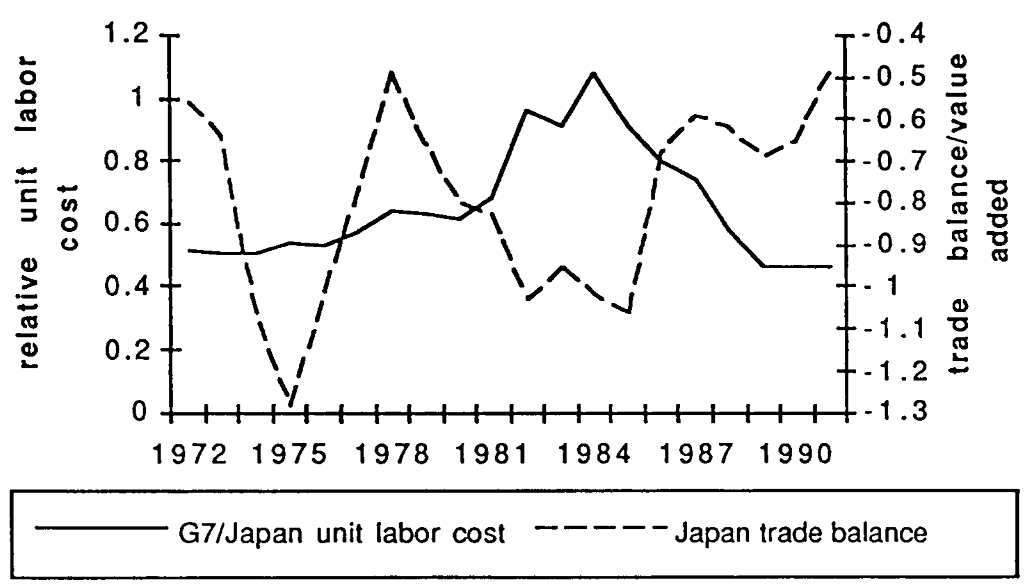
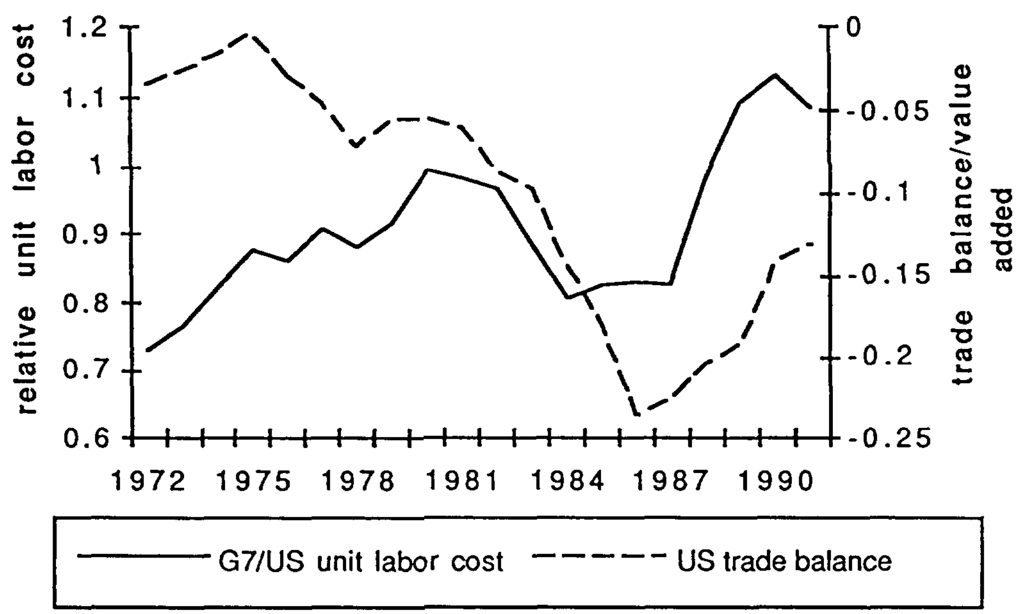


Figure 2d
Manufactures--Machinery and Equipment
Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and
G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

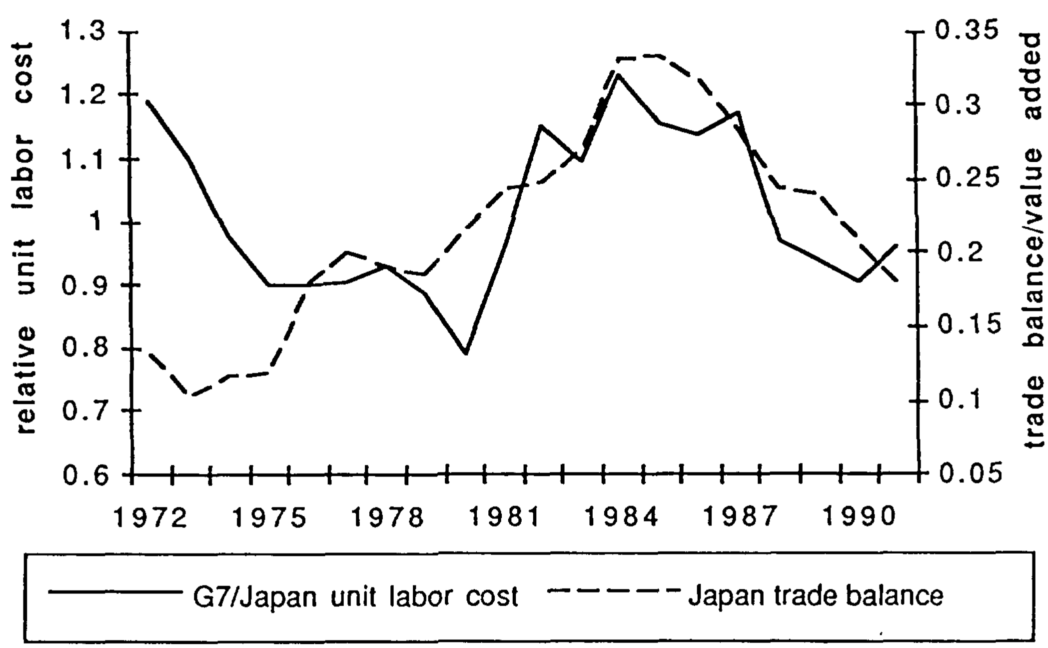
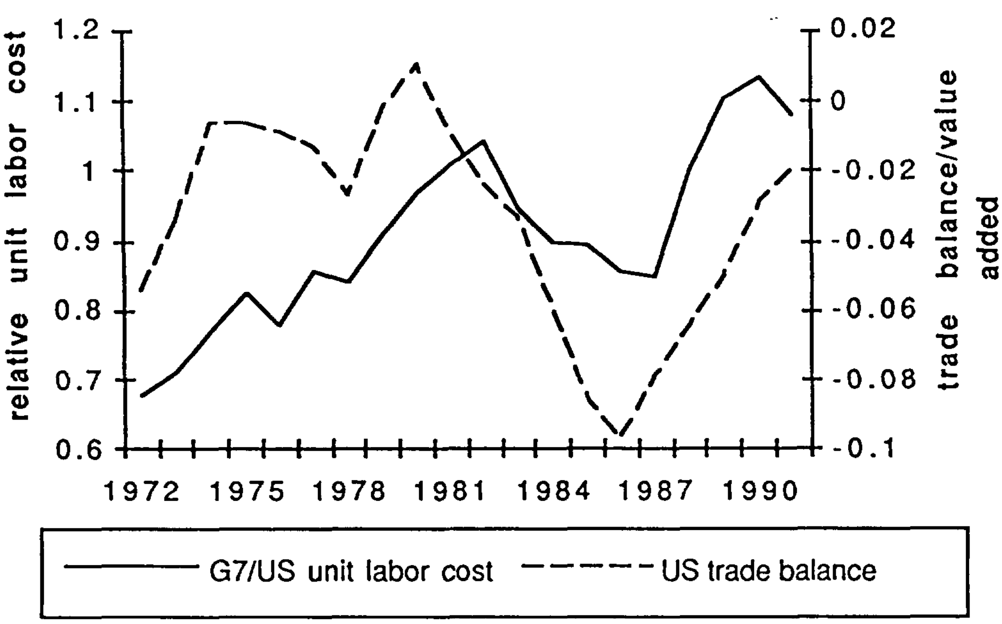


Figure 2e
Manufactures--Textiles
Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and
G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

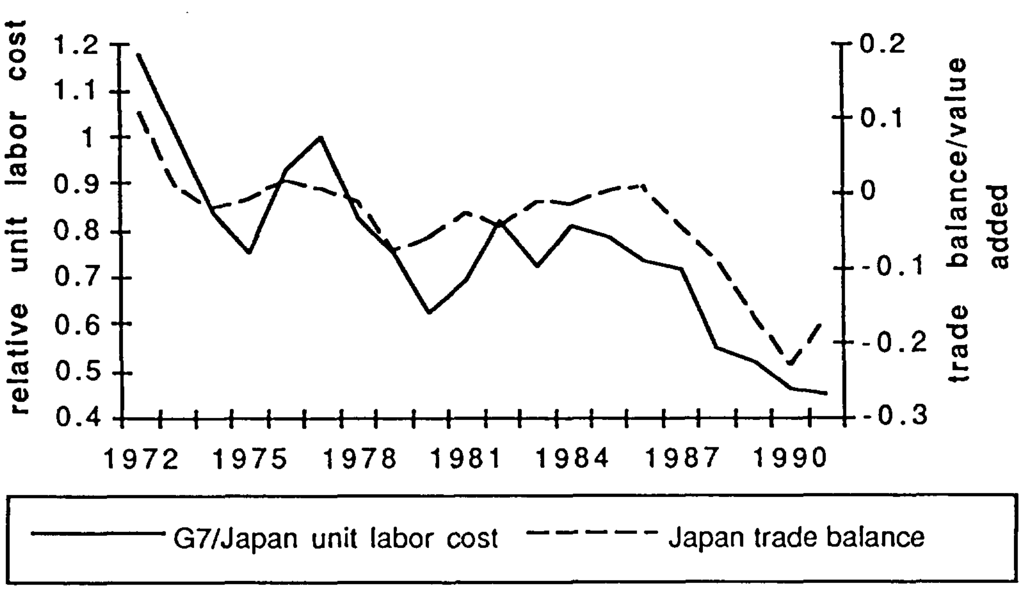
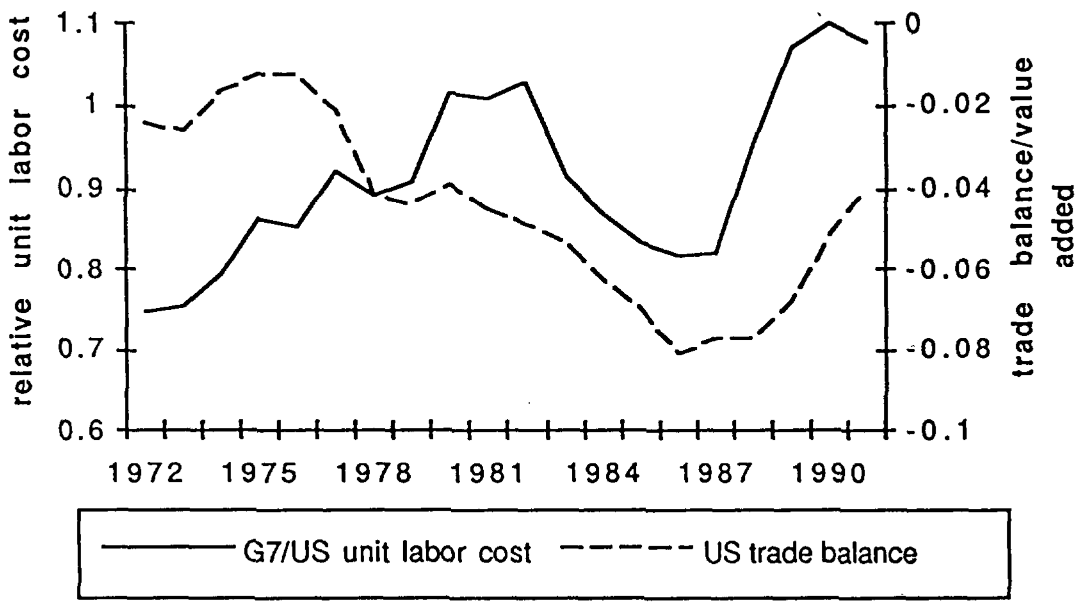


Figure 2 f
Manufactures--Non-Metallic Minerals
Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and
G-7 / National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

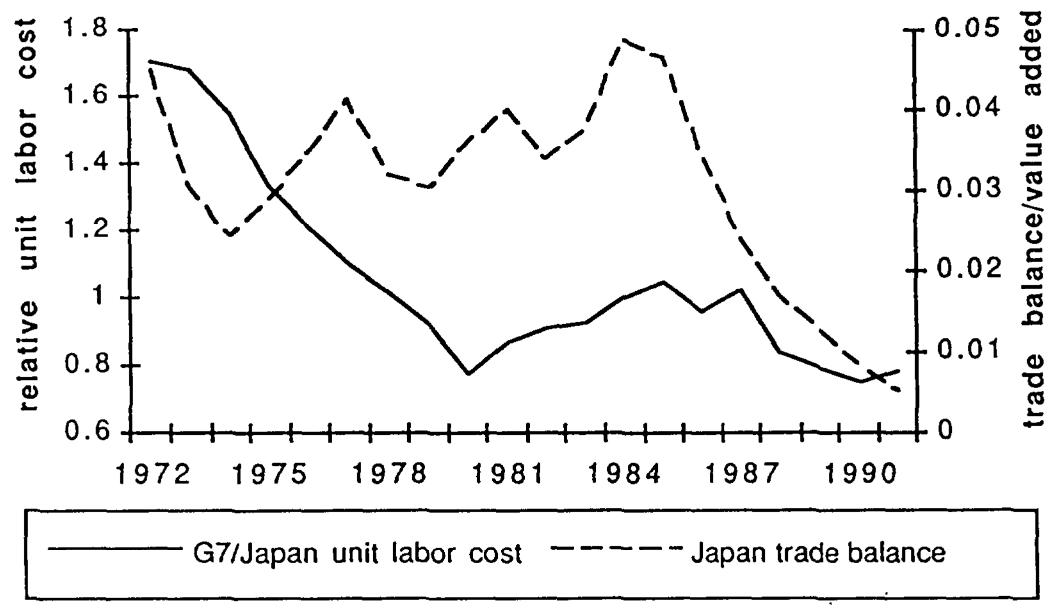
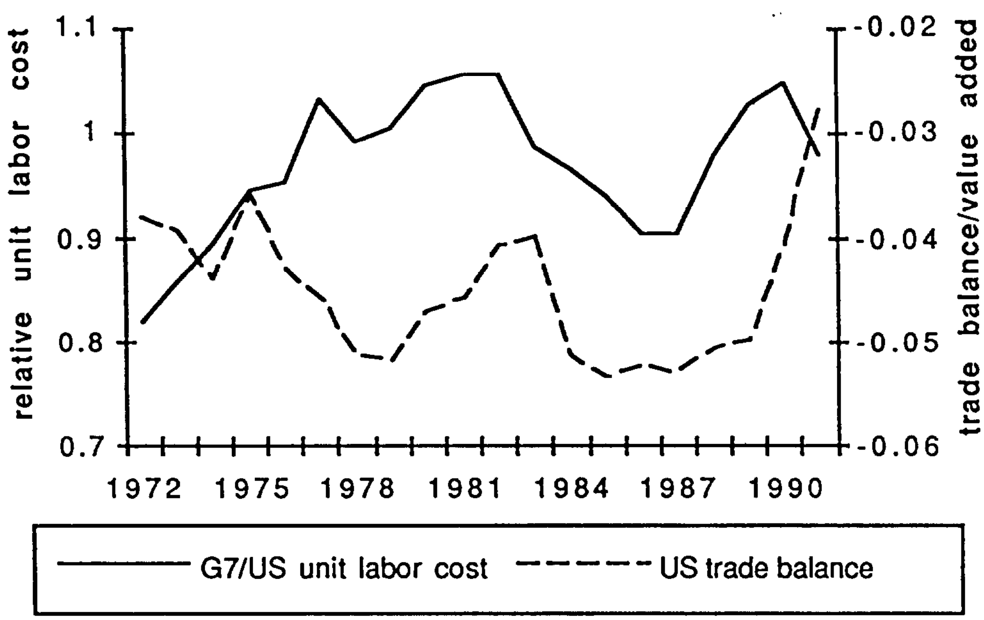


Figure 2 g
Manufactures--Paper and Printing
Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and
G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

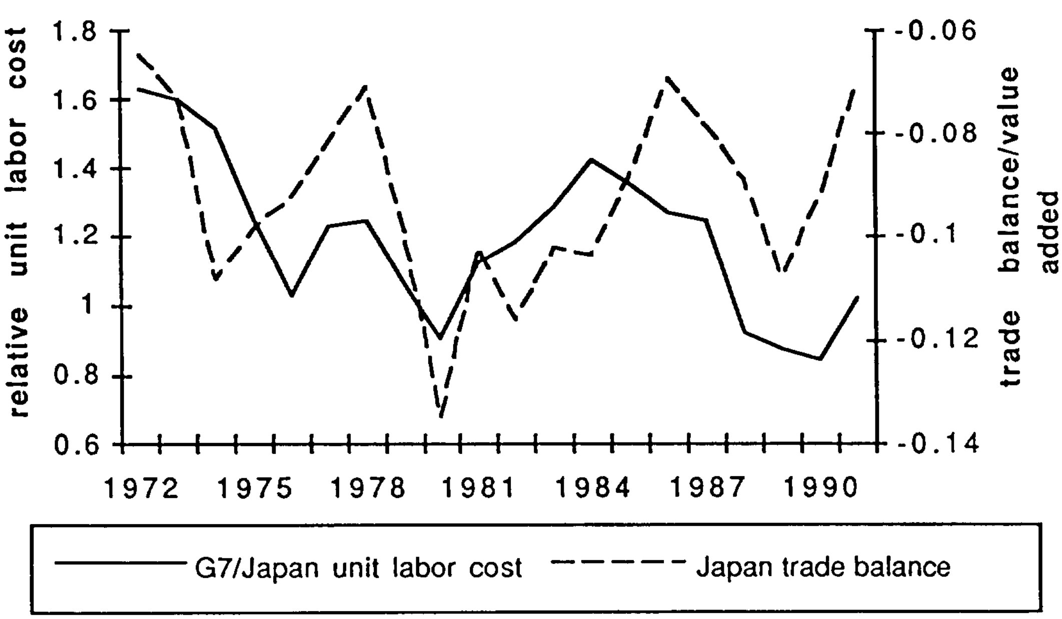
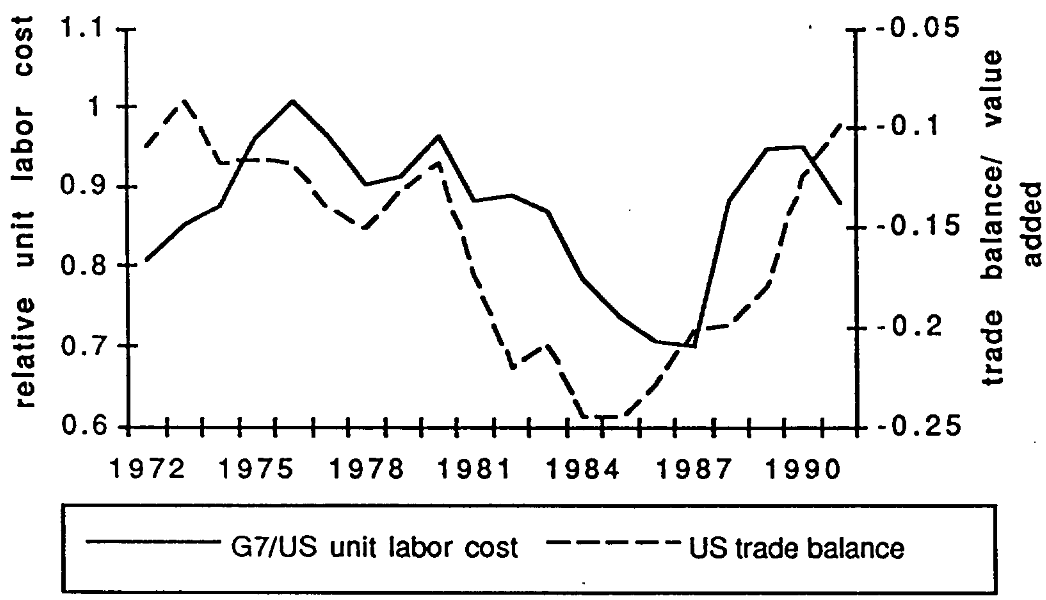


Figure 2[h]

Manufactures--Basic Metals

Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

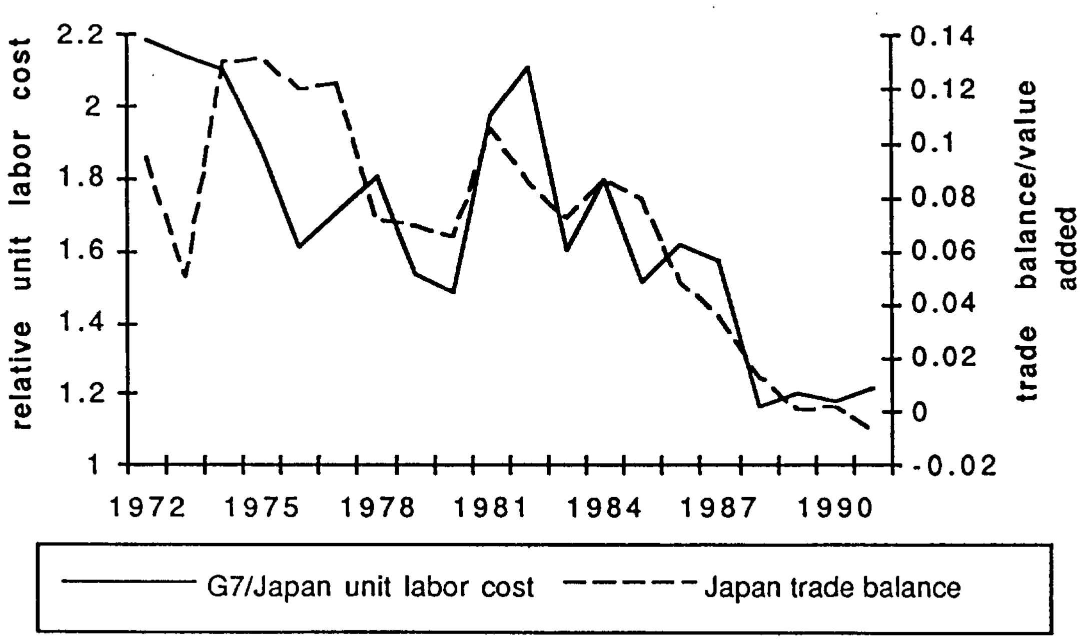
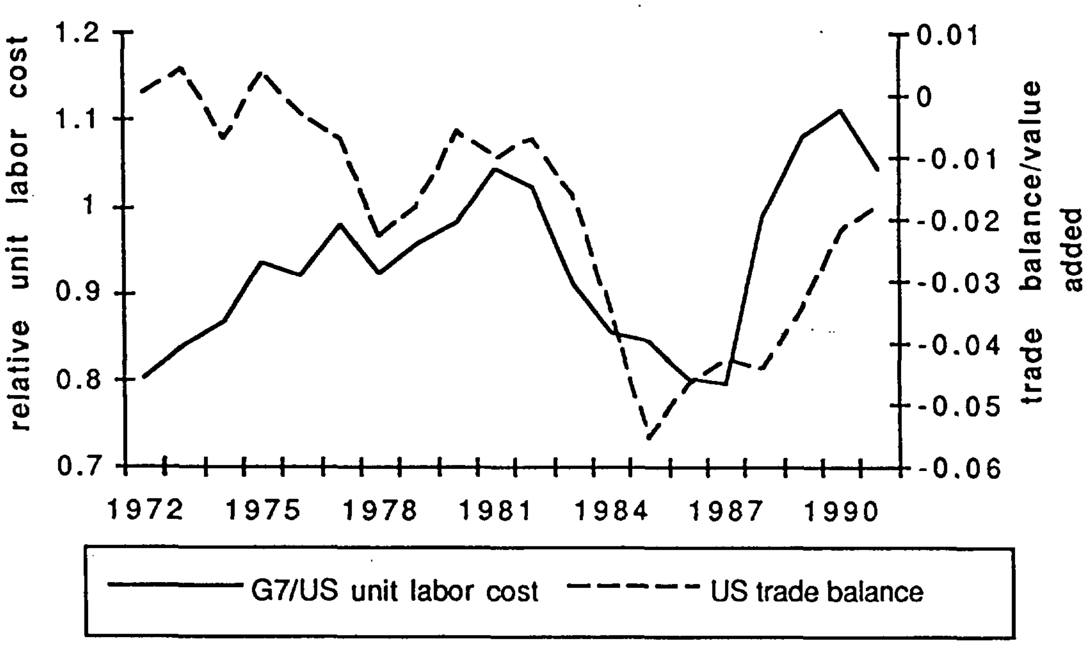


Figure 2 i
Manufactures--Chemicals
Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and
G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

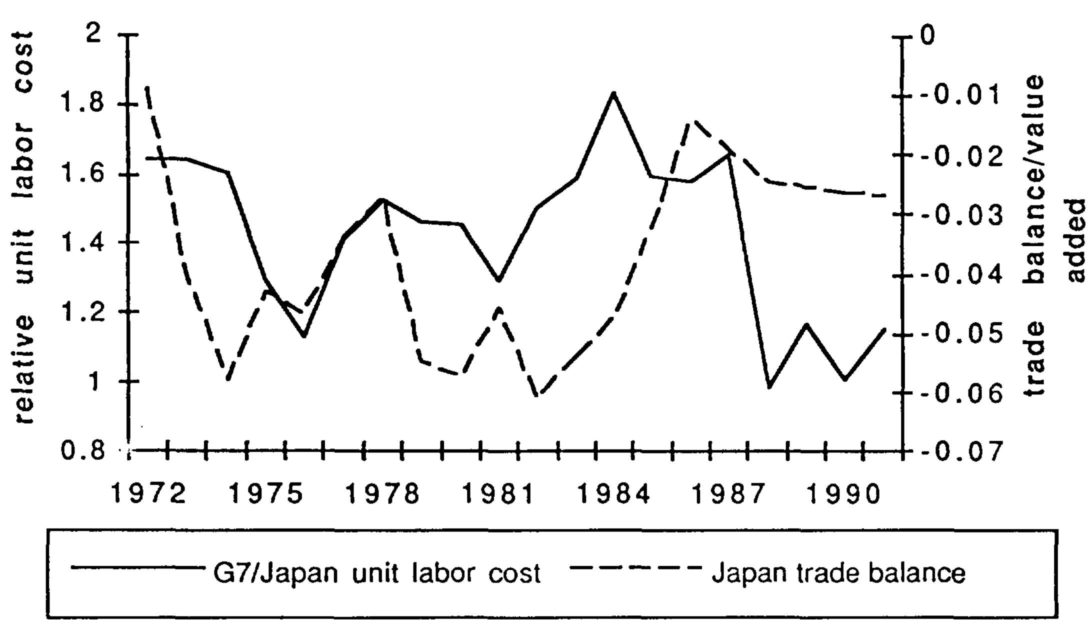


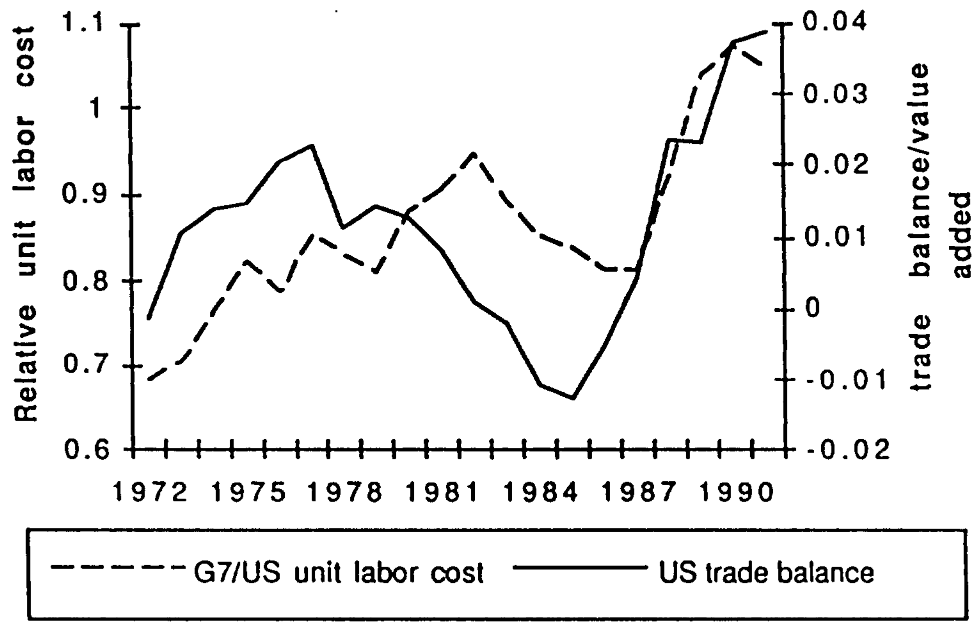
Figure 2 j

Manufactures--Food, Beverages, and Tobacco

Intra-G-7 Trade Balance as a Ratio of Sectoral Value Added and

G-7/National Relative Unit Labor Cost Two Years Earlier

U.S.



Japan

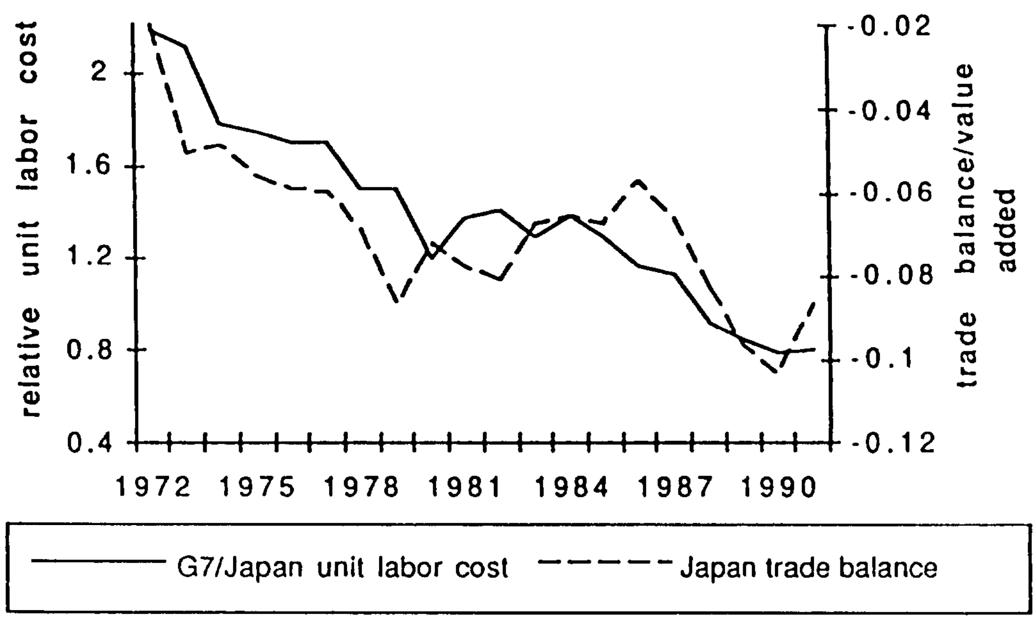


Table 4. Time Series Regression Coefficients:
Sectoral Trade Balance on Relative Sectoral Unit Labor Costs

	United States	Canada	Japan	Germany	France	Italy	United Kingdom
Manufacturing	-0.24	0.15	-0.23	-0.17	-0.01	-0.11	-0.03
	(4.5)**	(0.8)	(4.8)**	(2.3)*	(0.2)	(1.0)	(0.5)
Agriculture	-0.19	0.11	-0.25	0.05	-0.23	-0.04	0.21
	(3.1)**	(1.2)	(4.1)**	(0.6)	(4.6)**	(0.4)	(0.6)
Manufacturing sectors							
Food	-0.19	-0.16	-0.07	-0.11	-0.29	0.12	0.06
	(4.3)**	(0.9)	(2.4)*	(1.9)*	(6.0)**	(1.4)	(1.2)
Textiles	-0.36	-0.08	-0.36	0.23	-0.01	-0.97	-0.15
	(3.5)**	(0.5)	(6.4)**	(1.6)	(0.3)	(6.2)**	(1.4)
Paper	0.02	0.09	0.01	-0.09	-0.04	0.16	-0.04
	(1.2)	(0.6)	(0.2)	(1.5)	(2.0)*	(2.4)*	(0.5)
Chemicals	-0.10	0.09	0.05	-0.06	-0.03	-0.03	-0.00
	(4.6)**	(0.1)	(1.5)	(0.7)	(0.5)	(0.2)	(0.5)
Nonmetallic minerals	-0.06	0.03	-0.07	-0.07	-0.17	-0.23	-0.03
	(1.4)	(0.5)	(3.3)**	(1.3)	(2.8)**	(3.4)**	(0.4)
Basic metal	-0.30	-0.05	-0.19	-0.18	-0.19	0.04	-0.38
	(3.5)**	(0.3)	(2.4)*	(1.3)	(0.9)	(0.2)*	(2.0)
Machinery	-0.31	1.91	-0.42	-0.21	0.20	-0.18	-0.03
	(3.0)**	(2.5)*	(6.5)**	(2.5)*	(0.9)	(1.0)	(0.2)

Dependent variable is trade balance divided by sectoral value added. Independent variable is the logarithm of sectoral unit labor cost relative to G-7 average. T-statistics in parentheses. * and ** indicate significance at the 5 percent and 1 percent levels. For a more complete report on the regressions, see Table 7.

Other coefficients are reported in the Appendix Table 7. Domestic total GDP relative to G-7 total GDP is included to represent relative incomes and is expected to have a negative sign due to the effect on import demand. This is confirmed for most cases, although with varying statistical significance. The United States, Canada, Germany, and Italy tend to exhibit high income responsiveness, whereas Japan's is low. The time trend was included to capture structural change not reflected in the measured relative unit labor costs, as in Bosworth (1993). However, since the trade balances are intra-G-7, structural change cannot be interpreted as rising trade shares of developing countries. As in Bosworth (1993), the United States exhibits a negative trend growth in trade balances, while Japan has a strong positive time trend. Canada has an even larger positive time trend, although the t-statistics of the Canadian regressions may be unreliable in view of high serial correlation.

2. Cross-section regressions

To examine the role of relative unit labor costs across sectors rather than over time, cross-section regressions of the form

$$TB^{i} = a + b_{i}C^{i} \tag{5}$$

were run for each country using ten-year averages. However, the usefulness of these regressions is limited by the small sample of eight sectors (agriculture and the seven sub-sectors of manufacturing). The theory suggests a negative coefficient on relative unit labor costs. The results are reported in Table 5. Most countries do exhibit a negative coefficient, but the statistical significance is low. The only country with significant coefficients in both periods is Italy, although the United States has a marginally significant coefficient for 1980-89. Japan has negative coefficients for both subperiods, but they are insignificant.

3. Pooled regressions

Pooled cross-section time-series regressions were run for each country covering the 1970-89 period and eight sectors (agriculture and seven manufacturing industries). The specification for the pooled regressions is the same as for equation (4) except that the coefficients of unit labor costs were not constrained to a polynomial distributed lag, as this was not feasible in the panel estimation procedures used. Two pooling models were used: a fixed-effect model, which allows sector-specific constant terms but constrains the other coefficients to be the same; and a simple ordinary least squares model, which constrains all coefficients to be the same across sectors. Table 6 reports the results for the unit labor cost variable. For some countries (Canada and Italy especially) the choice of model makes a large difference in the results, in some cases changing the sign of the coefficient on unit labor costs. Japan, the United States, Germany, and the United Kingdom have statistically significant negative coefficients in both models, and France and Italy have a significant negative coefficient in one

Table 5. Cross-Section Regression Coefficients: Sectoral Trade Balance on Relative Sectoral Unit Labor Costs (Agriculture and Seven Manufacturing Sectors), Ten-Year Averages

	1970-79	1980-89
United States	-0.2 (1.5)	-0.5 (1.9)*
Canada	-- (--)	2.1 (0.9)
Japan	-0.1 (0.4)	-0.4 (1.0)
Germany	-0.5 (1.0)	0.2 (0.1)
France	0.2 (0.4)	0.5 (0.5)
Italy	-1.5 (2.1)*	-2.8 (3.0)*
United Kingdom	-0.1 (0.1)	-0.2 (0.4)

Dependent variable is trade balance divided by sectoral value added. Independent variable is the logarithm of sectoral unit labor cost relative to G-7 average. T-statistics in parentheses. * indicates significance at the 5 percent level.

Table 6. Pooled Regression Coefficients: Sectoral Trade Balance on Relative Sectoral Unit Labor Costs (Agriculture and Seven Manufacturing Sectors), 1970-89

	Simple OLS Model	Fixed Effect Model
United States	-0.16 (7.6)**	-0.12 (3.2)**
Canada	0.44 (2.0)*	-0.13 (1.3)
Japan	-0.10 (3.6)**	-0.18 (7.4)**
Germany	-0.16 (2.2)*	-0.12 (5.3)**
France	0.10 (1.6)	-0.19 (5.5)**
Italy	-0.73 (8.9)**	0.03 (0.7)
United Kingdom	-0.10 (2.2)*	-0.38 (6.9)**

Dependent variable is trade balance divided by sectoral value added. Independent variable is the logarithm of sectoral unit labor cost relative to G-7 average. T-statistics in parentheses. * and ** indicate significance at the 5 percent and 1 percent levels.

of the two models. The Japanese coefficient is among the largest for the fixed-effect model and about average in the simple OLS model. In general, the fixed-effect model seems to be giving greater weight to the time-series behavior, while the cross-section behavior is more strongly reflected in the simple OLS model.

V. Conclusions

This paper uses a Ricardian framework to clarify the role of microeconomic and macroeconomic factors governing the time-series and cross-section behavior of sectoral trade balances. This framework is used for a preliminary empirical analysis of the relationship between comparative advantage and sectoral trade balances. Unit labor costs and trade balances are calculated for a number of sectors for the G-7. The comparative advantage of the United States and Japan relative to the G-7 is evaluated and an attempt is made to explain sectoral trade balances using these unit labor cost measures. The time-series and cross-section variation in sectoral unit costs are decomposed into relative productivity, wage differentials, and exchange rate variations.

Japanese overall productivity has grown rapidly relative to other countries, but has an unusually high dispersion across sectors. In the late 1980s, Japan's productivity remained well below that of the United States and the G-7 average for many sectors, but in a few manufacturing sectors Japan was at the top of the G-7 productivity league. U.S. productivity in agriculture and aggregate manufacturing remained well above that of other G-7 countries. Relative to the aggregate economy, U.S. manufacturing wages were relatively high, while Japanese manufacturing wages tended to be slightly below average, which enhanced Japan's competitiveness in manufacturing. Over time, exchange rate changes have played a large role in the medium-term behavior of unit labor cost, especially in the 1980s, when U.S., Japanese, and German competitiveness were strongly influenced by the rise and fall of the dollar in the 1980s.

A statistical analysis of the effects of relative unit labor cost on sectoral trade balances finds that changes over time in sectoral trade balances are quite well explained by the evolution of unit labor cost, but the levels of these balances are sometimes difficult to reconcile with the levels of unit labor cost. In the time-series regressions, the United States and Japan stand out as having the highest responsiveness of trade flows to competitiveness. For total manufacturing and agriculture, the United States and Japan both have relatively large and statistically significant coefficients. Each of these two countries also have statistically significant negative coefficients for most of the manufacturing sectors. If we consider agriculture and the seven manufacturing sectors, the number of statistically significant negative coefficients is six for the United States and Japan, four for France, two for Germany and Italy, one for the United Kingdom, and none for Canada.

The cross-section regressions are less successful. Some of the limitations of the data on trade flows, productivity, and unit labor cost are more acute for assessing levels rather than changes over time. In particular, it is likely that sectoral nonlabor labor costs, such as raw materials, vary less over time than across sectors. In any case, the cross-section results are based on only eight observations. The pooled regressions, not surprisingly, reflect both the time series and cross-sectional results, although the way in which they do so is sensitive to the specification of the pooling model. For all countries except Canada, the pooled regressions provide some support for the theory of comparative advantage, as sectoral trade balances are negatively related to relative unit labor costs. Taken together, the regression results indicate that Japan's trading pattern is explained by the Ricardian model better than that of many other countries, contrary to the conventional wisdom that Japanese trade is unresponsive to market mechanisms.

The finding that a substantial part of Japan's trade is consistent with a Ricardian framework complements Saxonhouse's ((1983) and (1989)) results using the Heckscher-Ohlin-Samuelson model. That is, technological differences and factor endowments are both important in explaining Japanese comparative advantage. As Saxonhouse points out, this does not mean that protection is non-existent in Japan, but it does suggest that the extent to which trade patterns are determined by comparative advantage is greater for Japan than for many other countries. Consequently, the results reported here provide no support for the view that Japan's sectoral trade balances must be "managed" because Japanese trade is not responsive to normal market forces.

Future research should attempt to remedy some of the shortcomings of the data used in this paper. It would be desirable to:

- Disaggregate the data further and to extend the analysis to the service sector, as international trade in services is expanding rapidly.

- Use trade volumes instead of trade values. Consistent disaggregated trade volume data are not readily available, but there are some export and import price series that could be used to deflate the trade value data.

- Include the costs of raw material and capital. Transportation costs and other barriers could lead to substantial disparities between countries in these costs.

An alternative approach, which would test the Ricardian theory in a more precise manner on a particular country or bilateral relationship (such as U.S.-Japan trade), might shed further light on the relationship between trade patterns and comparative advantage. Such an approach could incorporate detailed information about particular sectors and policies, which is impossible to include in the present multi-country study.

Table 7. Time-Series Regressions of Sectoral Trade Balances, 1970-89

	ULC	GDP	Time	R^2	DW
Total Manufacturing					
United States	-0.24 (4.5)**	-0.8 (2.0)*	-0.10 (13.9)**	0.97	1.6
Canada	0.15 (0.8)	-2.4 (3.8)**	0.19 (7.6)**	0.88	1.6
Japan	-0.23 (4.8)**	-0.3 (2.2)*	0.13 (5.0)**	0.92	1.3
Germany	-0.17 (2.3)*	-0.7 (2.3)*	0.00 (0.1)	0.89	2.8
France	-0.01 (0.2)	-0.3 (0.9)	-0.03 (2.2)	0.57	1.9
Italy	-0.11 (1.0)	-0.8 (3.4)**	0.03 (2.3)*	0.80	1.7
United Kingdom	-0.03 (0.5)	-- (--)	-0.06 (2.6)**	0.91	1.7
Agriculture					
United States	-0.19 (3.1)**	-0.1 (0.1)	-0.03 (3.6)**	0.78	1.4
Canada	0.11 (1.2)	-1.1 (2.4)*	-0.06 (3.1)**	0.49	1.7
Japan	-0.25 (4.1)**	-- (0.3)	-- (0.1)	0.90	1.7
Germany	0.05 (0.6)	-0.8 (2.4)*	0.05 (2.4)*	0.93	2.8
France	-0.23 (4.6)**	-0.3 (1.4)	0.08 (5.6)**	0.95	3.0
Italy	-0.04 (0.4)	-- (0.2)	-0.01 (0.1)	0.32	2.2
United Kingdom	0.21 (0.6)	-1.2 (1.4)	0.01 (0.1)	0.66	2.7
Manufacturing Sectors					
Food, Beverages, Tobacco					
United States	-0.19 (4.3)**	0.4 (1.9)*	-0.03 (4.4)**	0.85	1.5
Canada	-0.16 (0.9)	-1.4 (2.2)*	0.09 (3.5)**	0.58	1.6
Japan	-0.07 (2.4)*	0.1 (1.2)	-- (0.2)	0.73	1.9
Germany	-0.11 (1.9)*	0.2 (0.6)	0.05 (2.4)*	0.88	1.9
France	-0.29 (6.0)**	-0.1 (0.8)	0.02 (2.0)*	0.93	2.1
Italy	0.12 (1.4)	-0.3 (2.2)*	0.04 (2.6)**	0.62	2.7
United Kingdom	0.06 (1.2)	0.1 (0.6)	0.01 (0.6)	0.18	1.3
Textiles					
United States	-0.36 (3.5)**	-0.6 (0.9)	-0.11 (6.9)**	0.87	1.2
Canada	-0.08 (0.5)	-1.6 (2.3)*	0.12 (5.1)**	0.75	1.2
Japan	-0.36 (6.4)**	-- (0.1)	0.06 (1.6)	0.88	1.7
Germany	0.23 (1.6)	-2.6 (4.4)**	-0.24 (4.4)**	0.81	2.6
France	-0.01 (0.3)	-0.7 (3.1)**	-0.13 (7.7)**	0.95	2.1
Italy	-0.97 (6.2)**	-0.3 (1.6)	0.15 (11.2)**	0.94	2.0
United Kingdom	-0.15 (1.4)	0.7 (1.6)	-0.05 (1.3)	0.95	2.4
Paper and Printing					
United States	0.02 (1.2)	-0.5 (5.1)**	-0.01 (7.0)**	0.84	2.4
Canada	0.09 (0.6)	0.3 (0.5)	0.03 (1.1)	0.49	1.0
Japan	0.01 (0.2)	-0.1 (0.6)	0.01 (0.2)	0.51	2.4
Germany	-0.09 (1.5)	-0.6 (1.7)*	0.01 (0.4)	0.93	1.6
France	-0.04 (2.0)*	-0.2 (2.1)*	-0.01 (2.2)*	0.79	2.8
Italy	0.16 (2.4)*	-0.7 (2.3)*	0.02 (2.0)*	0.54	1.4
United Kingdom	-0.04 (0.5)	-0.3 (0.8)	-0.02 (0.8)	0.30	2.0
Chemicals					
United States	-0.10 (4.6)**	-0.8 (5.2)**	-0.04 (15.0)**	0.96	2.7
Canada	0.09 (0.1)	0.4 (1.7)*	0.36 (1.7)*	0.54	0.4
Japan	0.05 (1.5)	-0.1 (0.5)	0.02 (1.0)	0.48	1.9
Germany	-0.06 (0.7)	-0.7 (2.0)*	-0.02 (0.6)	0.80	3.0
France	-0.03 (0.5)	0.4 (0.1)	0.01 (0.7)	0.26	2.0
Italy	-0.03 (0.2)	-1.4 (2.8)*	-0.07 (2.6)**	0.77	2.0
United Kingdom	-- (0.5)	0.4 (0.3)	0.14 (1.1)	0.43	2.1
Non-Metallic Minerals					
United States	-0.06 (1.4)	-0.2 (0.7)	-0.05 (8.3)**	0.92	0.8
Canada	0.03 (0.5)	-0.5 (0.8)	0.05 (2.0)*	0.65	2.0
Japan	-0.07 (3.3)**	-0.4 (4.8)**	0.07 (4.4)**	0.80	2.5
Germany	-0.07 (1.3)	-0.5 (2.5)*	-0.02 (1.8)*	0.76	2.6
France	-0.17 (2.8)**	-0.1 (0.6)	-0.00 (0.2)	0.79	2.4
Italy	-0.23 (3.4)**	-0.6 (3.7)**	0.04 (5.1)**	0.91	2.1
United Kingdom	-0.03 (0.4)	0.3 (0.9)	-0.01 (0.6)	0.83	1.9

Table 7 (concluded). Time-Series Regressions of Sectoral Trade Balances, 1970-89

	ULC	GDP	Time	R^2	DW
Basic Metal Products					
United States	-0.30 (3.5)**	0.3 (0.4)	-0.05 (3.3)**	0.89	1.9
Canada	-0.05 (0.3)	-1.0 (0.5)	0.07 (1.0)	0.39	2.7
Japan	-0.19 (2.4)*	-0.7 (2.1)*	0.08 (1.6)	0.66	1.3
Germany	-0.18 (1.3)	0.4 (0.8)	0.02 (0.7)	0.24	2.2
France	-0.19 (0.9)	0.1 (0.2)	0.03 (0.5)	0.65	1.9
Italy	0.04 (0.2)	-1.2 (1.3)	0.03 (0.9)	0.58	1.9
United Kingdom	-0.38 (2.0)*	0.1 (--)	-0.07 (0.4)	0.54	2.4
Machinery and Equipment					
United States	-0.31 (3.0)**	-0.4 (0.4)	-0.17 (9.3)**	0.95	1.5
Canada	1.91 (2.5)*	-5.6 (2.7)**	0.38 (4.4)**	0.77	0.9
Japan	-0.42 (6.5)**	-1.1 (4.3)**	0.23 (7.4)**	0.96	1.7
Germany	-0.21 (2.5)*	-1.0 (2.7)**	-- (0.1)	0.84	2.4
France	0.20 (0.9)	0.1 (0.3)	-0.05 (1.3)	0.55	1.6
Italy	-0.18 (1.0)	-0.7 (1.8)*	0.01 (0.8)	0.46	1.4
United Kingdom	-0.03 (0.2)	-0.4 (0.6)	-0.20 (3.7)**	0.91	1.4

Dependent variable is trade balance divided by sectoral value added. All independent variables are in logs. ULC = unit labor cost relative to G-7 average; GDP = domestic total GDP divided by G-7 total GDP. T-statistics in parentheses. * and ** indicate significance at the 5 percent and 1 percent levels.

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