

**DO MULTATIONALS SHIFT PRODUCTION IN  
RESPONSE TO EXCHANGE RATE CHANGES?  
DO THEIR RESPONSES VARY BY NATIONALITY?**

**EVIDENCE FROM 1977-1993**

**by**

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## Abstract

Multinational enterprises with networks of production facilities in multiple currency areas are, in principle, well-positioned to exploit changes in relative factor costs. Long-standing as it has been, this view has not been put to a systematic empirical test. After reviewing the relevant literature and further conceptualizing the phenomenon in terms of switching costs and exit and re-entry costs, this paper develops a new methodology and dataset to address this gap. Using data spanning the 17 years between 1977 and 1993 covering MNEs from nine countries operating in 6 industries, the paper explores the following questions: Do multinationals shift production in response to real exchange rate changes? What is the magnitude and speed of their responsiveness, and does it vary across industries and countries? In particular, do Japanese multinationals exhibit more sticky responses than their European and U.S. counterparts? The empirical exploration provides compelling evidence that multinational firms shift production systematically in response to exchange rate changes and that the vigor with which they do so is not visibly influenced by the country in which they are headquartered. In particular, Japanese multinationals respond at least as elastically to exchange rate changes as MNEs headquartered in Europe and the United States. Complete country-by-industry-by-year patterns of MNE production shifting behavior are presented in the paper.

# **Do Multinationals Shift Production in Response to Exchange Rate Changes? Do Their Responses Vary By Nationality?**

## **Evidence From 1977-1993**

No matter what the risk profile, the firm that is able to exploit...volatility possesses a competitive advantage gained by its ownership of a global network...In the case of...multinational[s this advantage]...might potentially consist of production shifting.  
Bruce Kogut (1985: 37)

Exchange rate changes don't figure high on the list of reasons that multinational enterprises locate operations abroad. But as the quote at the top suggests, once they locate operations in two or more currency areas, multinational enterprises (MNEs) may in many respects be well-positioned to exploit changes in exchange rates. In addition to hedging in currency markets, flexing profit margins, and improving productivity, MNEs may respond to exchange rate changes by also shifting production within their networks to areas made more competitive by the exchange rate change.

Although this simple concept has long held appeal to economists and management scholars, skeptics have wondered whether multinational enterprises really shift production--say between home and abroad--in response to currency swings. After all, these skeptics note, even at the margin, economic, institutional, and organizational factors (such as plant scale economies and insufficient coordination) may make such switching suboptimal or unfeasible. Moreover, considering the many well established differences in the average operating practices of MNEs headquartered in different countries, many observers including policy makers wonder whether U.S., European, and especially Japanese MNEs respond equally flexibly to exchange rate changes.

I have been exploring these questions with a data set constructed from the U.S. Bureau of Economic Analysis' (BEA) annual surveys on the operations between 1977 and 1993 of United States multinationals abroad and foreign multinationals in the

United States. To anticipate, let me summarize the key findings that emerge from this analysis: (i) Across the board, MNEs from the United States, Europe, and Japan exhibit systematic and statistically significant responsiveness in the anticipated manner to exchange rate changes. (ii) In terms of magnitude, the exchange rate responses of Japanese MNEs are as vigorous as those of MNEs headquartered in Europe and the United States. (iii) Finally, as one might expect, responsiveness varies sharply across the sub-industries within manufacturing. Accordingly, the paper concludes that when it comes to exchange rate-induced production shifting within MNE networks, industry matters but nationality doesn't.

I will present and discuss these findings after elaborating on the research questions and hypotheses, the data and methodology, and the model that I estimate empirically.

## **Production Shifting Within MNEs**

Multinational enterprises, like most firms, seek to maximize their profits, market share, and longevity. Exchange rate changes can influence all three of these goals and it therefore stands to reason that MNEs should respond to them. Indeed, in perfectly competitive markets, the question may be moot. But as Stephen Hymer (1976 [1960]) argued in his pioneering work, MNEs operate in imperfectly competitive markets where by virtue of certain firm-specific advantage these enterprises enjoy rents. Add to the presence of rents uncertainty over the future course of exchange rate changes, and institutional inertia becomes a feasible option. Therefore, it is legitimate from a research standpoint to ask: Do MNEs shift production in response to exchange rate changes?

Nearly three decades ago, Raymond Vernon (1966: 198) had noted that multinational enterprises with multiplant locations might source from low cost facilities when it became apparent that such facilities were cheaper net of transport costs and tariffs. More recently, Jane Little (1987: 46) has written that:

Firms with production and marketing facilities on both sides of an exchange rate possess an extra degree of flexibility in adjusting to a new competitive situation. These multinationals can turn to existing plants in countries where the currency is depreciating and, with comparative ease, expand output where relative production costs are falling.

Although this proposition has long held appeal to economists and management scholars (see Adler and Stevens, 1974; Caves, 1982; Dunning and Rugman, 1985; Ghoshal, 1989; Knetter, 1993; Kogut, 1985; Lessard, 1986; Lipsey and Kravis, 1986; Vernon, 1966), there has been considerable skepticism surrounding its feasibility. For instance, Bruce Kogut (1985: 32) has asked rhetorically, "Do managers perceive and identify potential options generated by being multinational?...Are there organizational mechanisms that permit the coordination of the international activities essential to the exploitation of flexibility?" David Goldsbrough (1981: 573-580) has argued that because "integrated plants" within a multinational firms' network might produce specialized outputs which "have fewer close substitutes,"

trade flows generated by the location decisions of a firm with large fixed investments in several countries may not respond as rapidly to shifts in relative prices as those of an independent producer...

What is the reality? Do multinational enterprises respond flexibly to exchange rate changes? Do they shift production within their internal networks--say between home and abroad--in response to currency swings? Controlling for other economic factors, do MNEs headquartered in different countries respond differently to exchange rate changes? Does their at-the-margin behavior reflect well-established differences in average tendencies?

It is fitting to explore these issues in the context of a conference entitled "Does Ownership Matter?," because that question gets raised here in two important ways. In the first instance, multinational enterprises (MNEs) are networks of affiliated companies linked by ties of common "ownership." Thus trade between affiliates in an MNE network has been dubbed "hierarchical" trade, and many scholars have been interested in contrasting this trade to that conducted in arm's length "markets"

between unaffiliated firms. Accordingly, this set of scholars have pursued the question from an institutional angle by asking: Are hierarchies as responsive as arm's length markets in adjusting to exchange rate changes?.

The presumption has been that trade in arm's length markets is more responsive because hierarchical or intrafirm trade "usually...[takes] place in consequence of central commands rather than in response to price signals..." (Helleiner, 1981: 3). If this indeed is the case, then "ownership" matters in the sense that governance through internalization impedes flexibility and adjustment to relative price changes. The implications for both firms and nations are obvious and important.

But in the context of examining MNE responsiveness to exchange rate changes, the question "Does Ownership Matter?" may also be asked with an emphasis on firms' nationality. This formulation of the question reads: Do national factors influence the extent of production shifting that MNEs undertake in response to exchange rate changes? In particular, do MNEs headquartered in Europe and especially Japan respond as vigorously to exchange rate changes as MNEs headquartered in the U.S. (even when what is called for is a substitution away from home content into foreign content)?

The focus on Japan is important and interesting for at least two reasons. For one, as Paul Krugman (1991: 1) points out, "There is...a widespread sense that as Japan has moved from the periphery to the center of the world economy, it has continued to play the game by somewhat different rules than other advanced nations." This impression is based partly on casual empiricism, partly on some careful studies that document significant differences in the operating practices of Japanese enterprises (see Kreinin, 1988; and Lawrence, 1991), and partly on some well known facts.

For instance, it is well known that for a variety of reasons including the recency of their expansion abroad, the foreign affiliates of Japanese multinationals rely, on average, more heavily on home operations than do their European and U.S. counterparts. But considering the rise in global competition and the heightening of

trade tensions, managers and policy makers alike want to know whether such reliance is, even at the margin, relatively more sticky and inflexible. Peter Petri (1991: 52) has pointed out that some observers believe that the answer will turn out to be affirmative. He writes:

[There is a thesis that] is challenging the view that Japan has become more open with *endaka*. It emphasizes the relatively slow adjustment of the Japanese...bilateral trade surplus with the United States...notwithstanding sharp improvements in U.S. price competitiveness. The proponents of this view have argued that exchange rate adjustments, no matter how large, cannot satisfactorily open Japan.

A second reason why it is interesting to explore whether Japanese, European, and U.S. MNEs respond differently to exchange rate changes is because it provides another way by which we can infer something about the relative influence of market versus institutional forces.

The logic goes as follows: Exchange rate changes are a market-driven exogenous force that buffets all MNEs regardless of their nationality. What is different between Japanese and Western, especially U.S. enterprises, is the set of institutional arrangements under which they operate. Therefore, if after taking product mix differences into account it is found that Japanese, European, and U.S. firms respond differently to exchange rate changes, then the presumption is strengthened that institutional forces matter even at the margin. If significant differences are not found, we may conclude that, at least at the margin, certain market forces (exchange rate changes in this case) supersede institutional ones. Such a finding will weaken what importance the notion of path dependence has in international business and also imply that sufficiently large shifts at the margin may bring about convergence even at the mean.<sup>1</sup>

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<sup>1</sup> As the text indicates, in this research I treat exchange rate changes as exogenous. I assume that the sourcing responses and strategies of MNEs don't cause exchange rate changes, but, rather, that the chain of causality runs the other way. Also, consistent with a "random walk" characterization of exchange rate movements, all changes in rates are considered permanent.

In the remainder of this paper, I want to focus on the question of whether and to what extent MNEs shift production in response to exchange rate changes and whether there are systematic and significant national differences in the vigor with which they respond. I have addressed more directly in another paper the question of whether "markets" respond more flexibly than "hierarchies" to common exchange rate changes.<sup>2</sup>

In thinking conceptually about the issue of production shifting within MNEs, it will be useful to work with the following simple but not atypical scenario. Suppose there is a U.S.-headquartered MNE engaged in the manufacture and sale of products in the United States and Europe. For a variety of well-known reasons including transport costs and immovability of certain value added activities (such as distribution and service), the MNE co-locates the bulk of its operations near its markets. In other words, what the MNE sells in Europe it produces, for the most part, in Europe. But there remain some intermediate inputs that the European affiliates of this MNE source from the United States--almost exclusively from the parent unit. The net result is that the products that this MNE (or strictly speaking, its foreign affiliate) sells in Europe contain a mix of local (read European) and home (read U.S.) content, and the question at hand is: How do changes in real exchange rates influence the composition of this mix?

## **Factors in the Decision**

From a managerial-microeconomic perspective, there are several obvious factors over and above changes in real exchange rates that are likely to determine whether and how much the mix between local and home content will shift. At the top of the list may be the availability and lumpiness of suitable capacity in the location favored by the exchange rate change. A second factor may be the importance of scale

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<sup>2</sup> Rangan (1994).

economies. In the presence of sizable plant scale economies in the area where the currency is appreciating, exchange rate changes will have to be sufficiently large before switching becomes optimal.

Further, switching costs, such as severance payments and redesign charges, are undoubtedly part of the equation. The magnitude of switching costs is likely to differ from industry to industry (say being larger in autos than in electronics), and even from host country to host country (depending on local regulations regarding layoffs, local content, and export performance requirements). Like plant scale economies, the presence of switching costs will tend to make production shifting optimal only in response to relatively large shifts in exchange rates.

A factor that may enable MNEs headquartered in Europe and Japan to be more responsive to exchange rate changes than MNEs headquartered in the United States is the relative ease of “exit” in the United States compared to in Europe and Japan. Consider what might happen when the dollar appreciates. When the dollar appreciates, European and Japanese MNEs might shrink their U.S. operations and shift production to existing facilities at home. Because they dominate home markets, existing facilities back home are likely to be better placed to accommodate the increased demand, but in some cases, marginal expansion may be called for. But the response of U.S.-based MNEs to a dollar appreciation may appear more sticky because expansion in Europe or Japan to serve the home (i.e., U.S. market) is fraught with the risk of strained and costly exit (should the need arise). That is, getting in may be easy but getting out may not be. Mindful of a dampened ability to respond to future depreciations in the U.S. dollar, U.S. MNEs may not exhibit vigorous production shifting responses to appreciations in the dollar. Alternatively, they may exhibit a relatively sluggish or lagged response.

Another important factor that may matter in a few cases is whether the firms' competitive advantages are bound to a unique location (such as Silicon Valley, for instance). For firms and industries where this is the case, even large appreciations in the region's currency may not elicit a vigorous switching response. In the strategy

vocabulary popularized by Michael Porter, such firms compete on "differentiation" not "cost," and introducing newer, more sophisticated products might be their best response to low cost competitors based in regions where currencies have depreciated. Of course, such a strategy typically entails staying put in the location where the innovation occurs. Consequently, little or no production shifting may be observed.

Of course, even in such circumstances if the real exchange rate continues to appreciate over a prolonged period, then, eventually, the changed competitive position is likely to influence the sourcing patterns of these "location-bound" MNEs. Presumably, such lagged adjustment also occurs in cases where an MNE has plants in two or more currency areas but is unable to shift production readily among them because the plants are specialized.

The issue of lags in international trade adjustment was developed by Helen Junz and Rudolf Rhomberg (J&R) in a seminal paper written over two decades ago. J&R (1973: 413) suggest a temporal taxonomy of lags consisting of: recognition lags (the time taken to "become aware of the changed competitive situation"), decision lags ("the time taken for new business connections to be formed and new orders to be placed"), delivery lags (self explanatory), replacement lags (the time taken to wear out or deplete existing stocks before new orders can be placed), and production lags (the time taken by producers to decide to switch old or add new capacity to service foreign markets).

Going down this taxonomy, it would appear that in terms of the *speed* with which they can respond to common exchange rate changes, MNEs ought to be better-placed than arm's length traders who operate in international markets. In particular, Junz and Rhomberg's "decision" lags (the time taken for "new business connections to be formed and new orders to be placed") and "production" lags (the time it might take "producers...to become convinced that a profit opportunity which they perceive in certain markets is sufficiently large and permanent to warrant the expense and effort of shifting from supplying one market to another or adding capacity in order to supply

the other market...") ought to be shorter for multinational enterprises than their solely national counterparts.

Considering these information and scanning advantages that MNEs enjoy over arm's length traders, we might anticipate that to the extent MNEs shift production in response to exchange rate changes, they do so with shorter lags than those reported in traditional empirical studies of trade adjustment. Indeed, in related previous work (Rangan, 1994), I found that this hypothesis does receive support in the data.<sup>3</sup>

## Conceptual Models

Based on the preceding discussion, we can formulate three somewhat distinct models of multinational sourcing adjustment to exchange rate changes. I have portrayed these models in the three panels in Figure 1 which is drawn from the viewpoint of a foreign affiliate of an MNE parent. For illustrative purposes, let us suppose these pictures are drawn from the perspective of a German affiliate of an MNE headquartered in the United States.

In each panel, the X-axis depicts changes in the bilateral dollar-mark real exchange rate. Real depreciations in the dollar are indicated by shifts to the right of zero, and real appreciations by shifts to the left of zero. That is, to the right of zero, U.S. capacity is becoming relatively more competitive and to the left it is becoming less competitive. The Y-axis depicts the U.S. (or home) content level in products sold in Germany by the German affiliate of the U.S. MNE. With this context in mind, let us consider each model in turn.

**THE COMPLETE ADJUSTMENT MODEL.** The "complete adjustment" model posits that because firms have to factor in plant scale economies and switching costs it will not be optimal for them to shift production in response to small exchange rate changes. But if the magnitude of the exchange rate change is so large that the rate

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<sup>3</sup> Readers may refer to that paper for a fuller discussion of the issue of lags.

crosses a certain threshold (which is likely to vary by firm, industry, and country), then, even after factoring in switching costs and lost plant scale economies, it will be optimal for firms to shift production and they will do so completely. Clearly, this model places heavy emphasis on factor costs and predicts that multinationals will adjust in a complete and symmetric manner to threshold breaching changes in real exchange rates.

Thus, when the dollar depreciates in real terms and crosses the switching cost threshold, foreign production ceases altogether and the foreign market is served from facilities at home. In this extreme case, U.S.-content level in products sold abroad by U.S.-based MNEs rise to 100 percent. The converse holds when the dollar appreciates beyond the switching threshold. The pattern of adjustment is shown in the top panel in Figure 1. Of course, in reality, the complete substitution model of unbounded adjustment is unlikely to be a good representation of the manner in which MNEs shift production because switching costs are unlikely to be fixed and (due to re-entry costs) complete exit is likely to be rare.

THE RISING SWITCHING COSTS MODEL. This model goes some distance toward closing the gap between model and reality. This model posits that switching costs are likely to be a rising and perhaps convex function of the degree to which switching takes place. In other words, there is likely to be a sequence of switching thresholds each breached successively as the exchange rate moves secularly in a particular direction away from the initial rate. So a 10 percent change in the exchange rate may lead to a small adjustment, a 20 percent change leads to a larger adjustment, and a 40 percent change to an even larger adjustment. This pattern of adjustment is depicted in the second panel in Figure 1.

But like the “complete substitution” model, this model also assumes that adjustment can be unbounded (i.e., go to 100 percent). Of course, it is unlikely that solely in response to changes in exchange rates, an MNE would completely abandon its operations in countries that have become relatively less cost competitive. This notion of bounded responses motivates the final model.

THE FLOOR AND CEILING MODEL. The "floor and ceiling" model maintains the notion of thresholds and rising switching costs, but it also postulates that there is a certain level--call it the "floor"--below which home-country content cannot be reduced in the medium run (i.e. over the average exchange rate cycle). For instance, a critical or highly scale-intensive input may have to be fabricated in a single facility which, for historical and market size-related reasons, is located at home. Or it may be that because of relative newness, the input has to be fabricated near the site of innovation and ongoing research--home. Under such circumstances, changes in exchange rates may not trigger a shift in the locus of production of these inputs.

Likewise, there is also a "ceiling" above which the home-country content level cannot rise in the medium run, say because certain value-added activities (such as packaging, distribution, sales, and service) have to remain local. Among other factors, value-to-weight ratio of inputs, tariffs, the degree to which value is added in the provision of services, and local content regulations may all go into determining the height of the ceiling.

This model suggest a discontinuous adjustment curve with kinks on either side where the slope of the adjustment curve goes from being positive to zero. The kinks imply two things. First, that the responses are bounded. That is, in the time horizon contemplated here, the home-local mix cannot go to 1:0 or 0:1 proportions. Second, that given certain initial home content levels, responses may be asymmetric between appreciations and depreciations. For instance, if the initial home content level is near or at the floor, then even a relatively large appreciation in the home currency is unlikely to elicit switching responses. But threshold breaching depreciations will trigger a rise in home content. Likewise, if the initial home content level is near or at the ceiling, then even relatively large depreciations in the home currency won't elicit much of a response, but threshold-breaching appreciations will.

Among the three models sketched above, it would appear that the "floor and ceiling" is most plausible, especially if one thinks of the floors and ceilings as being endogenous over longer time horizons. To be sure, it will be difficult from an

empirical standpoint to distinguish between the “rising switching costs” model and the “floor and ceiling” model because: (a) the shortest time window over which changes can be examined in the BEA data is one year--a period whose length may be sufficient for firms to shift floors and ceilings; and (b) because in the sample interval (1977-1993) firms may be operating within the adjustment band--the positive sloped area that is away from either floor or ceiling--and may not brush up against either the upper or lower bounds.

THE ROLE OF COMPETITION, LIBERALIZATION, AND TECHNOLOGY. Beyond the factors considered in these simple models, three other factors are likely to bear upon the phenomenon. First, the intensity of international competition has risen considerably over the period covered in this study--1977 to 1993--and *a priori* one would think that this is likely to have caused elasticities of substitution to rise over this time. Second, over the last 15 years many countries have liberalized their trade regulations and taken other steps that make the transshipment of intermediate and final goods relatively more attractive and feasible. This is also likely to have caused elasticities to rise over this time period. Finally, considering the steep fall over the last 15 years in transportation and particularly telecommunications costs, it ought to have become easier and less expensive for multinationals to coordinate their production networks. This too is likely to have caused elasticities to rise over this time period.

## The Empirical Specification

Accordingly, the specifications I estimate are variations of the following:

$$\Delta C_{ijt} = \alpha_{ij} + \beta_{ij} \Delta e_{ijt} + \gamma_{ij} T_t + \varepsilon_{ijt},$$

where  $\Delta C_{ijt}$  denotes changes in home content level in products sold by MNE affiliates operating in industry  $i$ , country  $j$ , in period  $t$ ;  $\alpha_{ij}$  is the intercept;  $\Delta e_{ijt}$  denotes changes

in the industry-specific bilateral real exchange rate (explained below);  $T_t$  is a time trend variable whose coefficient is meant to capture the role of rising competition, liberalization, and falling telecommunication costs; and  $\varepsilon_{ijt}$  is an error term. Of course,  $\beta_{ij}$  is the exchange rate elasticity of the home content level and it can be estimated with lags.

Considering the breadth of the earlier discussion, this specification is clearly “parsimonious.” I want, therefore, to say a word about omitted variable bias and choice of functional form. First, firms don’t report and the BEA doesn’t gather data on switching costs or plant scale, not to mention “floors” and “ceilings.” Further, I am not aware of another source that provides these data specifically for multinational enterprises. Ergo, the reduced form specification.

Having acknowledged this, let me point out that the left out variables--including unavailability of capacity, switching costs, plant scale economies, location-boundedness, and being near a floor or ceiling--only impede or dampen responsiveness. This implies that the although the estimate of  $\beta_{ij}$  may be biased, it is only likely to be biased downward. Consequently, if  $\beta_{ij}$  turns out to be a positive and statistically significant, then we have a strong indication that the MNEs in the sample do actually shift production in response to exchange rate changes. In this sense, the parsimonious specification provides a strong test of the hypothesis that MNEs shift production in response to exchange rate changes.

On the issue of functional form I will note three things. First, in the absence of formal modeling on which to base a choice of alternatives, it is sensible to stick with a linear specification. Second, in existing trade literature the linear model is conventional.<sup>4</sup> Finally, the key dependent and independent variables are measured in percentage changes, and this too supports the choice of a linear specification.

## Variables, Methodology, and Data

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<sup>4</sup> See Stern and colleagues, 1976; Hooper and Mann, 1989; and Lawrence, 1990.

As noted earlier, I examine the production shifting responses for two sets of MNE affiliates--the majority-owned foreign affiliates of MNEs headquartered in the United States, and the U.S. (minority and majority) affiliates of MNEs headquartered in Canada, Europe and Japan. Consequently, there are two sets of dependent variables in my analysis.

In my analysis of the production shifting responses of U.S. MNEs, the dependent variable is the percentage change in U.S. content levels in sales made abroad by their majority-owned foreign affiliates. The dependent variable in my analysis of European and Japanese MNEs is the percentage change in the foreign- (primarily home-) content levels in sales made in the United States by their U.S. affiliates.

Thus, in both cases I examine changes from the viewpoint of affiliates as opposed to parents (mainly because the estimation process is less prone to measurement error).<sup>5</sup> The changes in content levels are volume not value measures. To clarify, let me explain briefly how I estimate "volume" changes in content. Take the U.S.-content level in sales made abroad by U.S. majority-owned foreign affiliates (MOFAs). For the base year of the study I estimate U.S. content by dividing the U.S. exports made to MOFAs in a particular country in a particular industry in the base year by the sales made by MOFAs in that country in that industry in the same year.

For subsequent years, I estimate U.S. content levels in the same manner except that I first deflate export values by the industry-specific U.S. export price, and likewise deflate foreign sales values by the industry-specific producer price in the host country. Then, in order to remove currency translation effects, I convert back into national currencies all MOFA sales figures (which are reported in current U.S. dollars), and rescale these national currency figures back into U.S. dollars at the

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<sup>5</sup> In order to estimate production shifting responses from an MNE parents' point of view, we would need quite detailed information on each of the many countries from which MNE parents source inputs. Such information is not available annually on an industry by country basis and extrapolating based on available information is not only a challenging task but also one that is likely to aggravate measurement error.

nominal exchange rate that was in effect during the base year. This procedure assures that pure currency, pure price, and equivalent but opposing currency and price changes will not influence the U.S. content measure.<sup>6</sup>

The key independent variable in my analysis is, of course, the percentage change in industry-specific real exchange rates, which I estimate based on changes in bilateral nominal exchange rates and changes in industry-specific producer prices in the United States and the partner countries in the study.

The industries covered in this study include manufacturing as such, and within manufacturing, food, chemicals (including pharmaceuticals), metals, non-electrical machinery, electrical machinery, and motor vehicles and parts. Country coverage is guided by relative importance of countries as homes or hosts of MNEs, and by the availability of data. Thus, I examine the production shifting responses of U.S. MOFAs in 9 countries including Canada, France, Germany, Italy, Netherlands, Switzerland, United Kingdom, Japan, and Australia. And, on the flip side, I examine the production shifting responses of the U.S. affiliates of Canadian, French, German, Dutch, Swiss, British, and Japanese multinational parents.

The unit of analysis varies based on the question being addressed, but period-industry-country triplets form the basic units of observation. For example, the percentage change between 1985 and 1986 in real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in the chemical industry in France is one such observation.

Exchange rate data and national price deflators come from the IMF's *International Financial Statistics*; the OECD's *Indicators of Industrial Activity*; and the U.S. Bureau of Labor Statistics' U.S. Export and Producer Price series. Data for estimating content levels come primarily from the U.S. Bureau of Economic Analysis' annual surveys of United States multinationals abroad and foreign multinationals in the United States. To date, annual surveys of foreign multinationals' operations in the

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<sup>6</sup> Upon request I will be happy to furnish details and some examples of how I estimate the content levels.

United States are available for 17 years from 1977 through 1993. Annual surveys of U.S. multinationals' operations abroad are available for 12 years from 1982 through 1993. I supplement this latter series with the BEA's 1977 benchmark survey.

Although this is not a very long series, the coverage here in terms of time, countries, and industries is wider than in any previous study that has considered these issues, not to mention the fact that this is what the existing data allow. Besides, as Figure 2 shows, the 1977-93 time interval encompasses at least one prolonged episode each of dollar appreciation and depreciation along with other less pronounced shifts in the exchange rate. So the results ought to be robust and generalizable.

## Empirical Results

### *U.S. MNEs Abroad*

Let us begin by looking at how exchange rates and home content levels have moved over the course of the study period. Consider Figure 3A which plots exchange rate movements and sourcing patterns within the Canadian affiliates of U.S.-headquartered MNEs.

To get oriented, look to the center of Figure 3A at the panel entitled "Chemicals and allied products." The solid line in this panel plots the course of the real exchange rate that is specific to the chemical and drug industry, and the dotted line tracks U.S. content levels in sales made by the Canadian chemical and drug affiliates of U.S. MNEs. Both the exchange rate, which is stated in terms of U.S. dollars per Canadian dollar, and the home content levels are plotted as indexes. The scale on the left pertains to exchange rates (1980 = 100) and the scale on the right pertains to home content levels (1982 = 100).

Eyeballing the solid line in this panel, we can identify roughly three exchange rate episodes over the 1977-93 period between the U.S. and the Canadian dollar. First between 1977 and 1981 the U.S. dollar appreciated by about 10 percent, then between

1981 and 1991 it depreciated by about 30 percent, and finally between 1991 and 1993 it appreciated by about 10 percent. So in the index, we see a down-up-down pattern.

Likewise, keeping in mind that estimates of U.S. content levels between 1978 and 1981 are missing because the BEA did not conduct annual surveys on the foreign operations of U.S. MNEs during those years, we can follow the dotted line in this panel to see the shifts in the U.S. content levels in sales made by Canadian chemical and drug affiliates of U.S. MNEs. We can see that when the dollar was appreciating (between 1977 and 1982) U.S. content levels fell by about 30 percent; then when the dollar was depreciating sharply (between 1982 and 1990) U.S. content levels rose by about 125 percent; finally when the dollar was again appreciating (between 1990 and 1993) U.S. content levels fell by about 10 percent.

The pattern is clear enough to suggest that at least in the chemicals and allied products industry, the Canadian affiliates of U.S. MNEs were shifting production quite vigorously in lock step with exchange rate changes. Moreover, they were doing so systematically and contemporaneously.

To get a sense for the absolute magnitudes of U.S. content, refer to the table on the right hand top corner of Figure 3A. The table contains two columns of information--one indicating the industry structure of U.S. multinational operations in Canada, and the other indicating U.S. content levels in 1982--the year for which the U.S. content index is set to 100. As we can see from this table, chemicals and allied products have on average accounted for 13 percent of the total sales made by the Canadian manufacturing affiliates of U.S. multinational parents. And, in 1982, U.S. content levels in sales made by Canadian chemicals and allied products affiliates stood at 11.9 percent. Now following the dotted line in the center panel, we can tell that in the intervening years, especially between 1982 and 1990 when the dollar was depreciating sharply, U.S. content levels in this industry rose to about 27 percent. So during a period when the dollar fell by 30 percent, the U.S. content levels in this industry rose by more than 100 percent (rising from 12 to 27 percent).

Contrast the patterns in the “Chemicals and allied products” panel with those in the “Motor vehicles and equipment” panel. In the latter case, there is virtually no movement in either the real exchange rate or the U.S. content level. The U.S. content level in motor vehicles and parts was 62 percent in 1982 and it remained virtually unchanged in 1993. Not only is this pattern unlike the one we saw in chemicals and allied products, but it also shapes the industry share-weighted aggregate pattern shown in the panel on the center top of the exhibit. This is because (at 43 percent of the total) motor vehicles and parts bulks largest in overall sales made by the Canadian manufacturing affiliates of U.S. parents.

Scanning the other panels, we can see coterminous movements in exchange rates and U.S. content levels in “Food and kindred products,” and perhaps in “Primary and fabricated metals.” But, in “Machinery, except electrical,” and “Electric and electronic equipment,” no particular relationship is apparent. And as noted earlier, the panel entitled “MOFA industry shares-weighted manufacturing” (in the top center of the page) provides a summary picture in which the weights reflect the six sub-industries’ shares in total manufacturing sales.<sup>7</sup>

Figures 3B through 3I, which are included in the appendix, show how exchange rates and U.S. content levels moved in the other countries studied (i.e. France, Germany, Italy, the Netherlands, the United Kingdom, Switzerland, Japan, and Australia--all countries where U.S. multinational enterprises have sizable foreign operations). In flipping through these exhibits, look particularly at the center top panel which shows the industry share-weighted aggregate patterns. Although there are wide variations by industry, and some panels where content levels are not shown due to missing data, by and large, real exchange rates and U.S. content levels move together as predicted.

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<sup>7</sup> The category called “Other” includes manufacturing sales that occur outside the six product categories shown here. As the table on the top right hand corner of the figure indicates, this “Other” category accounts for only 16% of the sales made by the Canadian manufacturing affiliates of U.S. MNEs.

Now consider figures 4A and 4B which show scatterplots of movements in exchange rates and U.S. content levels. If the foreign affiliates of U.S. MNEs were flexing their U.S. content levels in response to shifts in real exchange rates then we would expect the points in the plot to be arrayed in an upward sloping pattern.

Consider first figure 4A. Overall there appears to be a positive correlation. During the dollar appreciation period of 1980-85 U.S. content fell (see points in the lower left quadrant), and during the dollar depreciation period of 1985-89 U.S. content rose (see points in the upper right quadrant). But it appears that the responses during the dollar depreciation period are more systematically related to exchange rate changes than those during the dollar appreciation period. Indeed a regression line through the points on the top right quadrant is positively sloped and statistically meaningful.

But this is not the case for the points on the bottom left quadrant of Figure 4A. These points are estimates from the first half of the 1980s when the U.S. dollar was appreciating. Reading from the X-axis, we can see that between 1980 and 1985 the dollar had appreciated by between 20 and 40 percent against the currencies of the countries considered. How did U.S. content levels move? Clearly since all the points except the one for Germany fall to the south of the zero mark on the Y-axis, we know that U.S. content levels fell over this period. But the extent to which content fell in each country shows no relationship to the extent to which exchange rates changed. For instance, whereas the Swiss manufacturing affiliates of U.S. MNEs dropped their U.S. content by about 50 percent, the German manufacturing affiliates which faced an even steeper dollar appear to have raised their U.S. content over this period.

Clearly, unless unobserved country effects dominate (and they are unlikely to), there is no systematic relationship between changes in exchange rates and U.S. content levels during this dollar appreciation period. I want to suggest two possibilities that might explain the pattern or lack thereof. First, recall that since annual data on U.S. content levels are available only after 1982, we don't know how content levels moved between 1979 and 1982 when the dollar appreciated most

steeply. If firms' responses were contemporaneous and thus "front loaded," we would have missed it. In my opinion, this is likely to be a major contributing factor.

Second, we can see from the little tables in Figures 3A through 3I I that the absolute levels of the U.S. content was already quite low in Germany (3.9 percent), the United Kingdom (5.8 percent), and Italy (4.1 percent)--countries which showed the least response. It is plausible that U.S. MNEs given their long history of being multinationals had localized all but the most critical inputs. Thus they were operating at or near the "floor."

In any event, turn to Figure 4B which covers at the 1989-93 period. Here, with the exception of Japan, appreciations and depreciations are unmistakably correlated positively with drops and rises, respectively, in U.S. content. We will look at the results of regressions after reviewing the production shifting patterns of the U.S. affiliates of MNEs headquartered in Europe and Japan.

### *Foreign MNEs in the United States*

Before reviewing the sourcing patterns of the U.S. affiliates of foreign multinational enterprises, I must note two differences which are driven by data availability. The helpful difference is that unlike in the case of U.S. MNEs abroad, here the BEA data allow us to estimate content levels for the entire sample period including 1978-81.<sup>8</sup> So we get a more complete picture here.

The second difference is that the content level tracked here is the foreign or non-U.S. content level. Strictly speaking, since the independent variable is a bilateral real exchange rate, we would like to track just the home content level. But the BEA data do not allow us to decompose by country of origin imports made by the U.S. affiliates of foreign MNEs. Fortunately, the damage done ought to be limited because

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<sup>8</sup> The BEA extrapolates its data for 1977, 1978, and 1979 from the 1980 benchmark survey. Second, even here there are years when the data are missing for one or another industry.

between 60 and 80 percent of the imports made by these affiliates are sourced from their parents.<sup>9</sup>

With this in mind, turn to Figure 5A which shows the movements in foreign content levels in sales made by the U.S. affiliates of British multinationals. Note that this figure is set up exactly as Figure 3A. And as was the case for the foreign affiliates of U.S. multinationals, the food and chemical industry show the most noticeable patterns, but as the center top panel entitled “Affiliates’ Industry Shares-Weighted Manufacturing” suggests, even overall, the patterns are remarkable and the story is clear--foreign content and exchange rates move in lock step.

Likewise, consider Figure 5B which shows the movements in foreign content levels in sales made by the U.S. affiliates of Japanese multinationals. Although there are several patches of missing data, the pattern is again clearly noticeable. Indeed, eyeballing Figures 5C through 5G (enclosed in the exhibit appendix), one gets the sense that the patterns are rather robust and consistent. Lastly, Figures 6A and 6B show scatterplots for the U.S. affiliates of foreign MNEs and we can see quite clearly the anticipated relationship.

### *Regression Results*

So do Japanese MNEs shift production in response to exchange rate changes? Has their response been less elastic than those of their European and U.S. counterparts? Based on the pictures we saw so far we expect the answer to the first question to be yes, and, indeed, this is what the regression results in Table 1 show. The coefficient on exchange rates for Japan is positive and passes easily the conventional test for statistical significance. And since the exchange rate coefficients

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<sup>9</sup> Two points on this. First, between 1977 and 1993, the dollar has moved in roughly the same direction against other major currencies. This correlation between bilaterals (dollar-pound, dollar-DM, etc.) ought to ameliorate to a great extent the problem just described. Second, the estimates of foreign content have been made after taking into account all available information. For instance, in deflating the import values, the share of imports that are sourced from parents are deflated by the industry-specific export price in the home country of the U.S. affiliate, and the balance is deflated by the industry-specific, U.S. import price.

in the table are elasticities, the results for Japan imply that for every one percent appreciation (depreciation) in the yen-dollar real exchange rate, the U.S. affiliates of Japanese MNEs drop (raise) by 1.3 percent their foreign content level.

In terms of comparison, we can see from the other columns in the table that Japanese MNEs respond at least as elastically as the British, French, or German firms. In fact, as the first column in Table 1 shows, the average exchange rate elasticity is around 1.06 which is not statistically different from the number for Japan alone.

Before moving to look at the results for U.S. MNEs, let me say a word about lags and the time trend variable. The inclusion of lagged exchange rates produced no change in the results and the lagged variables themselves took neither sizable nor even moderately significant coefficients. These results imply that the U.S. affiliates of foreign multinational enterprises not only shift production contemporaneously with exchange rate changes, but their response is also complete in the same year. Considering that we are working with annual data, absence of lags in these data is not implausible. A survey of the literature on lags in trade concludes that “while adjustment is not instantaneous, the lags are fairly short, with most of the effect occurring within four quarters or so” [Goldstein and Khan, 1985: 1067].

On the coefficient on the time trend variable, the story is the same. It is neither large nor statistically significant. Entering time as an interaction term with the exchange rate does not change the results. This finding is consistent with results shown in Table 2 which reports the results for multi-year windows. In column 1 of Table 2, we see that between 1979-85--a period when the home currencies were depreciating vis-à-vis the dollar--the production shifting elasticity of foreign multinationals in United States was 2.8. Then during the 1985-87 period, when their home currencies appreciated sharply against the U.S. dollar, foreign multinationals exhibited a production shifting elasticity of 1.17 (which if anything appears lower than the elasticity of the previous years). And finally, between 1989 and 1993, the production shifting elasticity for these entities was 1.39. These results suggest that the exchange rate elasticities have remained largely unchanged over these last years.

Table 2 also shows (in columns 4 and 5) the regression results for U.S. multinationals. At 1.49 and 1.88, there appears to be little to distinguish the U.S. results from the ones already reviewed.

## **Conclusion**

During the previous decade and a half real exchange rates have moved quite dramatically. Between the late 1970s and mid 1980s the U.S. dollar rose sharply and then tumbled against major currencies (especially the Japanese yen) in the years subsequent. Using these exchange rate episodes as a natural test bed, this paper has examined whether multinational enterprises respond by shifting their sourcing, and if they do so, whether their responsiveness differs by nationality of the parent firm.

The results just reviewed provide compelling evidence that multinational firms shift production systematically in response to exchange rate changes and that the vigor with which they do so is unaffected by the country in which they are headquartered. In particular, Japanese multinationals respond at least as elastically to exchange rate changes as MNEs headquartered in Europe and the United States. Indeed, the appreciation of the yen over the last decade has decreased sharply the reliance that the U.S. affiliates of Japanese MNEs place on their home operations.

This finding is consistent with the conclusion reached by other empirical studies (see Lawrence, 1991; and Petri, 1991) "that access to the Japanese market is not completely insensitive to incentives--that the implicit barriers to imports are more like tariffs than quotas" (Krugman, 1991: 4).

An equally noteworthy finding of this study is the absence of lags in the sourcing adjustment of European and Japanese multinationals. Why U.S. MNEs exhibit lags in adjustment while foreign MNEs don't is a puzzle that remains to be explored. One plausible reason is that U.S. MNEs face an asymmetric disadvantage in entering and especially exiting European and Japanese labor markets. There may also be factors related the degree to which firms outsource in responding to exchange rate changes. But more work remains to be done before these hypotheses can be

sorted out. Moreover, future work should distinguish between responsiveness that is wholly internal to the MNEs' own network and that which relies on outsourcing.

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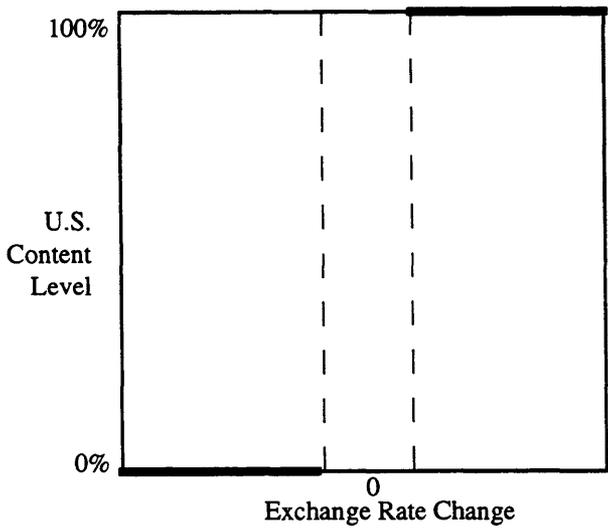
## **Exhibits**

Figure 1	Conceptual models of multinational production shifting
Figure 2A and 2B	Exchange rate movements between 1977-1993
Figure 3A	Plot of U.S. affiliates in Canada
Figures 4A and 4B	Scatterplots of U.S. MOFAs 1982-93
Figure 5A	Plot of British affiliates in the U.S.
Figure 5B	Plot of Japanese affiliates in the U.S.
Figures 6A and 6B	Scatterplots of U.S. Affiliates of Foreign Parents 1982-93
Tables 1 - 2	Regression results

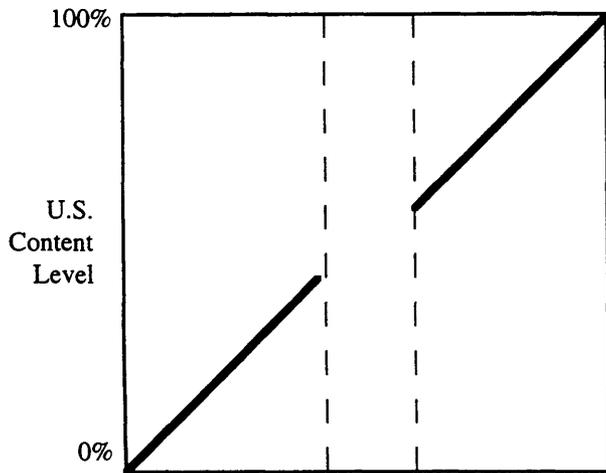
## **Appendix**

Figures 3B-I	Plots of U.S. MOFAs in other countries
Figures 5C-G	Plots of U.S. affiliates from other countries

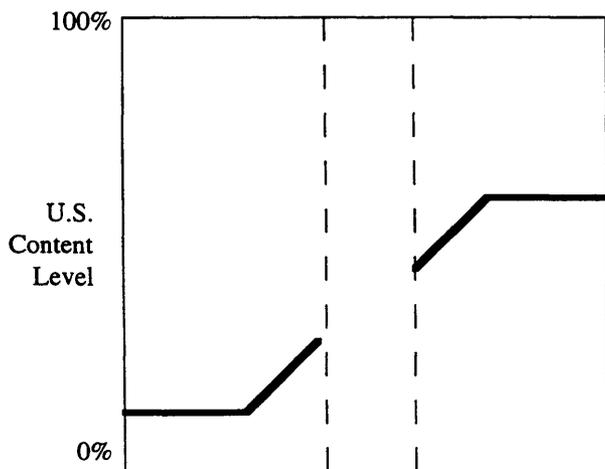
Figure 1. *Conceptual models of multinational sourcing responses to exchange rate changes*



**THE COMPLETE SUBSTITUTION MODEL**

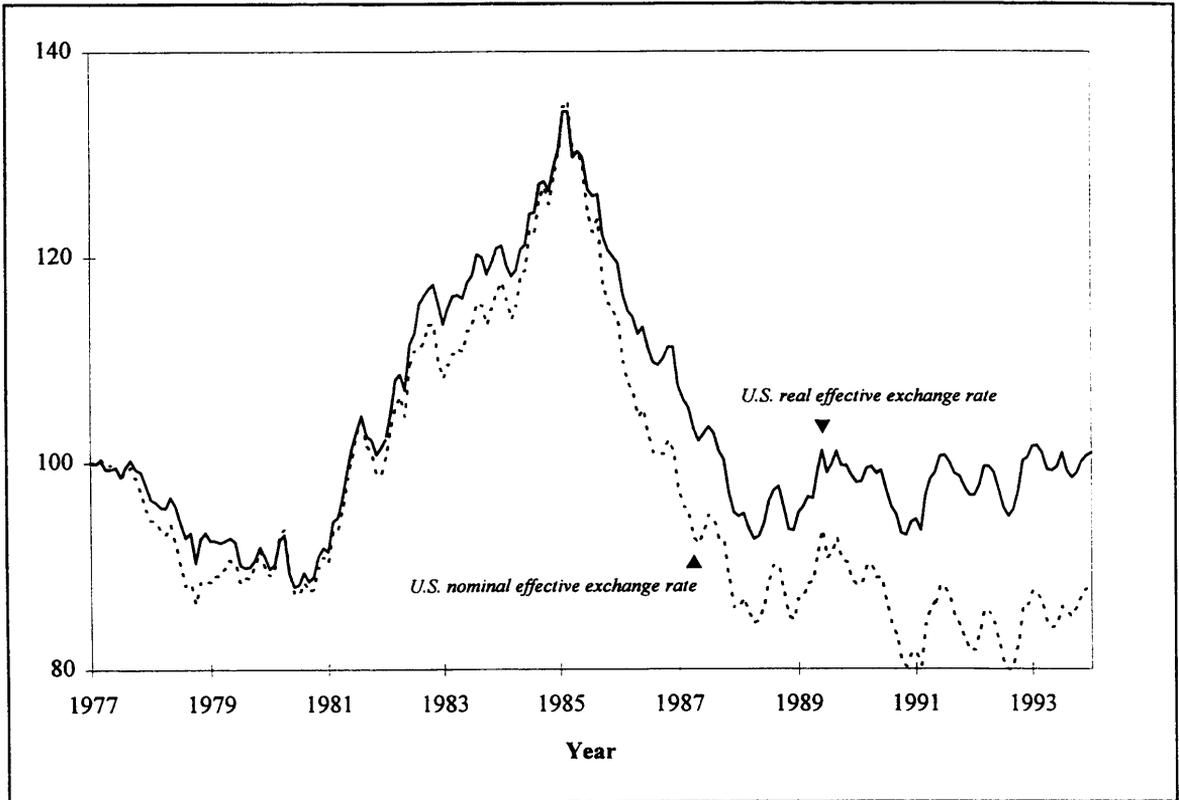


**THE RISING SWITCHING COSTS MODEL**



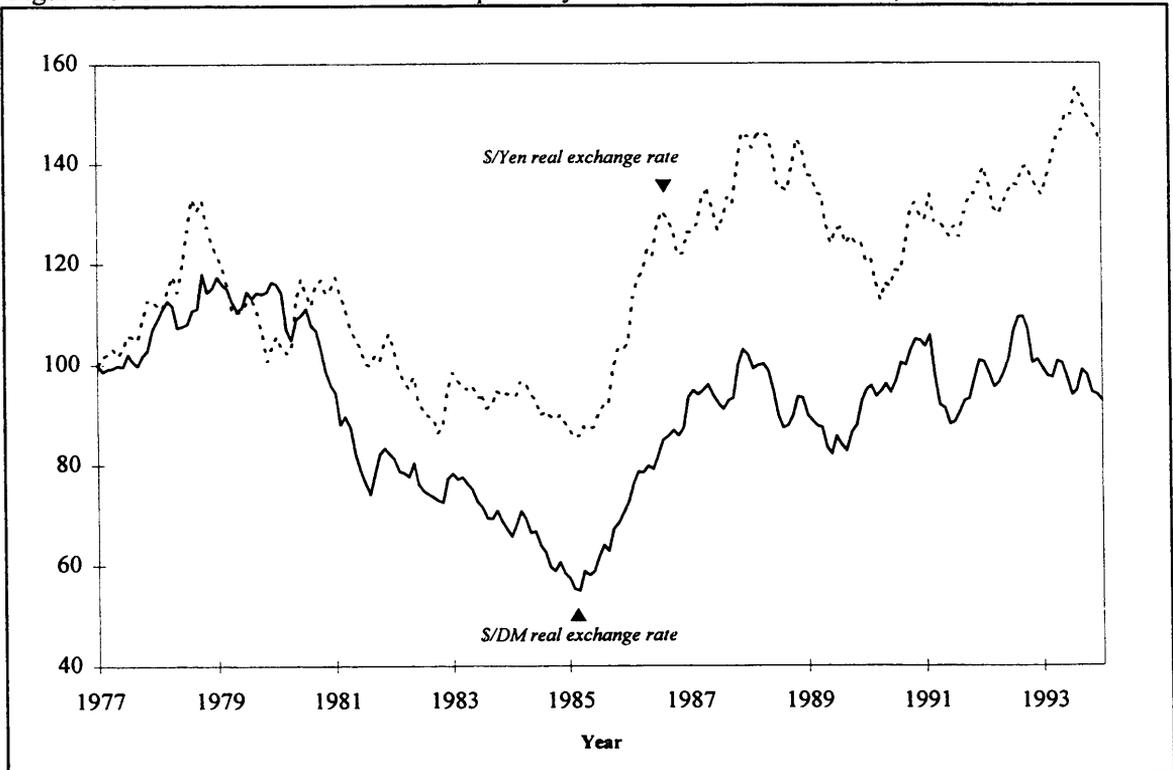
**THE FLOOR AND CEILING MODEL**

Figure 2a. Index of U.S. dollar's trade weighted exchange rate, 1977-1993



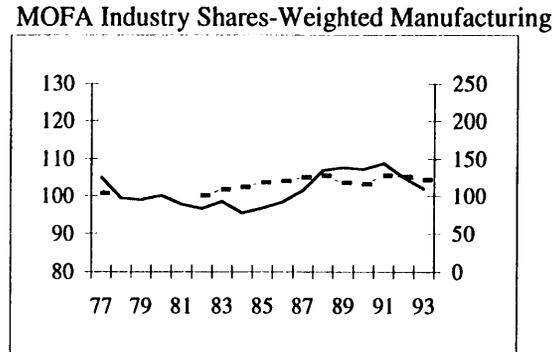
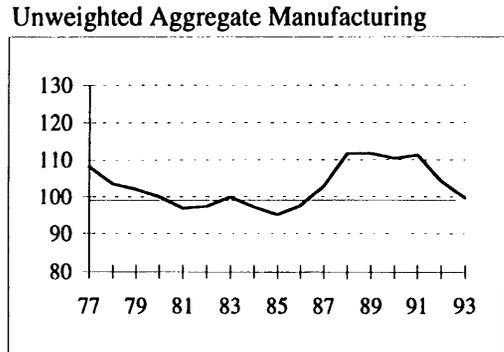
Source: J.P. Morgan

Figure 2b. The German mark and the Japanese yen vis-a-vis the U.S. dollar, 1977-1993



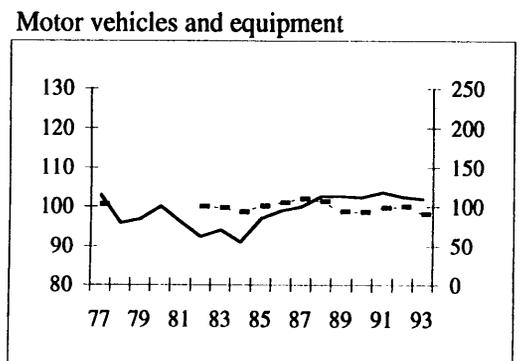
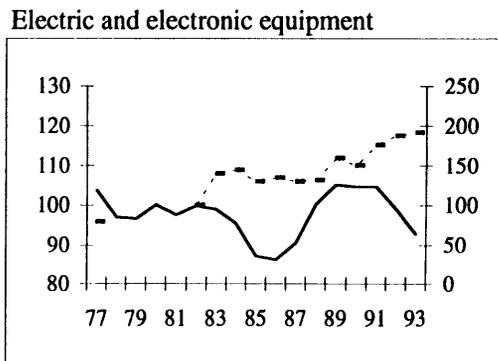
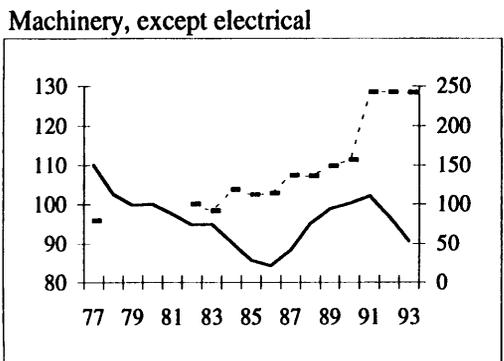
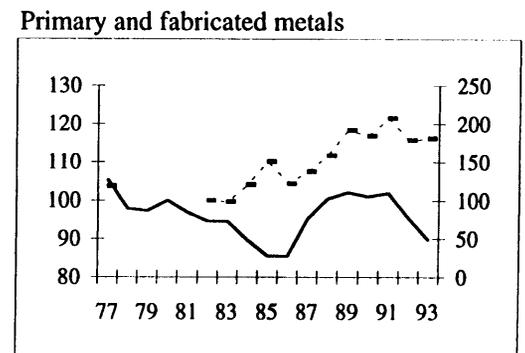
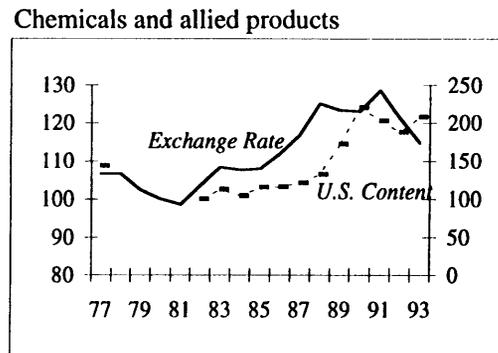
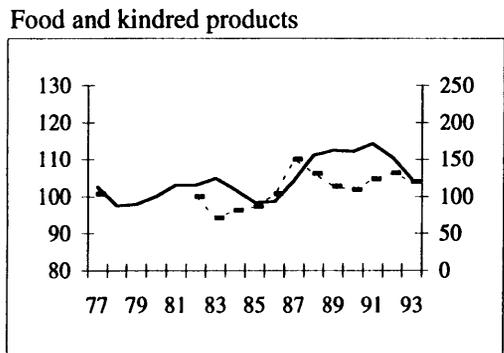
Source: IMF, *International Financial Statistics*, March 1996 compact disc.

Figure 3A. *Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in Canada, 1977-93*  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*



**Industry Shares and U.S. Content in Sales\*\***

Food and kindred	8%	7.3%
Chemicals and allied	13%	11.9%
Metals	5%	9.0%
Machinery, ex electrical	8%	25.7%
Electric and electronic	6%	16.1%
Motor vehicles and equipment	43%	62.0%
Other (not shown here)	16%	-
<b>All manufacturing</b>	<b>100%</b>	<b>30.9%</b>



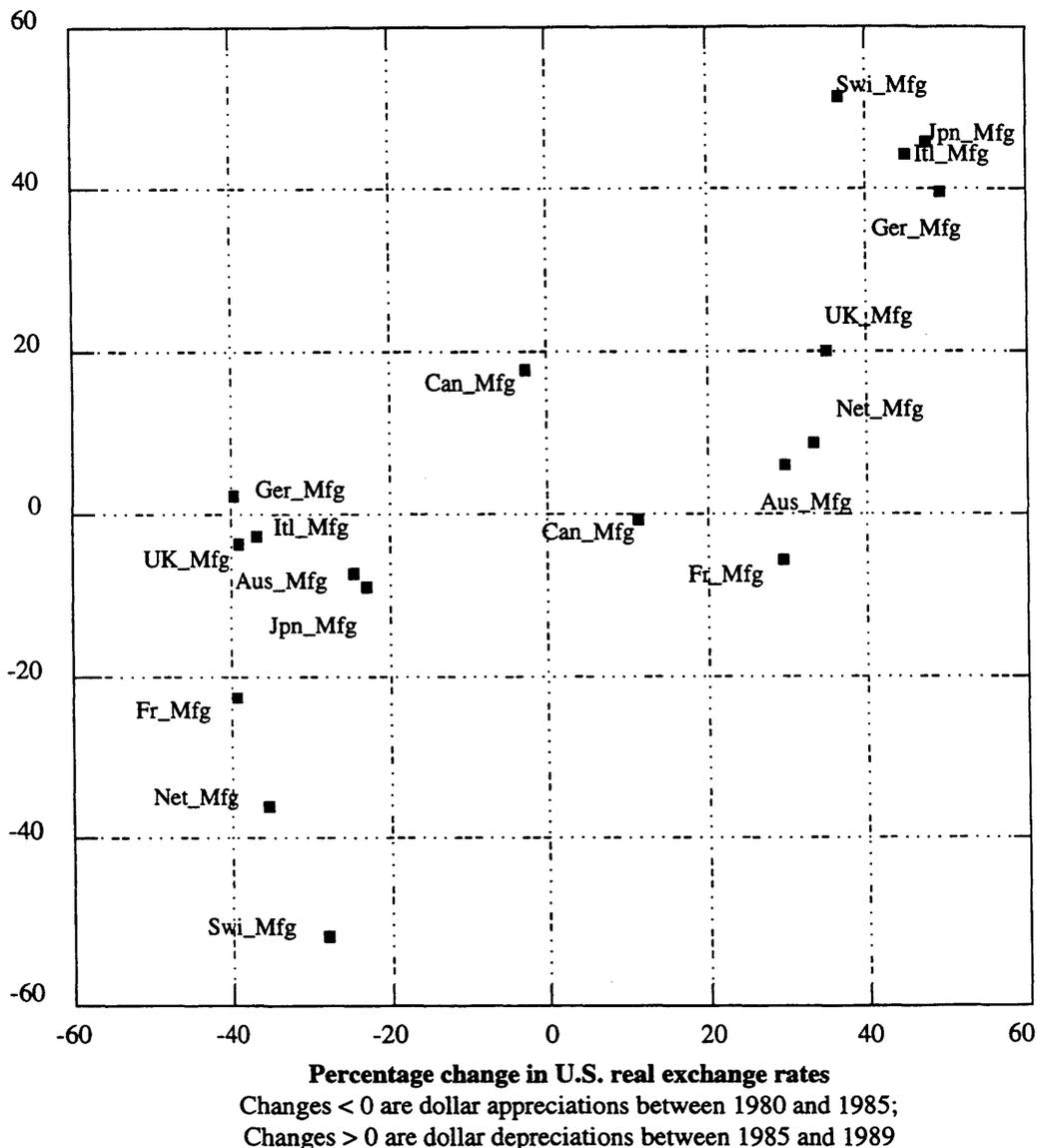
Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate =  $((\text{U.S. } \$/\text{Foreign Currency Unit}) \times (P^*/P_i))$ ; U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

Figure 4A. Change in U.S. content levels in sales made by all U.S. majority-owned foreign affiliates in Manufacturing, 9 countries, 1982-1985 and 1985-1989\*

**Percentage change in U.S. content levels  
in sales made by U.S. MOFAs**

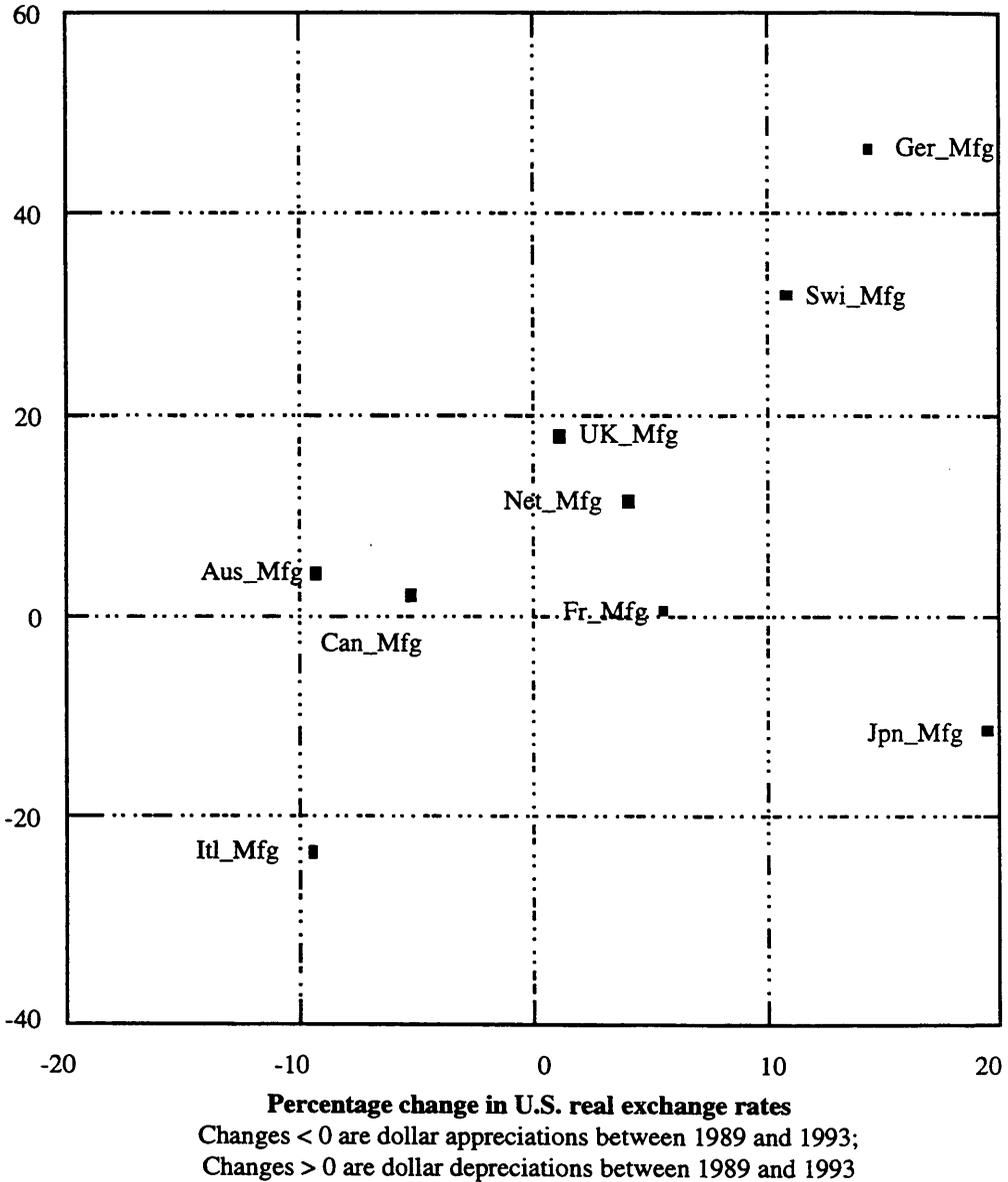


Sources: Author's estimates based on data obtained from the U.S. Bureau of Economic Analysis, *U.S. Direct Investment Abroad*; IMF, *International Financial Statistics*; OECD, *Indicators of Industrial Activity*; U.S. Bureau of Labor Statistics, U.S. Export Prices.

\*: For reasons stated in the text (lack of data), changes in U.S. content levels between 1982 and 1985 are plotted against changes in real exchange rates between 1980 and 1985.

Figure 4B. *Change in U.S. content levels in sales made by all U.S. majority-owned foreign affiliates in Manufacturing, 9 countries, 1989-1993*

**Percentage change in U.S. content levels  
in sales made by U.S. MOFAs**

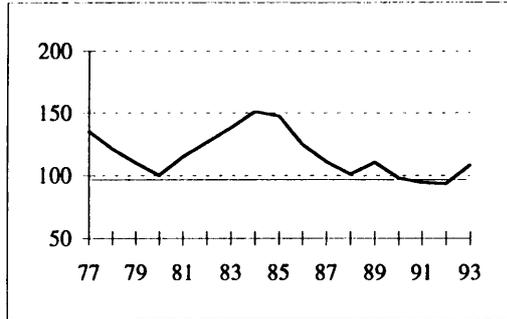


Sources: Author's estimates based on data obtained from the U.S. Bureau of Economic Analysis, *U.S. Direct Investment Abroad*; IMF, *International Financial Statistics*; OECD, *Indicators of Industrial Activity*; U.S. Bureau of Labor Statistics, U.S. Export Prices.

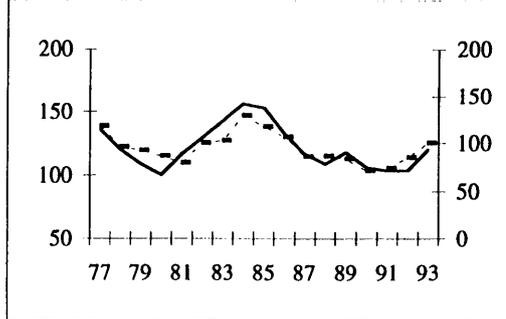
Figure 5A. *Industry-specific real exchange rates and foreign content levels in sales made by the U.S. affiliates of British multinationals, 1977-93*

Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to foreign content levels (set at 100 for 1982)\*

Unweighted Aggregate Manufacturing



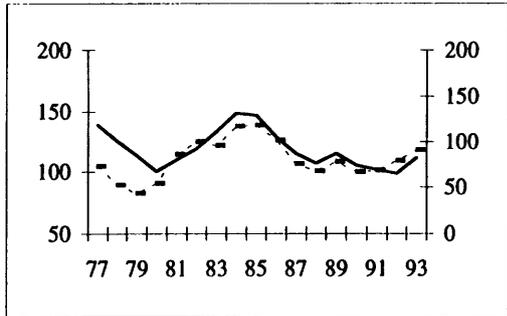
Affiliates' Industry Shares-Weighted Manufacturing



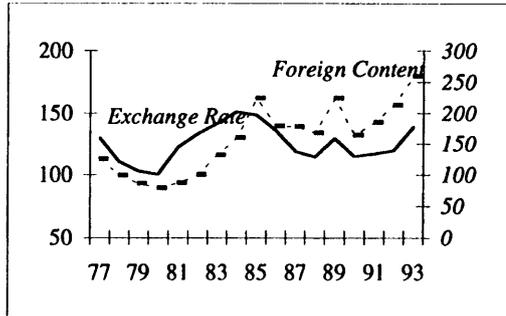
Industry Shares and U.S. Content in Sales\*\*

Food and kindred	20%	8.6%
Chemicals and allied	27%	4.4%
Metals	6%	2.5%
Machinery, ex electrical	9%	4.5%
Electric and electronic	6%	4.7%
Motor vehicles and equipment	3%	4.3%
Other (not shown here)	29%	-
All manufacturing	100%	7.5%

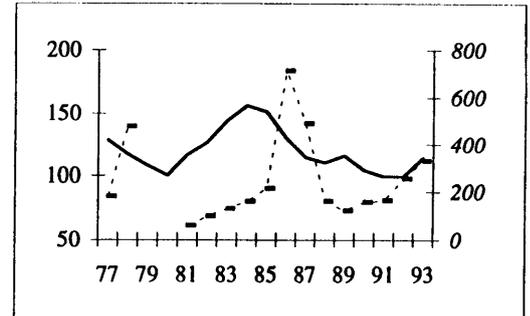
Food and kindred products



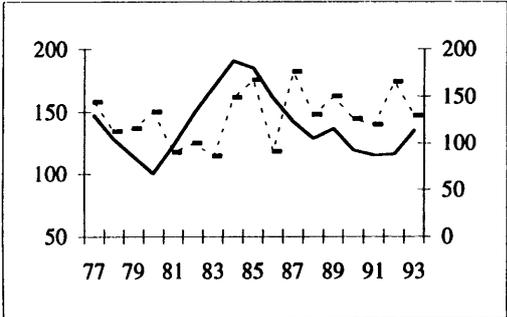
Chemicals and allied products



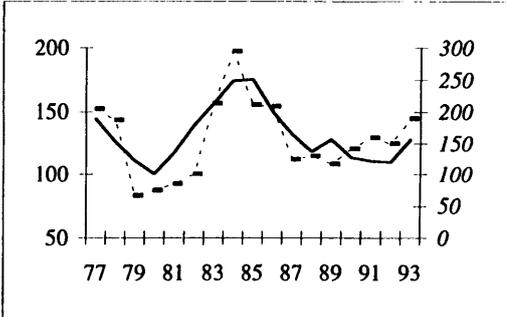
Primary and fabricated metals



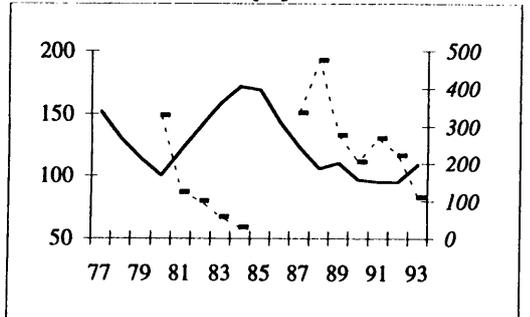
Machinery, except electrical



Electric and electronic equipment



Motor vehicles and equipment



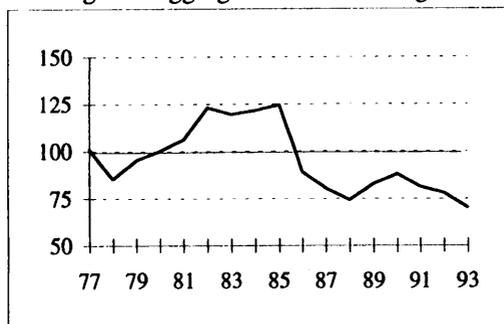
Sources: Bureau of Economic Analysis, Foreign Direct Investment in the United States; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((Foreign Currency Units/U.S. \$) x (Pi/P\*i)); foreign content levels estimated as described in the text.

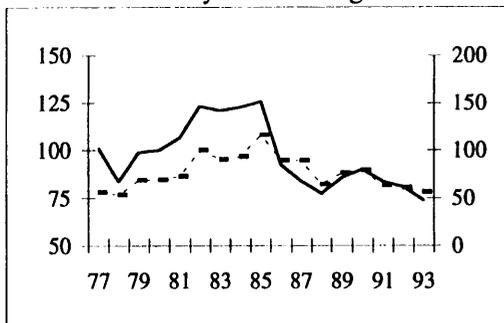
\*\* : Industry shares are based on affiliates' cumulative sales between 1977 and 1993; foreign content figures shown are for 1982, the base year; na = not available.

Figure 5B. *Industry-specific real exchange rates and foreign content levels in sales made by the U.S. affiliates of Japanese multinationals, 1977-93*  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to foreign content levels (set at 100 for 1982)\*

Unweighted Aggregate Manufacturing



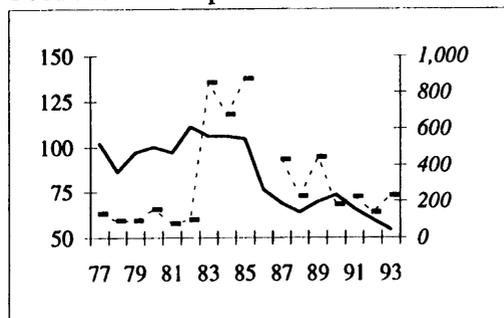
Affiliates' Industry Shares-Weighted Manufacturing



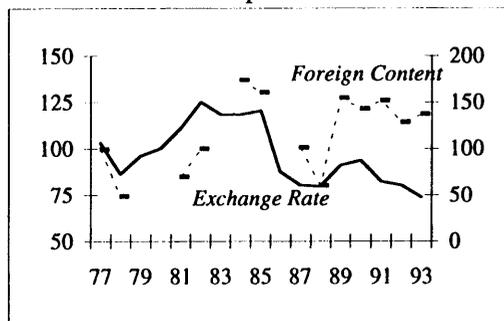
Industry Shares and U.S. Content in Sales\*\*

Food and kindred	7%	0.7%
Chemicals and allied	9%	2.1%
Metals (Content in 1980)	20%	6.8%
Machinery, ex electrical	17%	22.5%
Electric and electronic	12%	42.5%
Motor vehicles and equipment (1988)	17%	36.1%
Other (not shown here)	17%	-
All manufacturing	100%	19.1%

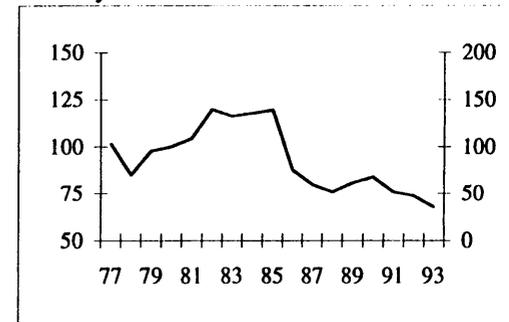
Food and kindred products



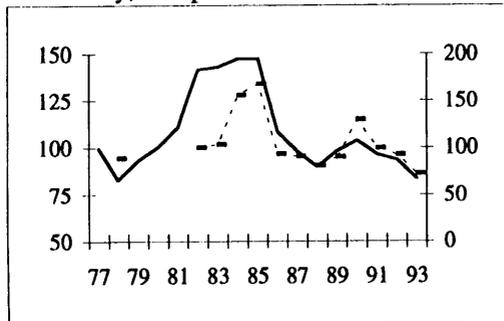
Chemicals and allied products



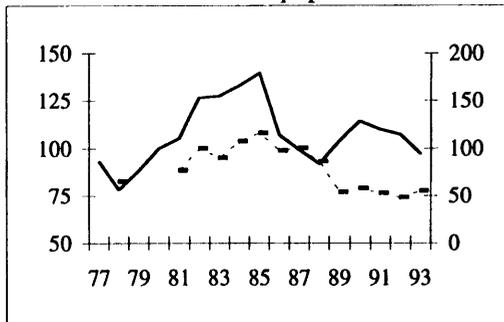
Primary and fabricated metals



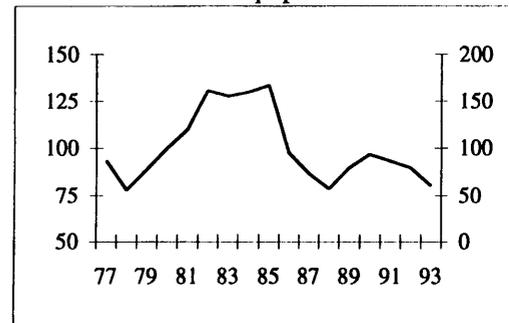
Machinery, except electrical



Electric and electronic equipment



Motor vehicles and equipment



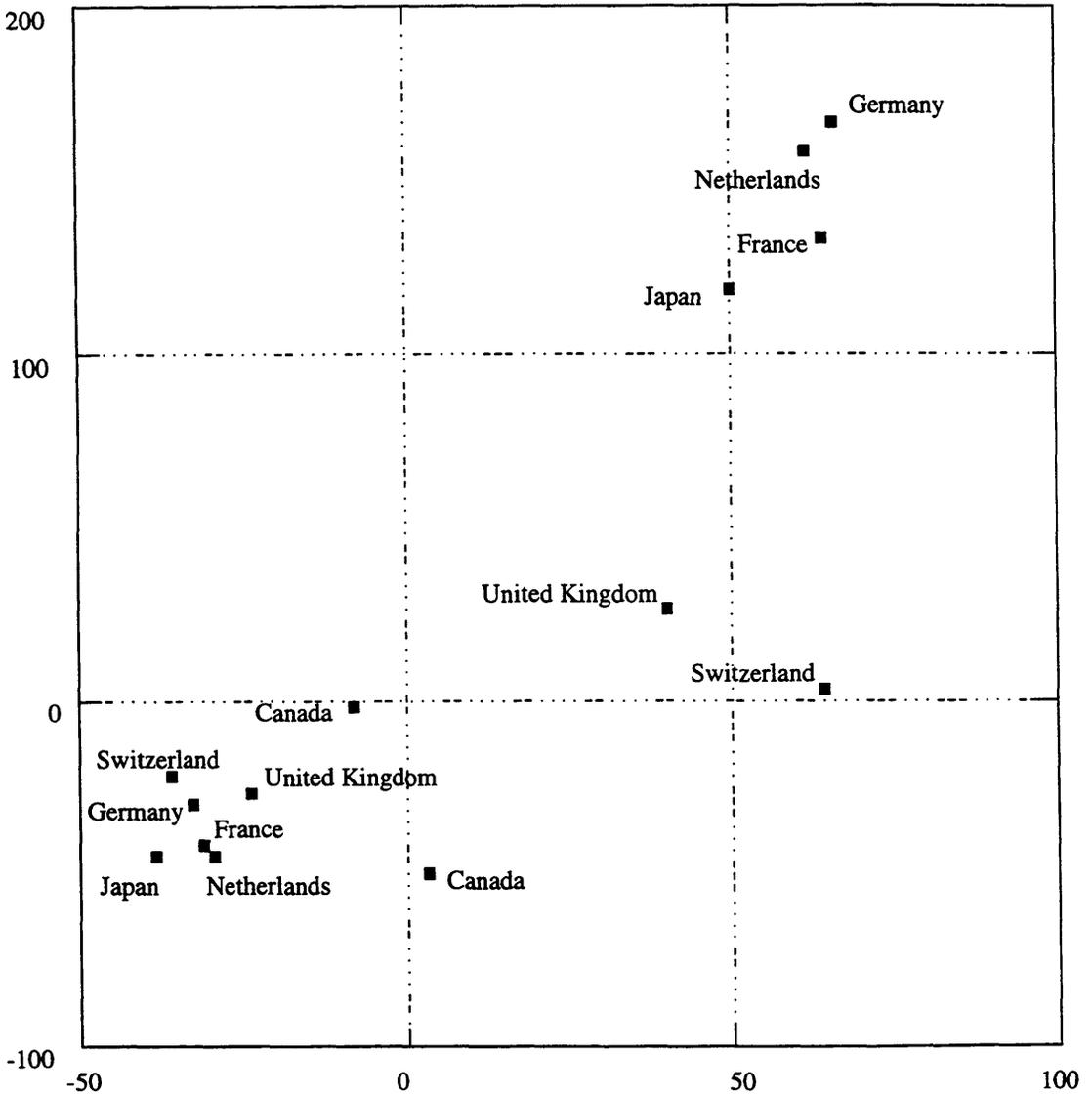
Sources: Bureau of Economic Analysis, Foreign Direct Investment in the United States; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((Foreign Currency Units/U.S. \$) × (P<sub>i</sub>/P<sub>U.S.</sub>)); foreign content levels estimated as described in the text.

\*\* : Industry shares are based on affiliates' cumulative sales between 1977 and 1993; foreign content figures shown are for 1982, the base year; na = not available.

Figure 6A. Changes in foreign content levels in sales made by the U.S. affiliates of foreign multinationals in manufacturing, 7 countries, 1979-1985 and 1985-1987\*

Percentage change in foreign content levels in sales made by the U.S. affiliates of foreign multinationals



Percentage change in home-country real exchange rates

Changes > 0 are depreciations in home country currency between 1979 and 1985

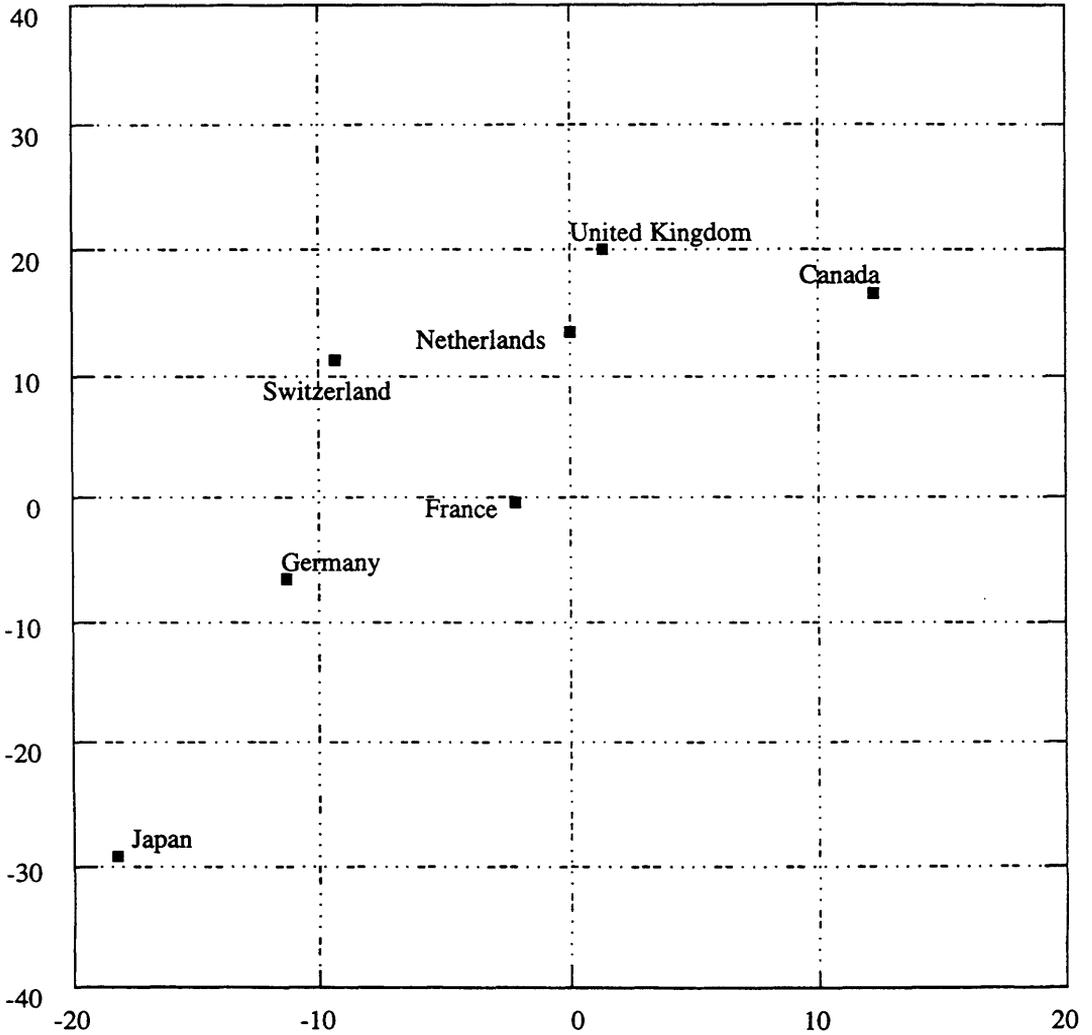
Changes < 0 are appreciations in home country currency between 1985 and 1989

Sources: Author's estimates based on data obtained from the U.S. Bureau of Economic Analysis, *U.S. Direct Investment Abroad*; IMF, *International Financial Statistics*; OECD, *Indicators of Industrial Activity*; U.S. Bureau of Labor Statistics, U.S. Export Prices.

\*: For Japan, the yen depreciation period begins in 1978 and goes through 1985.

Figure 6B. *Changes in foreign content levels in sales made by the U.S. affiliates of foreign multinationals in manufacturing, 7 countries, 1989-93\**

**Percentage change in foreign content levels in sales made by the U.S. affiliates of foreign multinationals**



**Percentage change in home-country real exchange rates**

Changes > 0 are depreciations in home country currency between 1979 and 1985  
 Changes < 0 are appreciations in home country currency between 1985 and 1989

Sources: Author's estimates based on data obtained from the U.S. Bureau of Economic Analysis, *U.S. Direct Investment Abroad*; IMF, *International Financial Statistics*; OECD, *Indicators of Industrial Activity*; U.S. Bureau of Labor Statistics, U.S. Export Prices.

\*: For Japan, the exchange rate change episode begins in 1990 and goes through 1993.

Table 1. *Regressions explaining year-to-year changes in the foreign-content levels in sales made by the U.S. affiliates of Japanese, British, French, and German multinationals, aggregate manufacturing, 1977-93*

<i>Independent variables</i>	<i>Country of Headquarters</i>				
	<i>All Foreign</i>	<i>Japan</i>	<i>United Kingdom</i>	<i>France</i>	<i>Germany</i>
Constant	2.24 (1.47)	3.24 (1.17)	0.17 (0.06)	4.67 (0.80)	3.0 (1.03)
Changes in real exchange rates	1.06 (7.25)	1.31 (5.34)	0.89 (3.19)	1.31 (2.35)	0.96 (3.91)
<i>Summary statistics</i>					
Adjusted R-squared	.32	.65	.38	.23	.49
Number of observations	112	16	16	16	16

Note: T-stats in parentheses.

results: japan, uk, france, germany - annual changes

Table 2. Regressions explaining changes in the home-content levels in sales made by foreign affiliates of U.S. multinationals and the U.S. affiliates of foreign multinationals, aggregate manufacturing, 1979-93

<i>Independent variables</i>	<i>Foreign Multinationals' U.S. Affiliates</i>			<i>U.S. Multinationals' Foreign Affiliates</i>	
	<i>Home Currencies Depreciating 1979-85*</i>	<i>Home Currencies Appreciating 1985-87</i>	<i>Home Currencies Appreciating and Depreciating 1989-93</i>	<i>Dollar Depreciating 1985-89</i>	<i>Dollar Appreciating and Depreciating 1989-93 **</i>
Constant	-60.80 (-0.99)	3.3 (0.25)	8.95 (1.96)	-28.51 (-1.65)	9.345 (2.13)
Changes in real exchange rates	2.80 (2.46)	1.17 (2.61)	1.39 (3.07)	1.49 (3.19)	1.88 (3.83)
<i>Summary statistics</i>					
Adjusted R-squared	.46	.49	.58	.51	.67
Number of observations	7	7	7	9	8

Note: *T*-stats in parentheses.

\*: For Japan, the yen depreciation is measured from 1978.

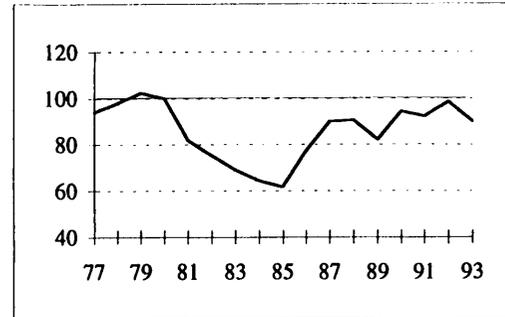
\*\* : Results shown are without Japan. With Japan, the coefficient on exchange rates is 0.45 with a *t*-statistic of 0.66.

results: u.s. - foreign regression results

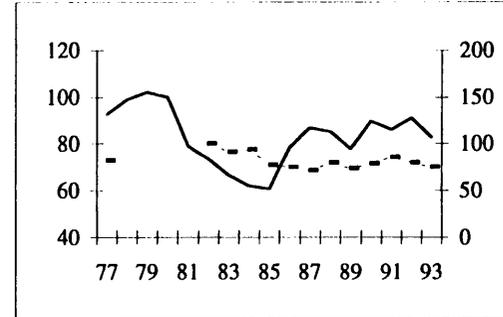
## **APPENDIX**

Figure 3B. Industry-specific real exchange rates and U.S. content levels in France, 1977-93  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

Unweighted Aggregate Manufacturing



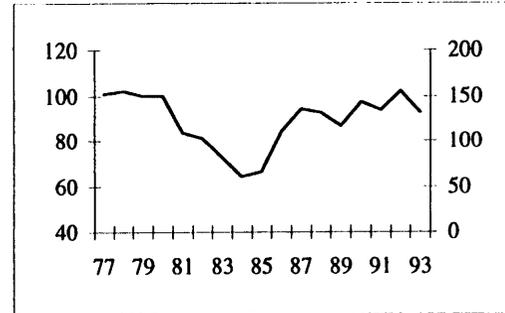
MOFA Industry Shares-Weighted Manufacturing



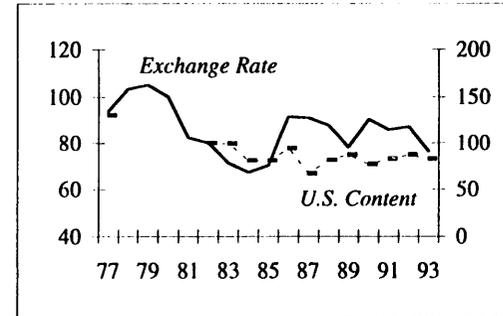
Industry Shares and U.S. Content in Sales\*\*

Food and kindred	11%	na
Chemicals and allied	27%	4.9%
Metals	4%	4.5%
Machinery, ex electrical	27%	7.0%
Electric and electronic	6%	7.3%
Motor vehicles and equipment	5%	2.2%
Other (not shown here)	21%	-
All manufacturing	100%	6.2%

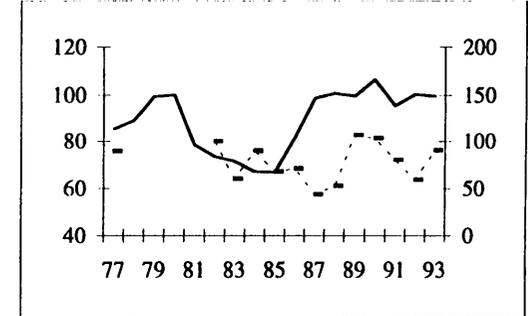
Food and kindred products



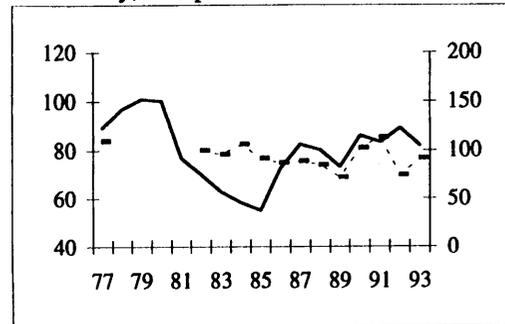
Chemicals and allied products



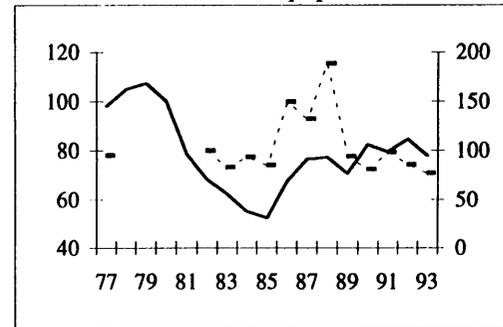
Primary and fabricated metals



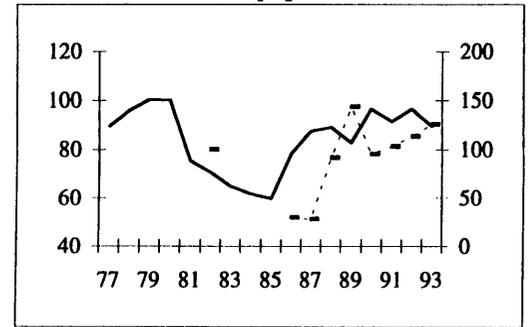
Machinery, except electrical



Electric and electronic equipment



Motor vehicles and equipment



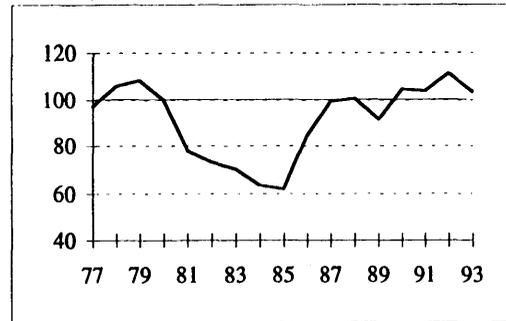
Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate =  $((\text{U.S. } \$/\text{Foreign Currency Unit}) \times (P^*/P_i))$ ; U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

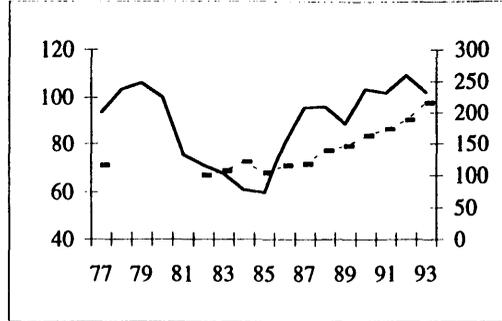
\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

**Figure 3C. Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in Germany, 1977-93**  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



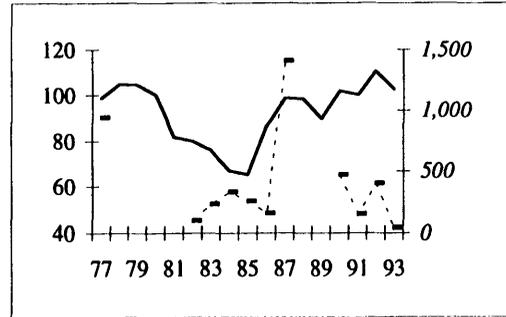
**MOFA Industry Shares-Weighted Manufacturing**



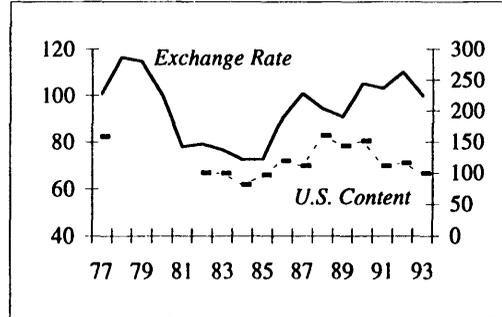
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred	8%	0.2%
Chemicals and allied	14%	3.8%
Metals	5%	5.5%
Machinery, ex electrical	20%	7.1%
Electric and electronic	6%	5.1%
Motor vehicles and equipment	33%	1.1%
Other (not shown here)	14%	-
<b>All manufacturing</b>	<b>100%</b>	<b>3.9%</b>

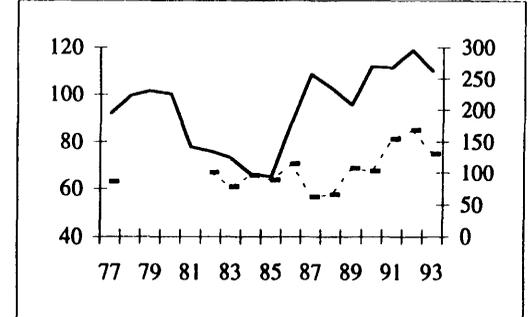
**Food and kindred products**



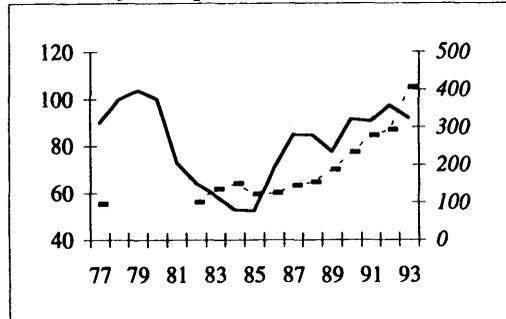
**Chemicals and allied products**



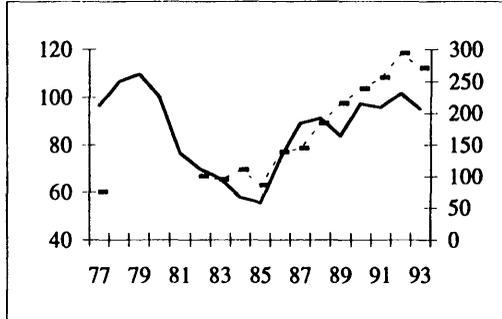
**Primary and fabricated metals**



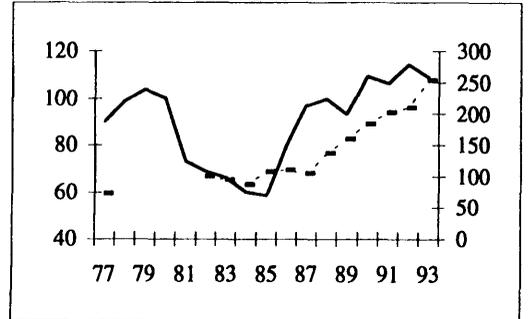
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



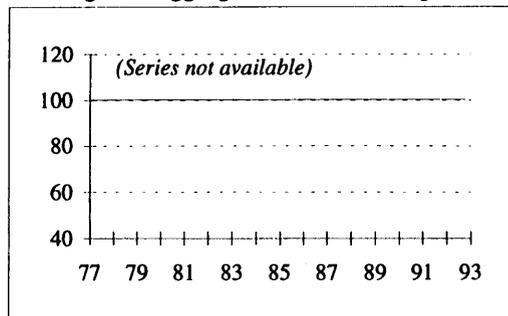
Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((U.S. \$/Foreign Currency Unit)x(P\*i/Pi)); U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

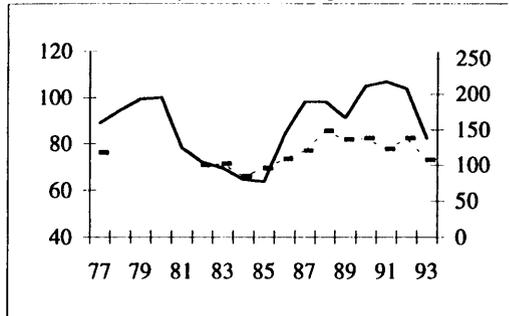
\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

**Figure 3D. Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in Italy, 1977-93**  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



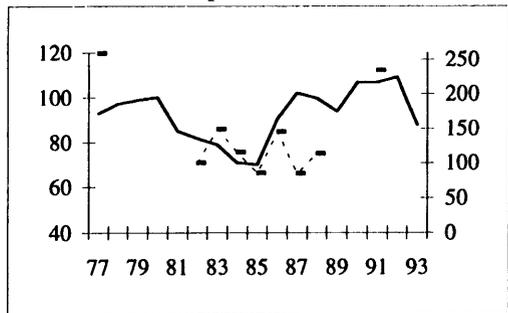
**MOFA Industry Shares-Weighted Manufacturing**



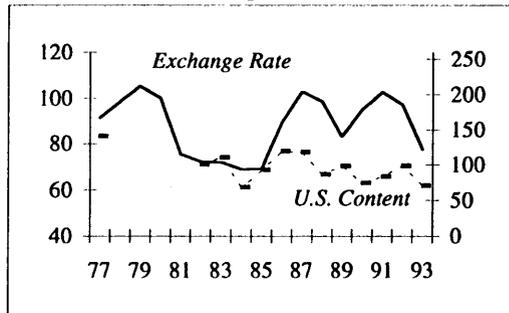
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred	11%	0.3%
Chemicals and allied	26%	5.2%
Metals	3%	3.6%
Machinery, ex electrical	30%	5.5%
Electric and electronic	7%	2.1%
Motor vehicles and equipment	6%	1.9%
Other (not shown here)	15%	-
<b>All manufacturing</b>	<b>100%</b>	<b>4.1%</b>

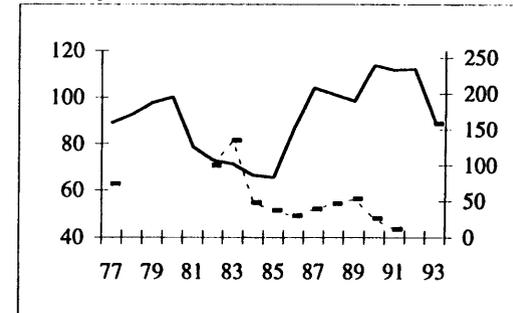
**Food and kindred products**



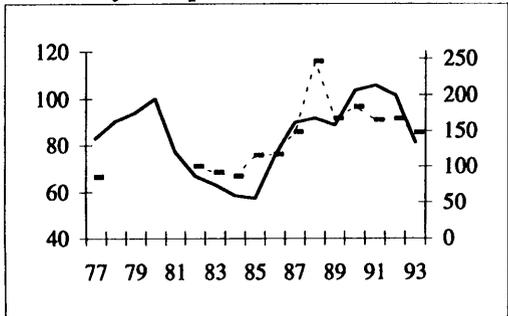
**Chemicals and allied products**



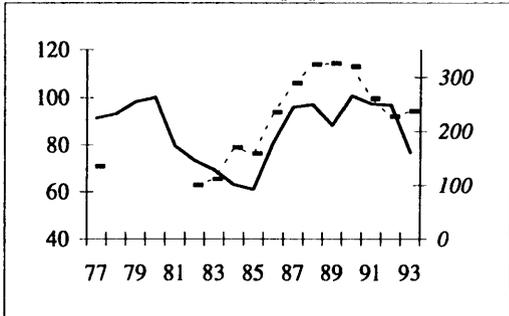
**Primary and fabricated metals**



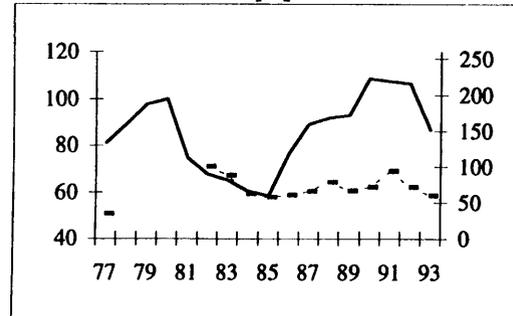
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



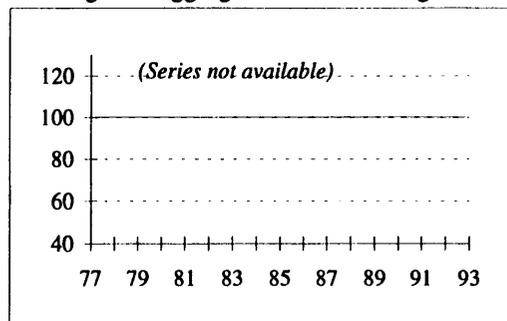
Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((U.S. \$/Foreign Currency Unit) × (P<sup>i</sup>/P<sub>i</sub>)); U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

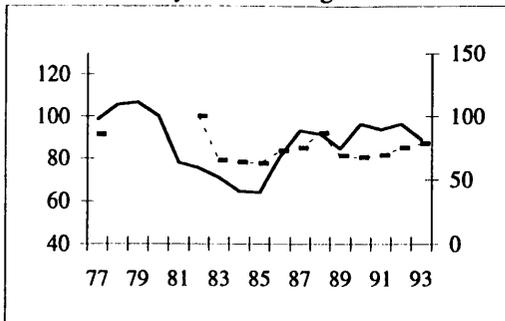
\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

Figure 3E. *Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in Netherlands, 1977-93*  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



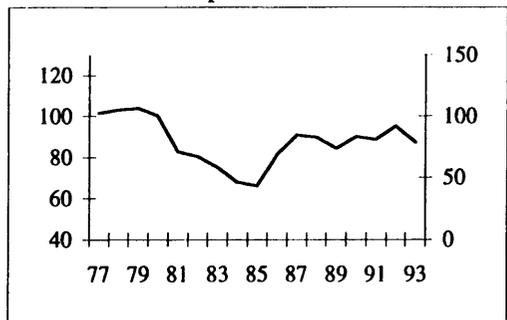
**MOFA Industry Shares-Weighted Manufacturing**



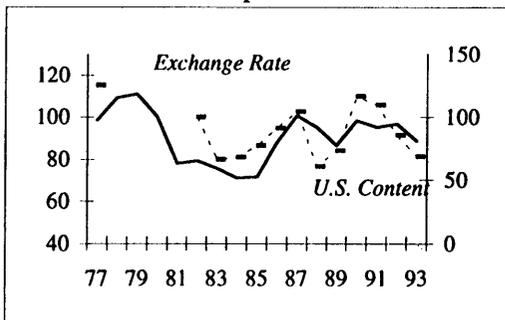
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred (Content in 1988)	22%	22.8%
Chemicals and allied	33%	6.9%
Metals	5%	6.8%
Machinery, ex electrical	15%	7.3%
Electric and electronic	4%	15.1%
Motor vehicles and equipment (1988)	1%	7.4%
Other (not shown here)	19%	-
All manufacturing	100%	12.2%

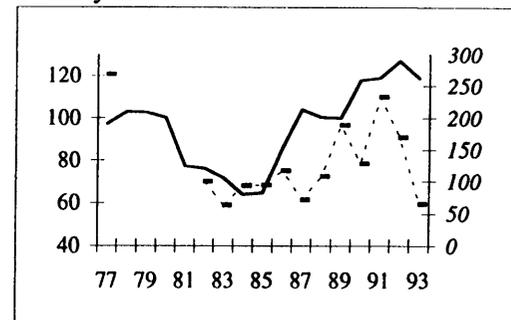
**Food and kindred products**



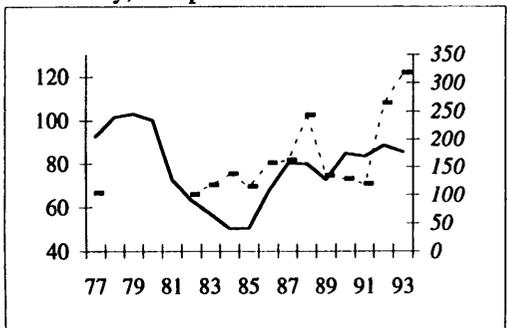
**Chemicals and allied products**



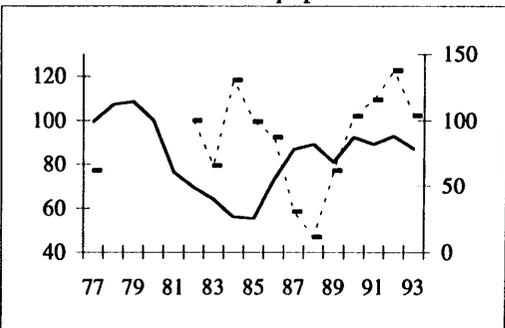
**Primary and fabricated metals**



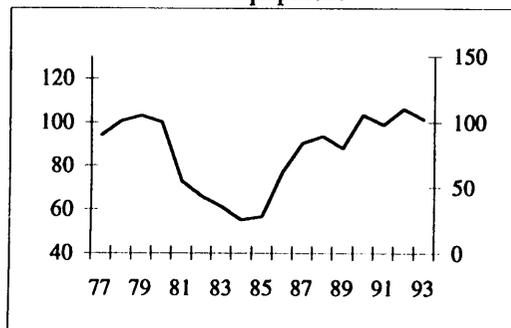
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



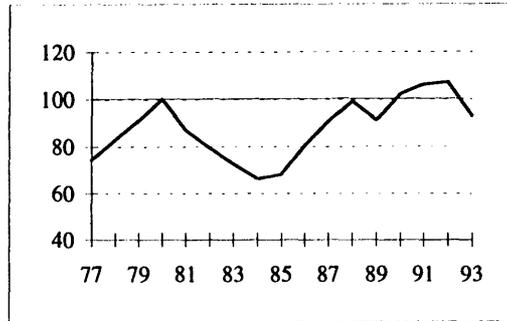
Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((U.S. \$/Foreign Currency Unit)x(P\*/i/Pi)); U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

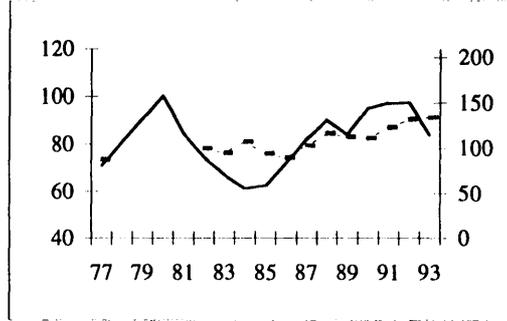
\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

**Figure 3F. Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in the United Kingdom, 1977-93**  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



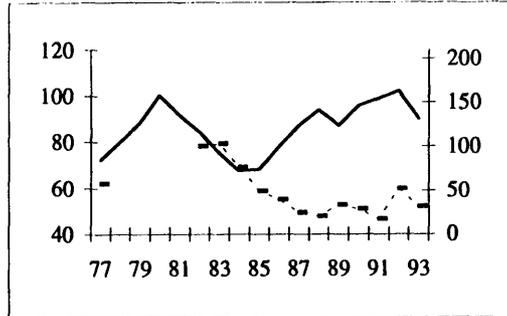
**MOFA Industry Shares-Weighted Manufacturing**



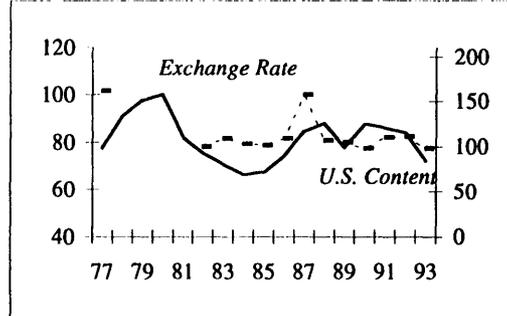
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred	11%	3.6%
Chemicals and allied	16%	4.8%
Metals	5%	5.0%
Machinery, ex electrical	22%	7.9%
Electric and electronic	5%	10.6%
Motor vehicles and equipment	21%	2.1%
Other (not shown here)	20%	-
<b>All manufacturing</b>	<b>100%</b>	<b>5.8%</b>

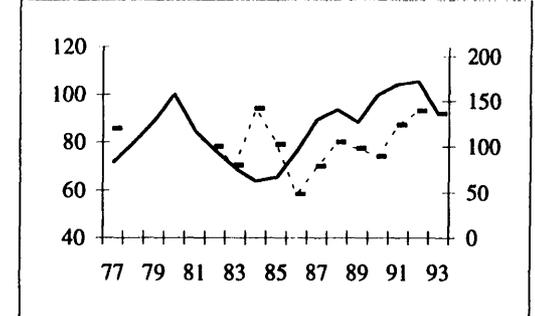
**Food and kindred products**



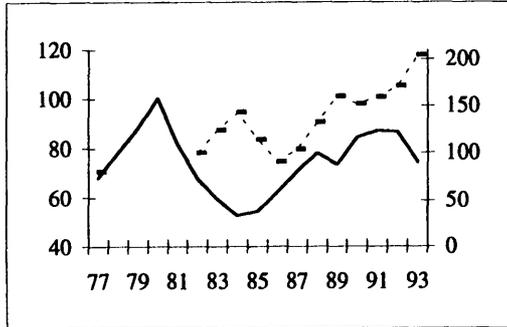
**Chemicals and allied products**



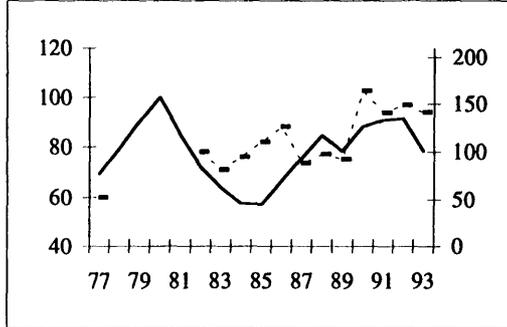
**Primary and fabricated metals**



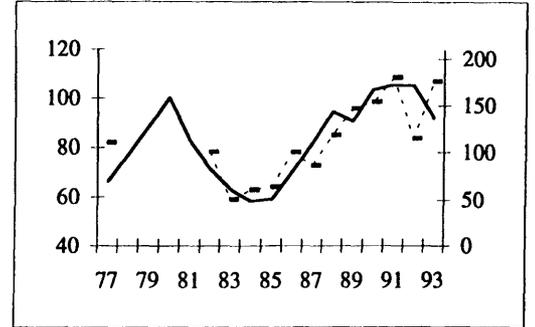
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

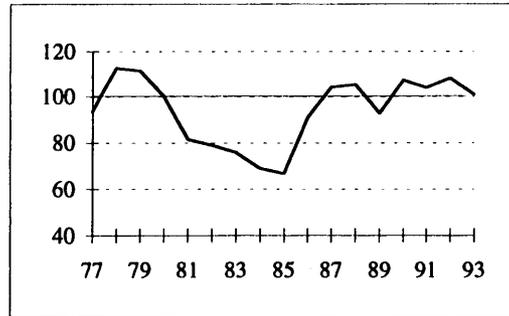
\*: Industry-specific real exchange rate = ((U.S. \$/Foreign Currency Unit)x(P\*i/Pi)); U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

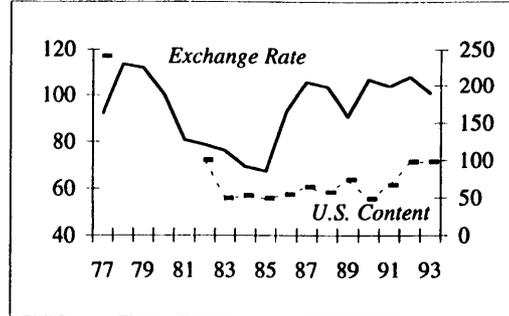
**Figure 3G. Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in Switzerland, 1977-93**

Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



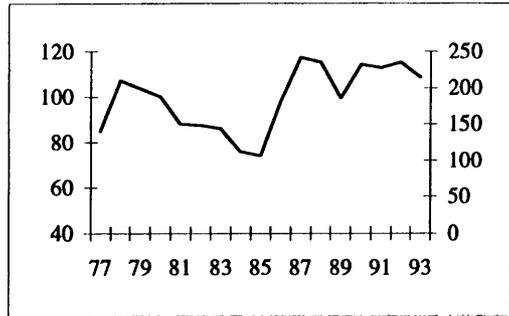
**MOFA Industry Shares-Weighted Manufacturing**



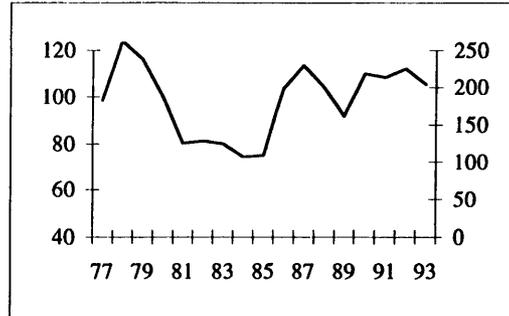
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred (Content in 1989)	11%	1.0%
Chemicals and allied (1993)	18%	3.4%
Metals (1993)	4%	6.9%
Machinery, ex electrical	8%	1.7%
Electric and electronic	10%	5.2%
Motor vehicles and equipment (1993)	0%	14.6%
Other (not shown here)	48%	-
<b>All manufacturing</b>	<b>100%</b>	<b>7.3%</b>

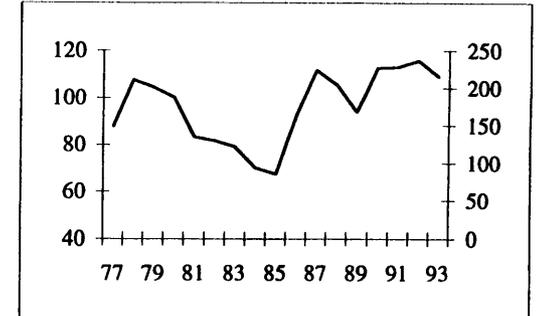
**Food and kindred products**



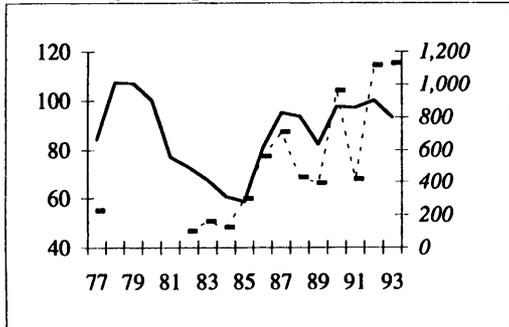
**Chemicals and allied products**



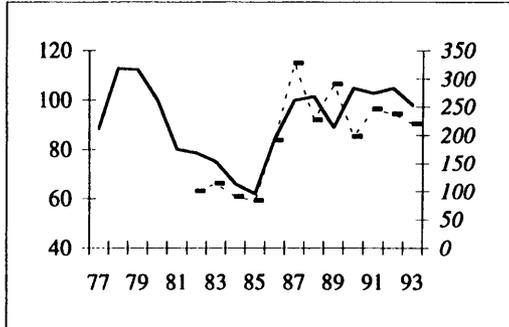
**Primary and fabricated metals**



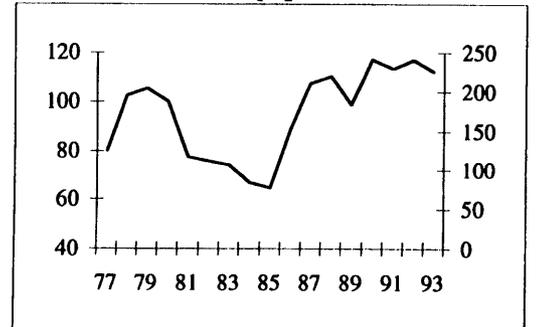
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

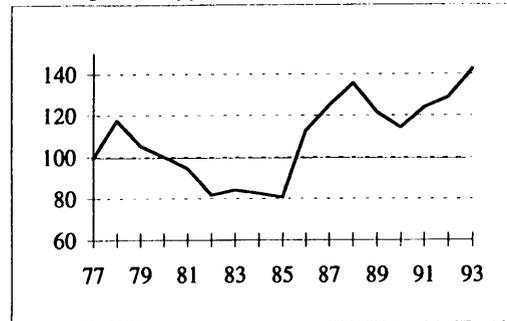
\*: Industry-specific real exchange rate = ((U.S. \$/Foreign Currency Unit) × (P<sub>i</sub>/P<sub>u</sub>)); U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

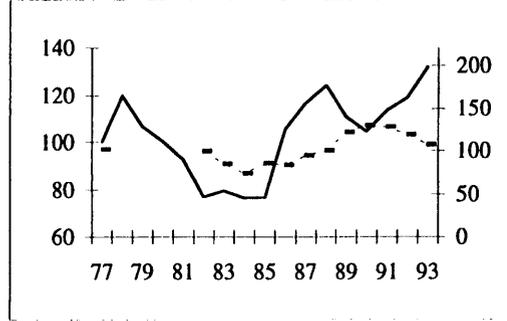
Figure 3H. Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in Japan, 1977-93

Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

Unweighted Aggregate Manufacturing



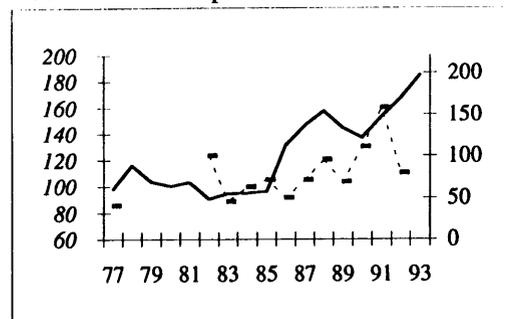
MOFA Industry Shares-Weighted Manufacturing



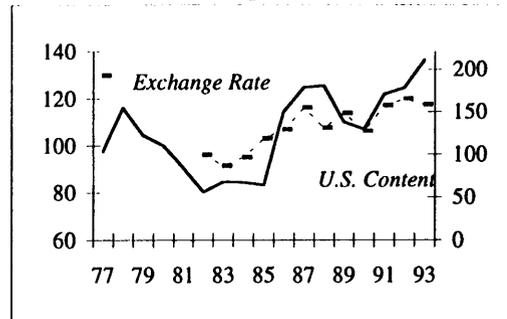
Industry Shares and U.S. Content in Sales\*\*

Food and kindred	9%	1.5%
Chemicals and allied	21%	6.5%
Metals	2%	7.4%
Machinery, ex electrical (1984)	43%	10.0%
Electric and electronic	12%	10.4%
Motor vehicles and equipment	1%	75.0%
Other (not shown here)	13%	-
All manufacturing	100%	10.8%

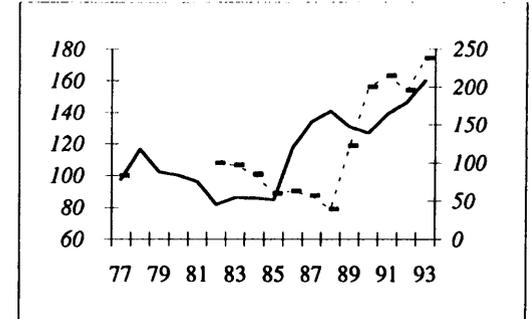
Food and kindred products



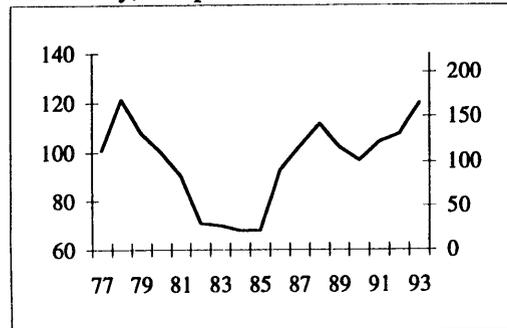
Chemicals and allied products



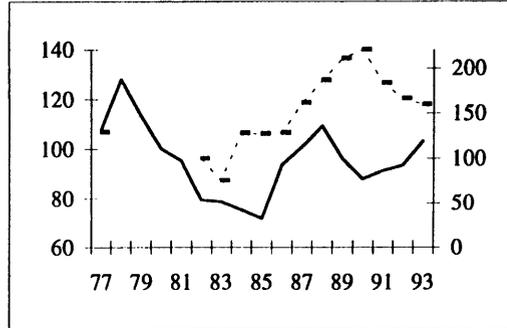
Primary and fabricated metals



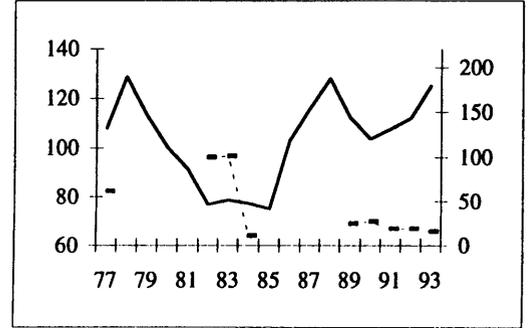
Machinery, except electrical



Electric and electronic equipment



Motor vehicles and equipment



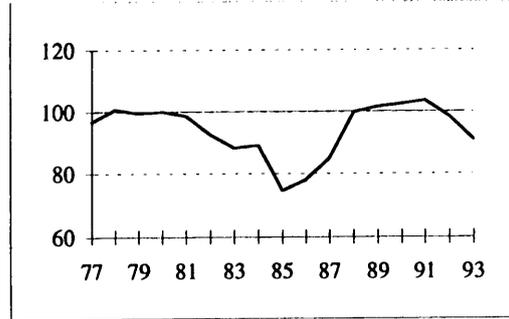
Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((U.S. \$/Foreign Currency Unit)x(P\*i/Pi)); U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

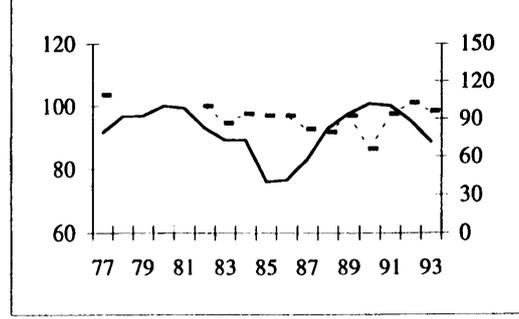
\*\* : Industry shares are based on MOFAs' cumulative sales in 1977, and 1982 through 1993; U.S. content figures shown are for 1982, the base year; na = not available.

**Figure 3I. Industry-specific real exchange rates and U.S. content levels in sales made by U.S. majority-owned foreign affiliates in Australia, 1977-93**  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to U.S. content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



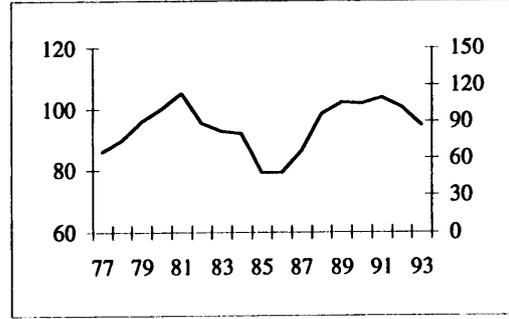
**MOFA Industry Shares-Weighted Manufacturing**



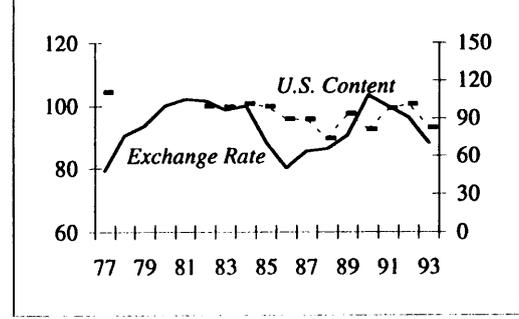
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred (Content in 1989)	18%	1.2%
Chemicals and allied	26%	8.1%
Metals (1989)	4%	2.6%
Machinery, ex electrical (1989)	10%	26.5%
Electric and electronic	5%	4.9%
Motor vehicles and equipment (1989)	21%	4.6%
Other (not shown here)	17%	-
<b>All manufacturing</b>	<b>100%</b>	<b>8.3%</b>

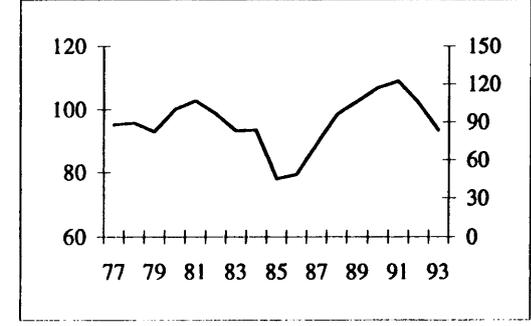
**Food and kindred products**



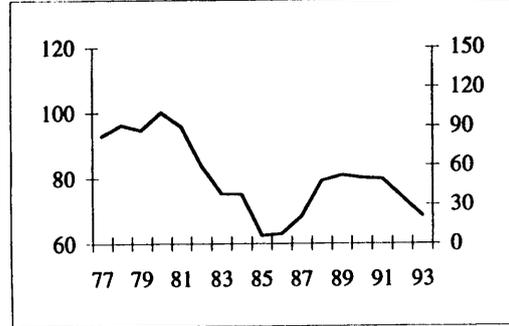
**Chemicals and allied products**



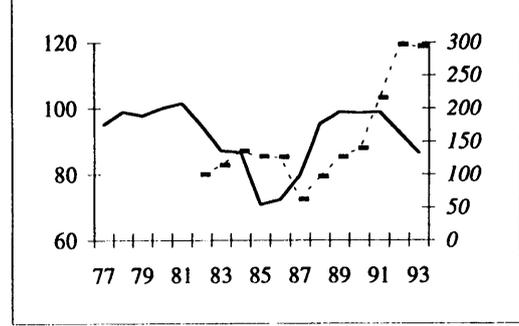
**Primary and fabricated metals**



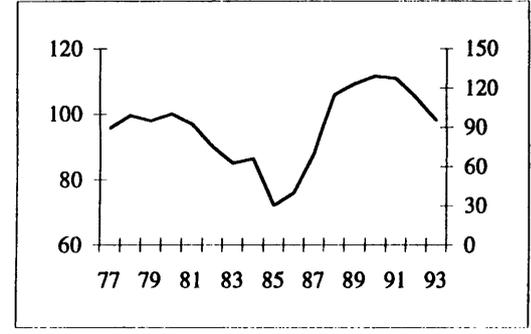
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



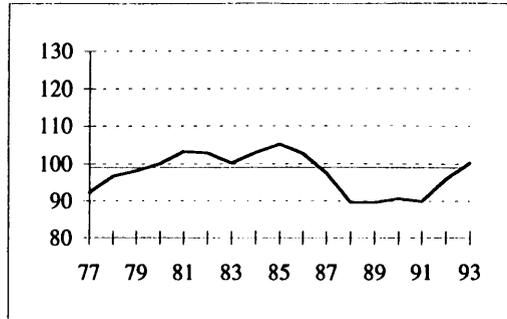
Sources: Bureau of Economic Analysis, U.S. Direct Investment Abroad; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((U.S. \$/Foreign Currency Unit)x(P\*<sub>i</sub>/P<sub>i</sub>)); U.S. content levels estimated as described in the text. U.S. content levels for years 1978-1981 are not available.

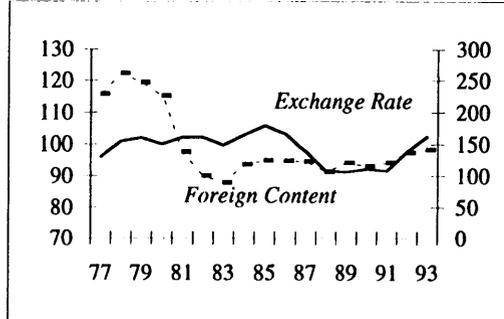
\*\* : Industry shares are based on MOFAs' cumulative sales in 1977 and 1982 through 1993; U.S. content figures are for 1982 unless otherwise indicated; na = not available.

Figure 5C. Industry-specific real exchange rates and foreign content levels in sales made by the U.S. affiliates of Canadian multinationals, 1977-93  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to foreign content levels (set at 100 for 1982)\*

Unweighted Aggregate Manufacturing



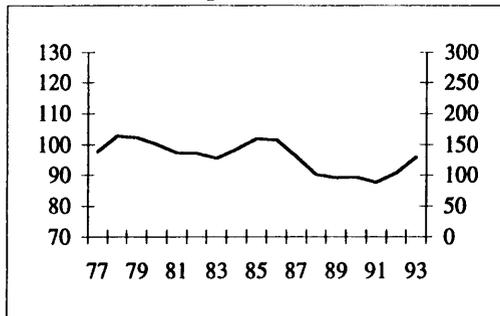
Affiliates' Industry Shares-Weighted Manufacturing



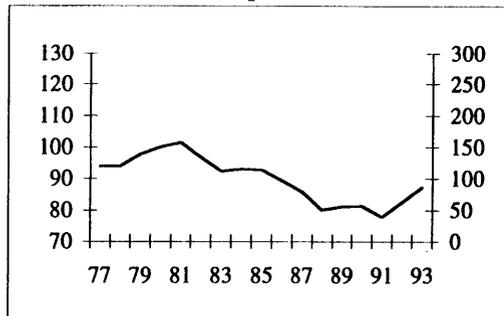
Industry Shares and U.S. Content in Sales\*\*

Food and kindred (Content in 1983)	8%	16.9%
Chemicals and allied (1979)		19.4%
Metals	13%	23.2%
Machinery, ex electrical (1979)	3%	31.0%
Electric and electronic (1979)	9%	28.4%
Motor vehicles and equipment	2%	13.6%
Other (not shown here)		-
All manufacturing	100%	7.7%

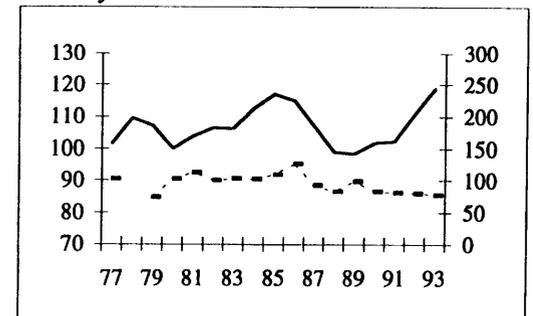
Food and kindred products



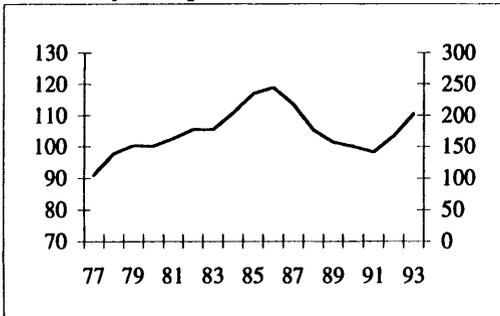
Chemicals and allied products



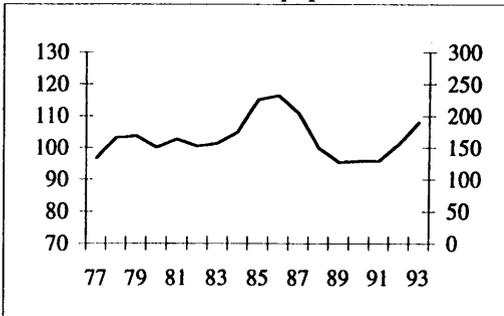
Primary and fabricated metals



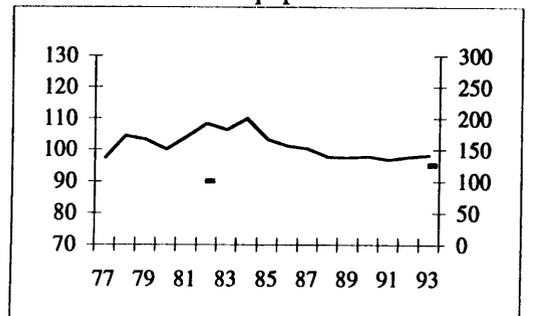
Machinery, except electrical



Electric and electronic equipment



Motor vehicles and equipment



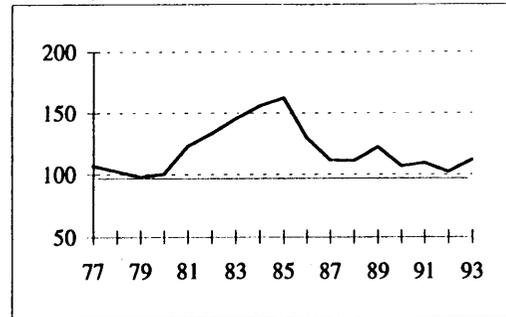
Sources: Bureau of Economic Analysis, Foreign Direct Investment in the United States; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((Foreign Currency Units/U.S. \$) x (Pi/P\*i)); foreign content levels estimated as described in the text.

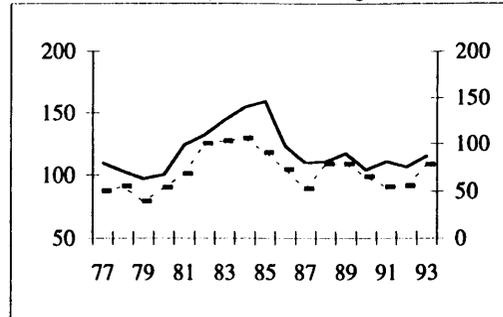
\*\* : Industry shares are based on affiliates' cumulative sales between 1977 and 1993; foreign content figures shown are for 1982, the base year; na = not available.

**Figure 5D. Industry-specific real exchange rates and foreign content levels in sales made by the U.S. affiliates of French multinationals, 1977-93**  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to foreign content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



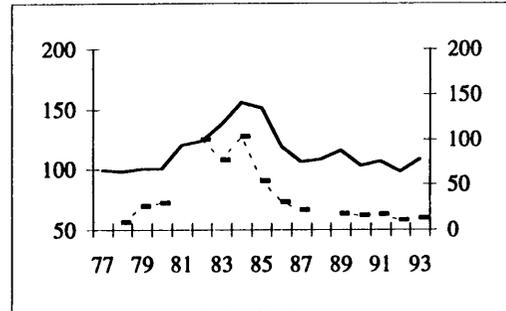
**Affiliates' Industry Shares-Weighted Manufacturing**



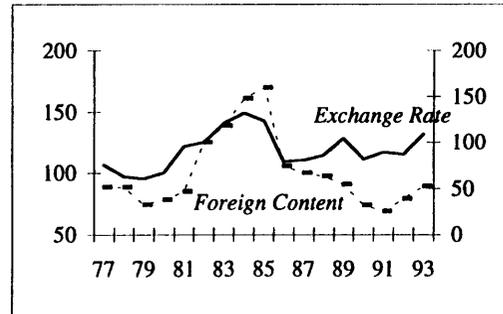
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred	6%	27.3%
Chemicals and allied	16%	18.6%
Metals	17%	8.6%
Machinery, ex electrical	5%	4.2%
Electric and electronic	10%	17.8%
Motor vehicles and equipment	15%	23.1%
Other (not shown here)	31%	-
<b>All manufacturing</b>	<b>100%</b>	<b>16.2%</b>

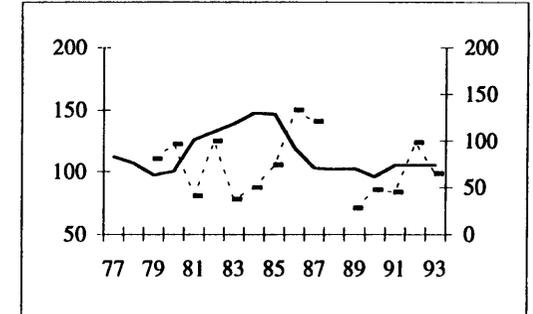
**Food and kindred products**



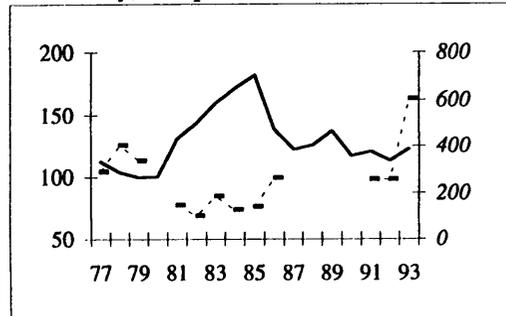
**Chemicals and allied products**



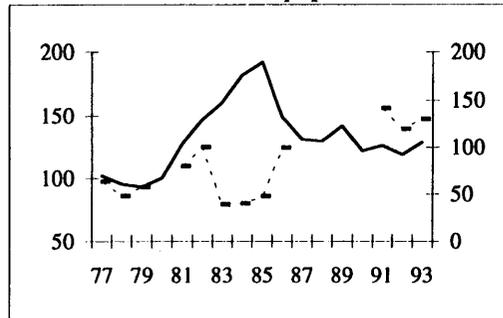
**Primary and fabricated metals**



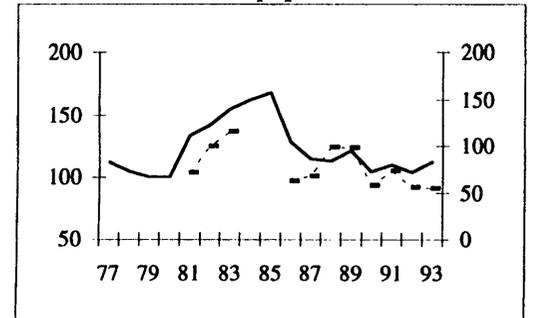
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



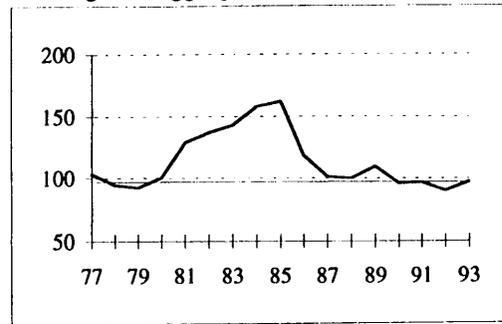
Sources: Bureau of Economic Analysis, Foreign Direct Investment in the United States; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((Foreign Currency Units/U.S. \$) x (Pi/P\*1)); foreign content levels estimated as described in the text.

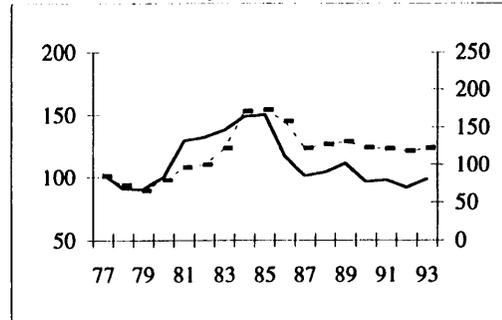
\*\* : Industry shares are based on affiliates' cumulative sales between 1977 and 1993; foreign content figures shown are for 1982, the base year; na = not available.

Figure 5E. *Industry-specific real exchange rates and foreign content levels in sales made by the U.S. affiliates of German multinationals, 1977-93*  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to foreign content levels (set at 100 for 1982)\*

Unweighted Aggregate Manufacturing



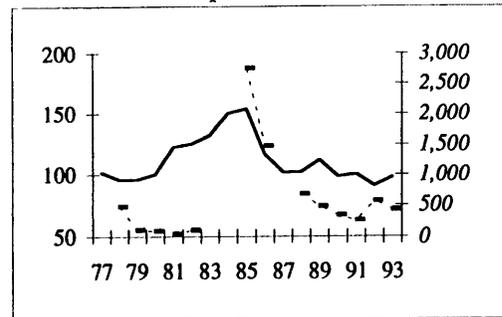
Affiliates' Industry Shares-Weighted Manufacturing



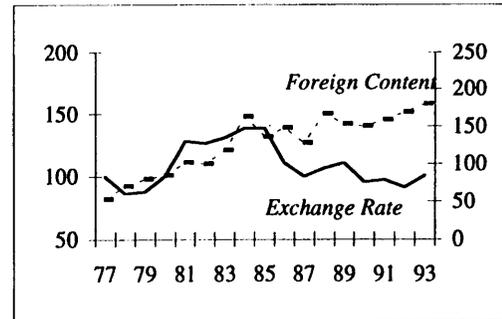
Industry Shares and U.S. Content in Sales\*\*

Food and kindred	1%	1.6%
Chemicals and allied	51%	5.9%
Metals	8%	13.7%
Machinery, ex electrical	8%	21.6%
Electric and electronic	11%	10.8%
Motor vehicles and equipment (1982)	3%	11.6%
Other (not shown here)	19%	-
All manufacturing	100%	8.3%

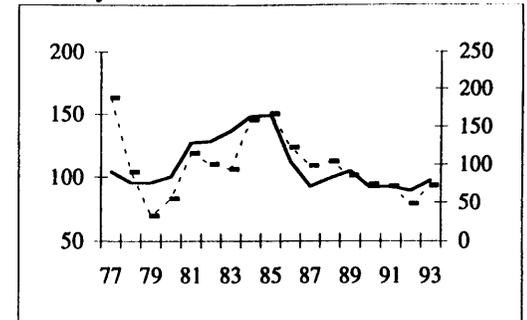
Food and kindred products



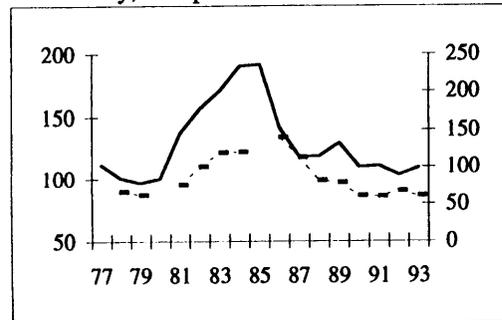
Chemicals and allied products



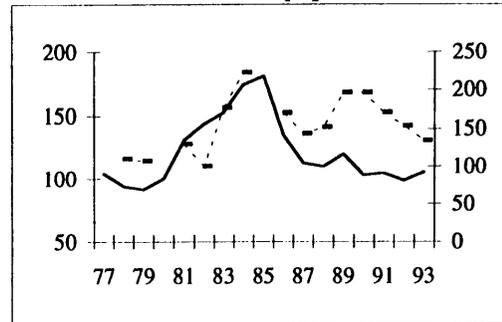
Primary and fabricated metals



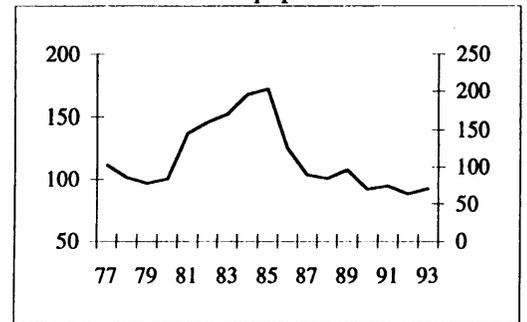
Machinery, except electrical



Electric and electronic equipment



Motor vehicles and equipment



Sources: Bureau of Economic Analysis, Foreign Direct Investment in the United States; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

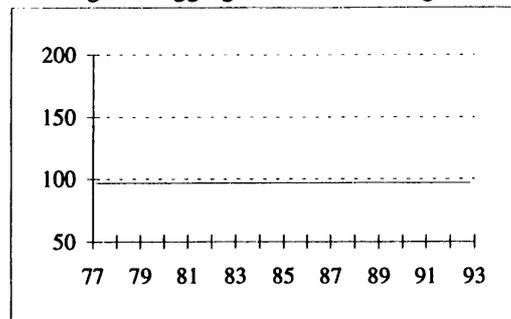
\*: Industry-specific real exchange rate =  $((\text{Foreign Currency Units}/\text{U.S. } \$) \times (\text{Pi}/\text{P}^* \text{i}))$ ; foreign content levels estimated as described in the text.

\*\* : Industry shares are based on affiliates' cumulative sales between 1977 and 1993; foreign content figures shown are for 1982, the base year; na = not available.

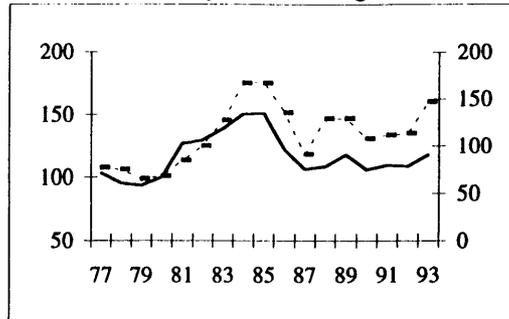
Figure 5F. *Industry-specific real exchange rates and foreign content levels in sales made by the U.S. affiliates of Dutch multinationals, 1977-93*

Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to foreign content levels (set at 100 for 1982)\*

**Unweighted Aggregate Manufacturing**



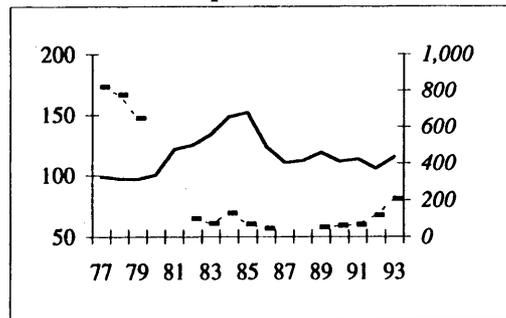
**Affiliates' Industry Shares-Weighted Manufacturing**



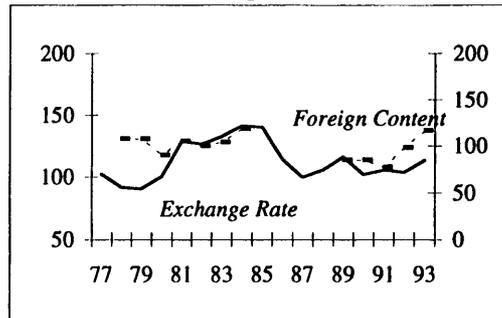
**Industry Shares and U.S. Content in Sales\*\***

Food and kindred	8%	1.5%
Chemicals and allied	45%	2.3%
Metals	3%	7.5%
Machinery, ex electrical (Cont. 1983)	1%	18.2%
Electric and electronic		na
Motor vehicles and equipment	0%	2.0%
Other (not shown here)		-
<b>All manufacturing</b>	<b>100%</b>	<b>7.3%</b>

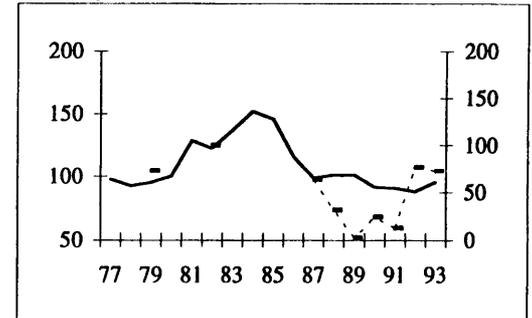
**Food and kindred products**



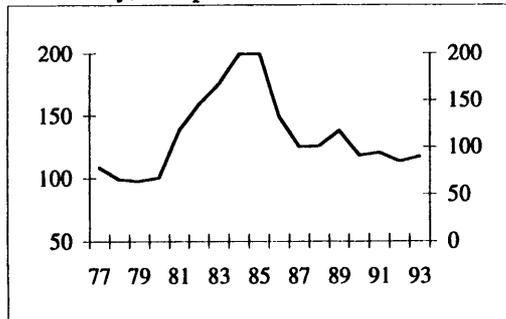
**Chemicals and allied products**



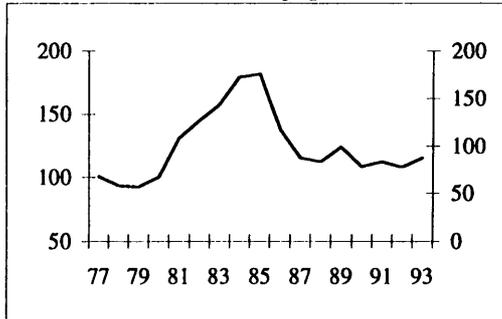
**Primary and fabricated metals**



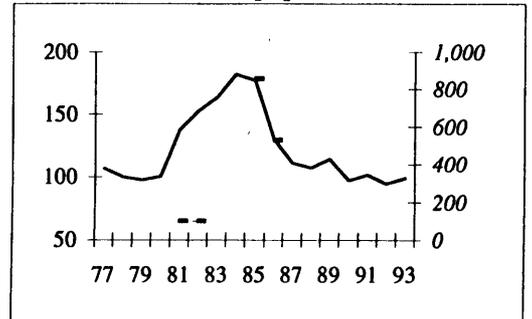
**Machinery, except electrical**



**Electric and electronic equipment**



**Motor vehicles and equipment**



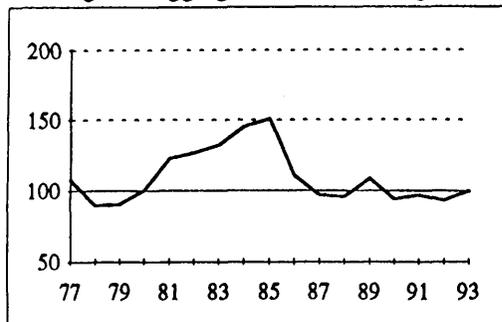
Sources: Bureau of Economic Analysis, Foreign Direct Investment in the United States; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate = ((Foreign Currency Units/U.S. \$) $\times$ ( $P_i/P^*$ )); foreign content levels estimated as described in the text.

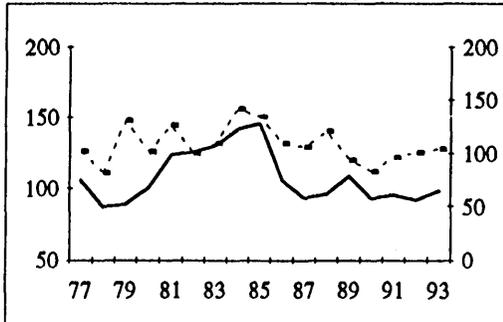
\*\* : Industry shares are based on affiliates' cumulative sales between 1977 and 1993; foreign content figures shown are for 1982, the base year; na = not available.

Figure 5G. Industry-specific real exchange rates and foreign content levels in sales made by the U.S. affiliates of Swiss multinationals, 1977-93  
 Scale on left side and solid line pertain to real exchange rates (set at 100 for 1980); scale on right side and dotted line pertain to foreign content levels (set at 100 for 1982)\*

Unweighted Aggregate Manufacturing



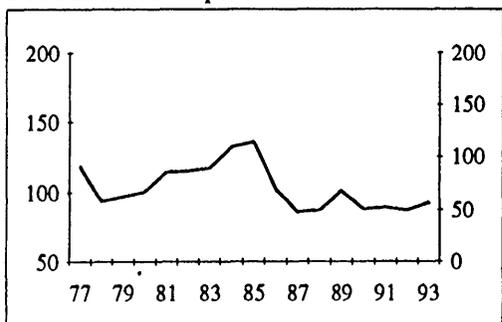
Affiliates' Industry Shares-Weighted Manufacturing



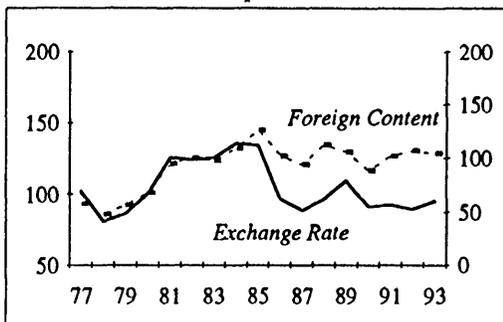
Industry Shares and U.S. Content in Sales\*\*

Food and kindred (Content in 1991)	20%	1.6%
Chemicals and allied	27%	7.9%
Metals (1978)	6%	1.6%
Machinery, ex electrical (1981)	9%	18.5%
Electric and electronic (1981)	6%	29.9%
Motor vehicles and equipment (1987)	3%	7.9%
Other (not shown here)	29%	-
All manufacturing	100%	6.1%

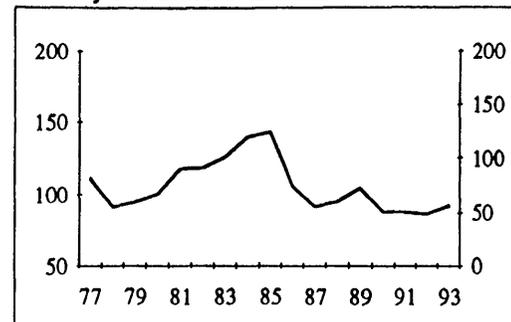
Food and kindred products



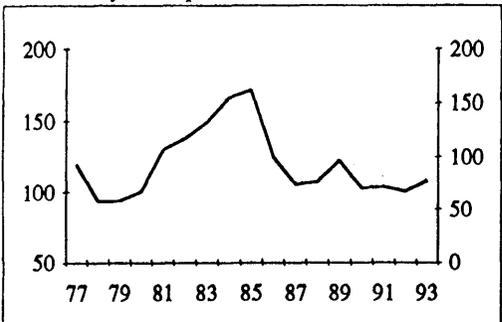
Chemicals and allied products



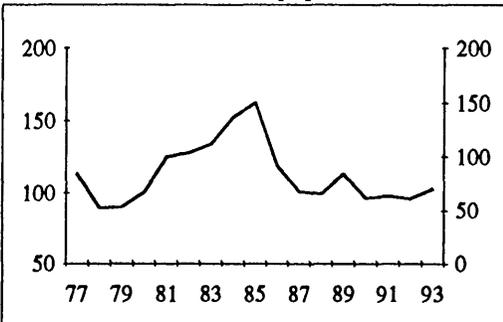
Primary and fabricated metals



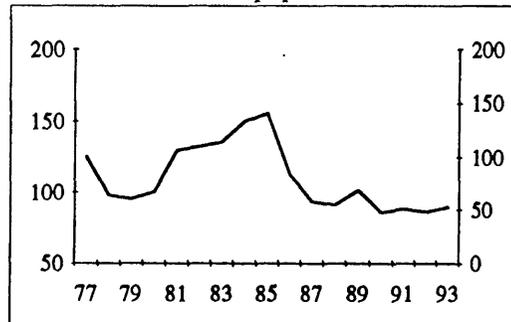
Machinery, except electrical



Electric and electronic equipment



Motor vehicles and equipment



Sources: Bureau of Economic Analysis, Foreign Direct Investment in the United States; IMF, International Financial Statistics; and OECD, Indicators of Industrial Activity.

\*: Industry-specific real exchange rate =  $((\text{Foreign Currency Units}/\text{U.S. \$}) \times (\text{P}_i/\text{P}^*))$ ; foreign content levels estimated as described in the text.

\*\* : Industry shares are based on affiliates' cumulative sales between 1977 and 1993; foreign content figures shown are for 1982, the base year; na = not available.