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Chapter Author: Elias Dinopoulos, Mordechai E. Kreinin

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4 The U.S. VER on Machine Tools: Causes and Effects

Elias Dinopoulos and Mordechai E. Kreinin

4.1 The Machine-Tools VER

In March 1983 the Association for Manufacturing Technology (NMTBA) (the U.S. trade association of machine-tool producers) petitioned the Secretary of Commerce to limit imports of machine tools on national security grounds. A restriction was requested for eighteen types of machine tools, with the objective of limiting imports to 18 percent of domestic consumption. In May 1986, following several years of pressure, President Reagan decided to seek voluntary export restraint (VER) agreements with Japan, Taiwan, Germany, and Switzerland, on several categories that make up half of total machine-tool imports into the United States. In November 1986 he secured a formal five-year agreement (beginning 1 January 1987) with Japan and Taiwan, covering: machining centers, milling machines, lathes (NC [numerically controlled] and non-NC), punching and shearing machines (NC and non-NC). The VER limits were imposed as a fixed percentage of estimated U.S. consumption per category. Although West Germany and Switzerland refused to accept VERs, there was an informal understanding that these countries would not take advantage of the vacuum created by the VERs with the two Far Eastern countries. Table 4.1 indicates the limits on the exports of Japan and Taiwan expressed as a percentage of projected U.S. apparent consumption (in units). As can be seen, the limits vary greatly among categories.

Figure 4.1 displays total machine-tool imports into the U.S. as a percentage of consumption. Imports began growing rapidly around the mid-1970s (coin-

Elias Dinopoulos is associate professor of economics, University of Florida. Mordechai E. Kreinin is professor of economics, Michigan State University.

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Table 4.1 **Limitations on U.S. Machine Tool Imports as a Percentage of U.S. Consumption Under the VER**

	VER as a Percentage of U.S. Consumption		U.S. Apparent Consumption (Units)	
Type of Machine	Japan	Taiwan	1987	1988
NC (numerically controlled) lathes (horizontal & vertical)	57.47%	3.23%	5,897	6,175
Non-NC lathes (horizontal & vertical)	4.81	14.70	4,521	4,827
Machining centers	51.54	4.66	3,806	4,095
Milling machines	3.15	19.29	11,275	11,664
NC punching & shearing	19.25	—	770	704
Non-NC punching & shearing	9.14	—	3,780	4,072

Source: VER Agreement between the U.S. and Japan and between the U.S. and Taiwan.

ciding with the introduction of new computer technologies), but growth ended with the VERs in 1987.

Administration of the VERs was placed in the hands of the two exporting countries. Each year the U.S. government forecasts apparent consumption for the following year and allocates the respective quotas to Japan and Taiwan on this basis. In turn, the government of each of the two countries distributes export licenses to its respective producers. The U.S. customs insists that a certificate endorsed by the Japanese or Taiwanese governments accompany each shipment into the United States.

In the next section we explore the reason why VER protection was given to the machine-tool industry.

4.2 Causes of the VER: The Political Economy of Protection

In recent years there has been a burgeoning professional literature attempting to explain the existence and level of protection in terms of certain features of the protected industry (endogenizing protection). In this section, we explore the awarding of a VER to the machine-tool industry by examining in succession each of the characteristics commonly used in this strand of the literature.[1]

1. *The pressure group model* (associated with Olson (1965) and Pincus (1975)), which states that a small number of firms or high degree of concentration is necessary for an industry to organize itself and lobby for protection, can hardly explain the machine-tool case. The industry consists of nearly thirteen hundred firms, two-thirds of which have fewer than twenty employees

1. The characteristics are those listed in Baldwin (1984, 1989), and Hamilton (1989). For a description of these models see Kreinin (1991, 384–86, and the literature cited in note 5).

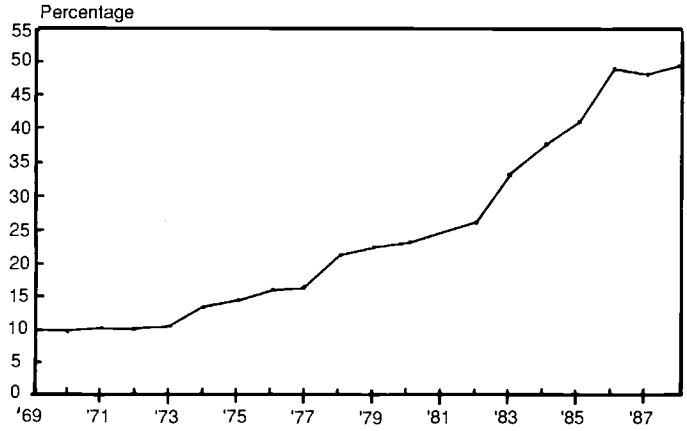

Fig. 4.1 U.S. machine tool imports as a percentage of U.S. machine-tool consumption

Sources: The Economic Handbook of the Machine Tool Industry 1989/90 (Arlington, Va.: National Machine Tool Builders Association, 1990), 127

Table 4.2 Structure of the U.S. Machine-Tool Industry, 1982

	No. of Firms	No. of Employees
A. No. of employees:		
1–49	1,132	12,100
50–499	214	29,200
500–2,500	46	36,300
Total	1,392	77,600
B. Region:[a]		
New England	166	14,590
Middle Atlantic	178	12,100
North Central	669	46,010
South	71	1,630
West	165	2,910

Note: Includes both restricted and unrestricted categories of machine tools.

Source: National Machine Tool Builders Association 1990.

[a]The regional data includes states with 150 employees or more.

each. At the other end of the spectrum, fifteen companies have over a thousand employees; and only one has more than twenty-five hundred employees. The size distribution of firms is shown in table 4.2, A. Not only does the industry consist of many small firms, but American machine-tool builders are known to be fiercely independent (Harvard Business School 1988). And although there is a measure of geographical concentration in the north-central states, the industry is widely scattered throughout the country (table 4.2, B).

In sum, since the industry is made up of many small establishments and spread throughout the continent, it should be difficult to organize according to the pressure group model.

That the industry found it difficult to mobilize for protection is supported by the following quotation concerning its early attempts to seek protection in light of Japanese government targeting of the industry for subsidized development:[2]

> Historically, American machine tool builders were fiercely independent entrepreneurs who sought to avoid government intervention in their business. One of the first cracks in this tradition occurred in 1977 when concerns over rising imports led the NMTBA to look into alleged Japanese dumping. After the Japanese announced a voluntary price floor for their exports, the U.S. Justice Department seized the NMTBA records. Justice was concerned about possible collusion between American and Japanese manufacturers to fix prices. This effectively stalled any further action by the NMTBA until 1980 when the case was dropped.
>
> The next effort to seek government intervention came from Houdaille Industries, one of the makers of NC machining centers bearing the brunt of the Japanese invasion. Fearing the permanent loss of market share and its own demise, Houdaille petitioned the federal government for relief from imported machine tools, claiming unfair competition from a government-subsidized Japanese cartel. Desiring a quick response, Houdaille avoided the better-known legal avenues toward import relief which mandated studies or hearings and routed the petition through slow, deliberative bodies, such as the International Trade Commission (ITC). Rather, Houdaille called upon Section 103 of the Internal Revenue Act of 1971 to deny investment tax credits for purchases of imported machine tools, submitting the brief in June 1982. Fees for the 714-page brief alone cost Houdaille half a million dollars and Houdaille's president, Philip A. O'Reilly, devoted considerable personal effort stumping for the cause.
>
> Section 103 had never before been used. It allowed that the president could exclude foreign goods from eligibility for the investment tax credit if the foreign government had engaged in discriminatory acts. Houdaille argued that the Japanese practice of "industry targeting" constituted due discrimination. Houdaille chose to use Section 103 because, unlike more commonly used remedies in U.S. trade law, it left enforcement entirely up to the discretion of the executive which meant, theoretically, that the president could act on it immediately. Unfortunately for Houdaille, President Reagan decided to defer action indefinitely. Observers speculated that by early 1983 Reagan had decided to reject the Houdaille petition and was simply waiting for the most opportune moment to do so publicly.
>
> The expected failure of the Houdaille petition put the responsibility for a trade initiative back into the hands of the NMTBA. There was considerable debate among the members about whether the industry should request trade restrictions at all; if they did, what kind of trade barriers would be most

2. For an account of MITI's treatment of the industry see Sarathy (1989).

beneficial to the industry; and which administrative routes offered the most promising prospects for success. (Harvard Business School 1988)

2. *The adding machine model,* proposed by Caves (1976), stresses the importance of an industry's size in employment terms in achieving protection. With a grand total of 77,600 employees and value added of $3.3 billions, the industry does not appear to represent sufficient voting strength to secure protection. Machine tools constitute 0.1 percent of GDP in the U.S., 0.6 percent in Germany, and 0.3 percent in Japan.

3. *The adjustment assistance model* was developed by Cheh (1974). According to this model, protection tends to be given to those industries in which it is difficult for workers to move to new jobs with comparable pay. One way to infer the sector specificity of the industry's labor force is to examine the existence and persistence of unemployment in the face of changing employment conditions in the industry. Although there are no hard data, the impression of well-informed observers is (*a*) that there is no persistent unemployment in the industry as workers who lose their jobs find employment elsewhere, and (*b*) that the skills of machine-tool builders translate well into machinist requirements in other industries. Thus there appears no need for adjustment-assistance-triggered protection.

4. *The equity concern model* states that industries with low wages are more likely to obtain protection. Although the average hourly compensation of production workers in the machine-tool industry is lower than that in the heavily unionized industries (such as autos and steel), it is 9 percent above the average for the manufacturing sector. It is also higher than in other countries (if values are converted to other currencies by the 1986 exchange rate). Most important, as column (1) of table 4.3 demonstrates, the ratio of compensation in the machine-tool industry to that in all manufacturing is higher in the United States than in any other major country except Japan. It is difficult to justify protection, and the implied income redistribution toward the industry, on grounds of equity.

Table 4.3 **Average Hourly Compensation, 1986**

Country	All Manufacturing (1)	Non-electrical Machinery (2)	Ratios (2)/(1)
United States	$13.21	$14.38	109%
Canada	11.04	11.43	103
France	10.27	10.69	104
Germany	13.35	13.93	104
Italy	10.01	10.57	105
Japan	9.47	10.82	114
Sweden	12.43	12.13	98
United Kingdom	7.50	7.67	102

Source: National Machine Tool Builders Association 1990.

5. *The international bargaining model,* which was proposed by Helleiner (1977), suggests that in its trade policy the government attempts to influence the policy of other governments. Although the United States has bargained intensely to induce Japan to open up its markets, the sequence of events leading to the machine-tools VER does not point to this model as a motivating factor.

6. *Comparative cost model:* According to this model, industries that lose comparative advantage and face increased import competition are more likely to be given protection (e.g., Bhagwati 1982). Between 1973 and 1987 U.S. unit labor cost (ULC) in metal-working machinery (the industry that includes machine tools) increased by 9.1 percent annually, while that of Japan rose by 6.2 percent. This annual difference of 2.7 percent is higher than in other capital-good industries, including motor vehicles (Yamamoto 1989–90, table 3). It is consistent with the deterioration in the industry's competitive position, which was sharper than that of many other industries (ibid., table 1). The deterioration is also indicated by the decline in U.S. net exports (exports minus imports); the rise in the import penetration ratio (ratio of import to apparent consumption as shown in fig. 4.1); and the decline in the U.S. share of global output and exports (fig. 4.2). This evidence suggests that loss of comparative advantage could constitute a cause for protectionist action.

On the other hand the machine-tool industry produces highly differentiated products that give rise to considerable intra-industry trade. Most industrial countries import as well as export machine tools (table 4.4). Evidently, certain segments of the U.S. industry compete well in international markets, and that factor would lessen somewhat the strength of the comparative cost model as an explanation of protection.

7. *The status quo model,* associated with Lavergne (1983), asserts that protection obtained in the past is positively correlated with present and future protection. Because the industry does not have a history of protection, this model can be rejected as an explanation of the VER accorded to machine tools.

8. *Summary.* With the exception of the comparative cost model, none of the conventional political economy explanations of protectionism fits the machine-tool industry. What is left to consider is the national security argument.

9. *National defense:* As early as the 1940s the U.S. government considered machine tools essential for national defense:

> Machine tools underpin the entire industrial economy by providing tools to make tools. The first item embargoed for sale to Japan by the U.S. in 1940 was machine tools. In 1948, Congress passed legislation to establish a national reserve of machine tools to be used in cases of national emergency, with national defense and security very much in mind. When the Korean War found the U.S. short of critical machine tools, Congress passed a res-

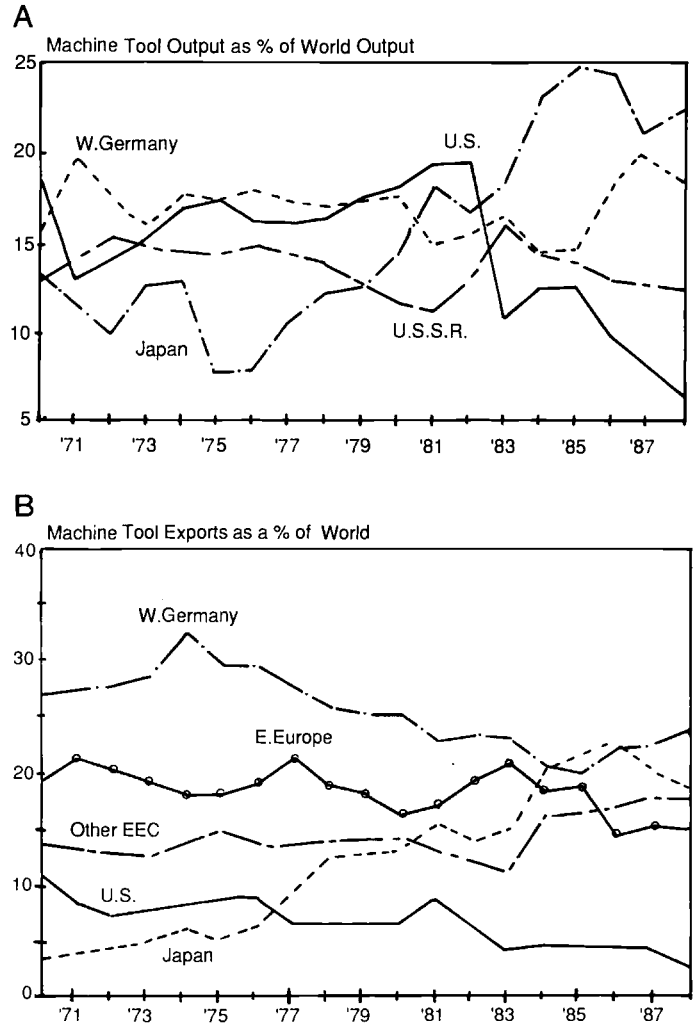

Fig. 4.2 Shares of the U.S. in world output and exports of machine tools
Source: The Economic Handbook of the Machine Tool Industry 1988/89, and 1989/90 (Arlington, Va.: National Machine Tool Builders Association, 1989, 1990).

olution indicating that the U.S. should not be dependent on foreign sources for critical machine tools. (Sarathy 1989, 139)

The original request for protection by the industry and the U.S. government's reason for granting it were explicitly based on national defense arguments. There appears to be little doubt that the industry is important to na-

Table 4.4 **Exports and Imports of Machine Tools, 1983 ($ millions)**

	U.S.	Germany	Japan	U.K.	France	Switzerland
Exports	355	1,440	1,178	263	242	603
Imports	799	348	105	224	330	102

Source: National Machine Tool Builders Association 1990.

tional security. Indeed, the numerically controlled machine-tool technology was first developed under Defense Department sponsored research. And the relation is further highlighted by the well-publicized Toshiba sale to the U.S.S.R. of sophisticated machine tools used for milling quiet propellers to aid Soviet submarines in avoiding detection (Sarathy 1989, 139). Certainly sophisticated machine tools are critical for the aerospace industry, where demands for close tolerance and precision must be met.

National security was used as the determining criterion at each step of the decision to select the particular product lines eligible for VER protection. Following is a direct quotation from a White House press release on the subject, dated 20 May 1986:

> In February 1984, the Secretary of Commerce submitted a report to the President concluding that *imports posed a national security threat in a number of product lines*. The President subsequently asked the Secretary to review his findings in this investigation in light of new planning guidelines being developed by *the National Security Council*. In March 1986, the Secretary of Commerce submitted a report incorporating the new planning guidance. The report concluded that *imports of seven of the eighteen product categories under consideration pose a threat to the national security*. Specifically, he indicated that imports of machining centers, horizontal numerically controlled lathes, vertical numerically controlled lathes, nonnumerically controlled lathes, milling machines and numerically and nonnumerically controlled punching and shearing machines *pose a security threat. These categories account for about half of U.S. machine tool imports*.
>
> The President has determined that we must take steps to *maintain a viable machine tool industry for national security purposes*. He also believes that the industry needs time to make adjustments to improve its competitive position. These adjustments cannot be made with the current level of imports. The President has decided to seek up to a five year program of voluntary import restraint. We anticipate that our trading partners will be willing to cooperate with us to help *maintain a critical element of the U.S. defense base*. (emphasis added)

Note the involvement of the National Security Council in all stages of the deliberations, and that the selection of seven of the eighteen product categories requested by the industry was made on national security grounds.

Thus the comparative cost model in conjunction with the national defense

argument offers the most credible explanation of the machine-tool VER. Although the NMTBA was not formed for the purpose of seeking import protection, its existence facilitated the pressure on the government to negotiate the VERs. Other countries, such as Japan, have similar trade associations. The U.S. recession in the early 1980s resulted in accelerating the deterioration in the industry's competitive position. Output and profits dropped sharply[3] and the import penetration ratio increased rapidly (see fig. 4.1). Between 1981 and 1983 total employment in the industry decreased by 35 percent. These conditions induced the industry to increase its pressure for protection. The NMTBA initiated its petition for the imposition of a VER in March 1983. Consequently, the comparative cost model and the U.S. recession in the early 1980s determined the timing of protection, whereas the industry was perceived to be important on national defense grounds since the early 1940s.

It should be emphasized that the VER was part and parcel of a comprehensive program by the Departments of Defense and Commerce to revive the U.S. machine-tool industry. The program included an undertaking by the Defense Department to integrate the U.S. industry into the defense procurement process by providing advance information of defense needs; research and other subsidies to modernize the industry; and the possibility of antitrust exemption for cooperative research and development effort in the industry.

4.3 Effects of the VERs

4.3.1 Trade Volume

Table 4.5 shows imports into the United States (in units) of machine-tool categories restricted by VERs from the restricted countries (Japan, Taiwan), the threatened countries (Germany, Switzerland), two other major suppliers (the United Kingdom, France), and the world as a whole.

That machine-tool imports are highly cyclical is illustrated by the sharp drop during the recession of the early 1980s, and the recovery after 1983. But the decline in both 1987 *and* 1988 occurred only in the restricted and threatened source countries as well as France. It did not occur in 1988 in the United Kingdom or the world as a whole. At least some of the decline can be attributed to the VER: It reduced the exports to the United States from the restricted and threatened countries, and in 1988 it appears to have caused substitution from the United Kingdom and the rest of the world. U.S. output of machine tools rose from 41,992 in 1987 to 48,668 in 1988. The resulting decline in the U.S. import to consumption ratio of five restricted machine-tool categories is shown in figure 4.3.

3. See National Machine Tool Builders Association (1990, 42, 262), for data on machine-tool shipments and profits.

Table 4.5 VER-restricted Machine Tool Imports Into the U.S. (units)

	Source Country						
Year	Japan	Taiwan	Germany	Switzerland	U.K.	France	World
1980	6,089	11,442	1,118	314	2,683	381	31,133
1981	7,676	9,000	1,123	325	2,331	313	29,884
1982	5,550	5,624	915	336	1,563	159	20,723
1983	4,523	3,572	459	233	1,214	113	13,680
1984	6,995	5,733	756	420	1,455	144	20,423
1985	9,190	7,118	1,235	349	1,778	112	26,270
1986	8,927	6,614	1,179	286	1,994	214	25,158
1987	6,209	4,190	648	268	1,689	199	17,706
1988	5,408	3,788	651	115	2,660	58	18,682

Source: Tabulations supplied by the International Trade Commission.

4.3.2 Unit Value

To assess the price effect of reduced imports into the United States, we used the following procedure. We estimated a price function for the years 1971–86 where the unit value (P) was a function of unit labor cost in manufacturing (ULC) (worker's compensation divided by productivity). Both variables were measured in dollars and transformed into logarithms. The resulting regression is

$$(1) \qquad \log(P) = -4.78 + 1.77 \log(ULC) \qquad R^2 = .94$$
$$(0.12) \qquad DW = 1.43,$$

where the number in parenthesis represents the standard error.[4] This equation was used to estimate a predicted price for 1987 and 1988. The excess of the actual over the predicted price is considered the effect of the VER on the price of machine tools produced by U.S. firms.[5] In 1987 that excess was $11,000, which is 17 percent of the actual price ($64,980). For 1988 there was no significant difference between the two prices. We conclude that the VER produced a substantial boost in the U.S. price but only in the first year of its existence.

How is the price hike reflected in corresponding changes in the export prices of Japan and Germany? Table 4.6 presents export unit values for these two countries. Column (1) includes only the *VER-restricted categories* of machine tools and shows their *export price (in thousands) to the United States* as

4. The prices were calculated from National Machine Tool Builders Association (1990, 93) and from U.S. Department of Commerce series MQ-35W. Unit labor costs were obtained from the U.S. Department of Labor, Bureau of Labor Statistics tabulations.

5. A similar methodology was used in Crandall (1985) and in Dinopoulos and Kreinin (1988). The latter study employed both hedonic regression analysis and time series analysis to calculate the price impact of the auto VER. Both analytical approaches resulted in very similar estimated price increases due to the VER.

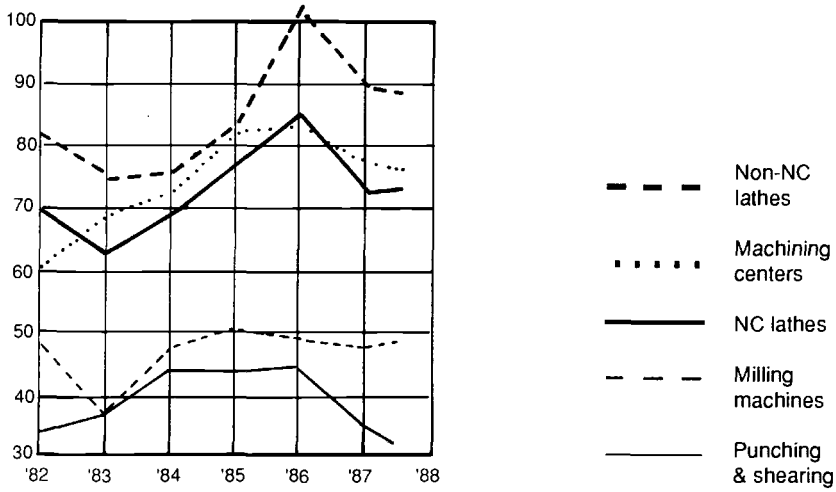

Fig. 4.3 Machine-tool imports in the United States, consumption import market share (percentage)
Source: E. E. Sprow, "Machine-Tool VRA's: Too Little too Late?" *Tooling and Production* (March 1989):64–70.
Note: Unit import share can exceed 100 percent because of reexporting.

well as an index number form (1980 = 100). Columns (2)–(5), presented for purposes of comparison, are in index numbers form and represent exports *to the world as a whole*. Column (2) shows the price index of metal working machinery, a category that contains machine tools. But the effect of the VER is diluted (relative to col. [1]) in two ways: first, column (2) includes many nonrestricted items; and second, column (2) shows export prices to the world as a whole rather than just to the United States. The price increases in all columns since 1985 reflect largely the depreciation of the dollar. It is the *differential percentage change between columns* that may reveal a VER effect (see fig. 4.4).

Between 1986 and 1987 Japan's dollar price of the restricted machine tools exported to the United States, rose by 19 percent,[6] that of metal-working machinery (which contains restricted machine tools) to the world rose by 16 percent, while the prices shown in columns (3)–(5) rose by 11 percent. The eight (19–11) percentage point differential suggests a significant price effect of the VER in the first year that corresponds to the rise in U.S. prices discussed earlier. Similarly for Germany the increase between 1986 and 1987 in column (1) was 43 percent, in column (2), 25 percent, and in the remaining columns 23 percent. Again this suggests a price effect of the VER threat. Thus both

6. Figure 4.5 displays Japanese domestic prices of machine tools in terms of yen, showing a temporary effect of price cutting in the restricted categories relative to overall machine tools. The general price reduction probably reflects a response to the depreciation of the dollar.

Japan and Germany appeared to have restricted their export volume and raised the export price to the United States.

As an alternative approach we estimated a price function for the restricted categories over the years 1971–86 for each exporting country. The export unit value (P) is made a function of unit labor cost in manufacturing (ULC). Both variables are measured in dollars and transformed into logarithms.[7] The estimated coefficients were used to predict the price for 1987 and 1988. The difference between actual[8] and predicted values is considered the effect of the VER. But the only country for which credible results were obtained is Taiwan. The estimated regression for that country is

$$\log(P) = -5.01 + 1.32 \log(ULC) \qquad R^2 = 0.92 \tag{2}$$
$$(0.20) \qquad DW = 1.22.$$

In 1987 the actual price exceeded the predicted price by $2,540, or 25 percent of the actual price ($9,980). For 1988 the excess was $980 which is 10 percent of the actual price ($10,130). This reinforces the earlier conclusion that the VER caused an export price increase in the exporting countries, resulting in a transfer of economic rents from the United States. A similar phenomenon was observed in the case of the auto VER, and indeed it is what economic theory leads us to expect.

One possible reason for the disappearance of the price effect in 1988 (in the U.S. regression) is the increase in Japanese production capacity in the U.S. that circumvents the VER. In the late 1980s Japanese investment accelerated. Added Japanese capacity in 1986–88 amounted to twenty-one plants and created three thousand new jobs, which represent about 5 percent of the industry's total employment. In other words, the Japanese investment share of total domestic employment increased from 2.2 percent in 1985 to 7 percent in 1987 (see *Wall Street Journal*, 8 January 1990, A9B). And the trend continued in 1989. There is reason to believe that a substantial portion of this investment activity was stimulated by the VER.[9]

Another reason for the relatively small price effect of the VER and its temporary nature could be the difference in market structure between machine-tool buyers and sellers. Buyers of machine tools in the auto and other industries are oligopsonists, and the U.S. machine-tool builders are competitive firms. This relative market structure may affect the pricing outcome. The Jap-

7. The unit labor costs were obtained from the U.S. Department of Labor tabulations; the export unit value for 1980–88 from the International Trade Commission and for 1971–79 was calculated from the U.S. Census tabulations of import statistics (*U.S. Import for Consumption* FT246).

8. From the actual prices one can glean an idea of quality and product mix and hence a measure of substitutability between sources of supply. The average export unit values of the restricted categories in 1987, all expressed in thousands of dollars, were Japan, 87; Taiwan, 10; U.K., 17; Germany, 123; France, 45; Italy, 35. In the U.S. the average domestic unit value of all machine tools was $65,000.

9. See, for example, a quotation attributed to Hitachi in Sprow (1989, 67).

Table 4.6 **Export Unit-Value Indexes for Japan and Germany (dollar basis)**

Year	Machine Tools Exported to U.S. (1)	Exported to World: Metal-Working Machinery (2)	Exported to World: Special Machinery (3)	Exported to World: Electrical Machinery (4)	Exported to World: All Manufacture (5)
			Japan		
1980	58 (100)	100	100	100	100
1981	72 (124)	107	104	102	105
1982	75 (129)	107	102	94	98
1983	64 (110)	108	98	90	97
1984	68 (117)	107	103	89	97
1985	69 (119)	110	107	86	97
1986	73 (126)	144	121	106	123
1987	87 (150)	167	131	118	137
1988	90 (155)	—	—	—	—
			Germany		
1980	60 (100)	100	100	100	100
1981	53 (88)	85	84	84	85
1982	61 (102)	89	82	82	83
1983	62 (103)	82	80	80	81
1984	85 (142)	76	74	73	75
1985	60 (100)	77	74	73	75
1986	86 (143)	108	103	100	104
1987	123 (205)	135	127	123	127
1988	92 (153)	—	—	—	—

Notes: Col. (1) includes only the VER-restricted categories of machine tools and gives actual prices, in $ thousands, *of exports to the U.S. by Japan and Germany,* followed by an index (1980 = 100) (information obtained from International Trade Commission). All other columns show unit-value indexes of exports to the world as a whole (from U.S. *Monthly Bulletin of Statistics,* Novermber 1989). Col. (2), "Metal-Working Machinery," includes machine tools. But the impact of the VERs is diluted in two ways. The category is far more inclusive than just the restricted items, and the column shows, relative to col. (1), export prices to the world as a whole rather than just to the United States.

anese machine-tool industry is also competitive (Sarathy 1989, 141, 142), facing an oligopsonist U.S. industry. And that would affect the distribution of *VER rents* between the two countries.

The Congressional Budget Office[10] estimated in early 1987 that the annual quota rents accruing to Japan and Taiwan were $100 million for 1987, 1988, and 1989, assuming a 23 percent increase in export prices due to the VER.

10. See Parker (1987). This study assumes that the VERs were designed to reduce the import value of machine tools to the 1981 share of domestic consumption. Assuming an import demand price elasticity of -1, the study arrives at an estimated 23 percent average quota rent per unit which is used to calculate the VER rent transfer.

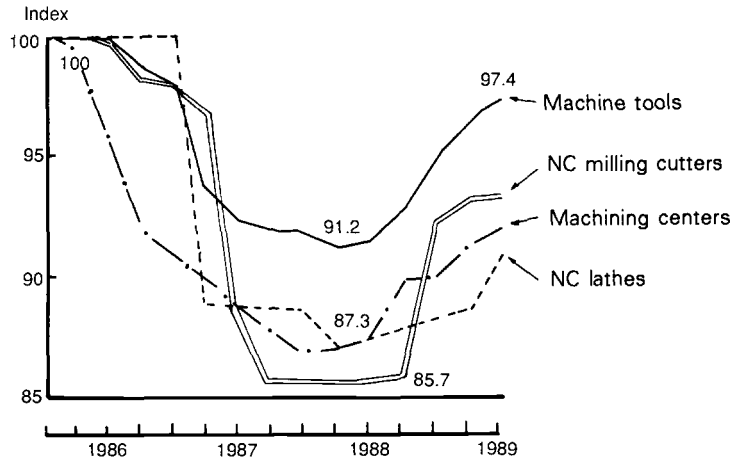

Fig. 4.4 Price changes in Japan expressed in yen
Source: Nikko Monthly Bulletin, June 1989.
Note: Compiled with data from Bank of Japan, "Monthly Report of Price Indices."

Our analysis suggests that the machine tool VER had virtually no effect on export prices beyond 1987 (that is, in 1988). An estimate of VER rents for 1987 is about $110 million for Japan and $10 million for Taiwan, assuming a 20 percent maximum increase in export prices.

4.3.3 Quality Upgrading

Because the VER restriction is applied separately to each of seven categories, quality upgrading can occur only within each category. But data on characteristics necessary to run hedonic regressions (as in the case of automobiles) are not available. So the possible existence of upgrading can be examined only superficially.

Each of the restricted categories contains several seven-digit tariff-line items, and these vary greatly in price. To check for the possible existence of upgrading, we examined the percentage distribution of U.S. imports from Japan within each category to see whether there has been a shift toward the more highly priced items. Examples of two categories are presented in table 4.7. In the first case the results are mixed, while in the second case there has been a noticeable shift toward the higher-priced items. In the other five categories the results are mixed, and no clear-cut picture of upgrading emerges.

But the question of upgrading in the case of capital goods is complicated by the activity-specific nature of the machine, which limits the extent of interitem substitution and hence of upgrading. For example, hardly any substitution is possible between vertical NC lathes and horizontal NC lathes. There is also much information available to the buyers about the specifications of alterna-

Table 4.7 **Percentage Distribution of Quantities of U.S. Imports from Japan within Each Restricted Category**

TSUSA Category	1987 Unit Value	Percentage Distribution of Quantity		
		1984	1986	1987
Machining centers:				
6743404	$88,000	66	61	58
6743406	105,000	3	9	5
6743409	164,000	23	17	25
6743411	82,000	8	13	12
		100	100	100
Milling machines:				
6743464	$128,000	28	53	63
6743467	18,000	29	2	4
6743468	45,000	12	15	3
6743469	52,000	31	30	30
		100	100	100

Source: U.S. Bureau of the Census, *Import for Consumption*, Publication FT246.

tive machines.[11] We conclude that if any upgrading took place, it was limited in scope.

4.4 Conclusions

This paper investigates the causes and effect of the U.S. VER on machine tools negotiated with Japan and Taiwan in 1986 and the VER threat against Germany and Switzerland. The research is less tractable than a similar study of the auto VER (see Dinopoulos and Kreinin 1988) for several reasons. Less information exists for machine tools; the VER was negotiated only for a segment of the industry, for which the data is even scarcer and less well defined than for the entire industry; and the small size of the industry makes the VER effect difficult to capture. Finally, post-VER data are available for only two years, 1987 and 1988.

In terms of the political economy of protection, we show that a plausible explanation of the awarding of protection to a relatively small and geographically scattered industry is the erosion of its competitive position coupled with its perceived importance to national security. All other widely held hypotheses are not applicable to the machine-tools case.

We have shown that the VER resulted in a decline in the import share in the U.S. apparent consumption. The decline was concentrated in the restricted sources, and there was some substitution from nonrestricted sources such as the United Kingdom. During the first year of the VER, U.S. prices of machine

11. Corporate machine buyers often must compare three to seven competitive bids before they make a purchase decision. See Kreinin (1989).

tools rose, as did the prices of exports to the United States by Japanese, German, and Taiwanese supplies. Presumably there was some redistribution from buyers to sellers within the United States as well as a transfer of economic rents from the United States to the exporting countries. Because of scarcity of data, it is difficult to assess the extent of these transfers. But $100 million in 1987 and zero in 1988 is a reasonable estimate. Finally, there is no clear-cut evidence of quality upgrading because of the VER.

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Comment

Kala Krishna

This paper has two goals: First, to use a number of standard models of the political economy of protection in order to say something about why the machine-tool industry might have been successful in obtaining protection. Dinopolous and Kreinin conclude that the erosion of the competitive position of U.S. producers, and the perceived importance of the industry for national security reasons appear to be the reasons for the protection. Second, they seek to say something about the restrictiveness of the quota and the extent of implicit quota rents. Here they point out, as does the Congressional Budget Office study to which they refer, that the size of quota rents depends on demand and supply conditions as well as the form and level of the VER.

Dinopoulos and Kreinin are relatively successful in attaining their first goal but less so in attaining their second one. I shall direct my comments to their second goal, as this best complements Tom Bayard's discussion. I have four broad sets of comments to make on their approach.

First, they model machine tools as being perfect substitutes. This assumption does need some justification, as machine tools are almost certainly differentiated. Each firm typically chooses a niche in the spectrum of products possible. Thus, even the existence of a large number of producers need not guarantee zero profits. A monopolistic competition model or a model of monopolistic competition with a competitive fringe may be more appropriate. Some idea from industry sources on the price-cost margins typical for the industry, as well as the extent of product differentiation, would help in choosing the model.

Second, they argue that as the VER is in terms of market share, it does not bind when demand shifts out *if* the supply curve of the restricted suppliers is steeper than that at home. The argument seems plausible since in this case a price increase leads to a small response from foreign suppliers but a large one

Kala Krishna is associate professor of economics at Harvard University and a faculty research fellow at the National Bureau of Economic Research.

from domestic suppliers, the combination of which would make the VER nonbinding. In an appendix to their paper, they use a linear supply-and-demand model of homogeneous products to try to show this. They show that if b and b^* are the slopes of domestic and foreign inverse supply, and a and a^* are the intercepts, and inverse demand has an intercept of M and slope of $-K$, and

$$b^* > \frac{(1 - R)b}{R}, \tag{1}$$

then for any given R, where R is the market share to which foreigners are restricted, the VER would not bind if demand increases. Unfortunately, their argument is not complete. This is most easily seen in a counterexample given in figure 4C.1. Depicted in this figure are domestic demand (D), domestic supply (S), residual domestic demand ($RD = D - S$), and foreign supply (S^*).

The intersection of S^* and RD gives the free trade price and quantity, P^F and Q^F. The line $\theta^F S^F$ emanating from the intercept of S and through the intersection of S^* and RD gives the free trade market share of imports. If this is to the right of foreign supply at a given price, foreign supply is not restricted by the VER at that price. If it is to the left of it, foreign supply is restricted. In figure 4C.1, domestic supply is flatter than foreign supply, yet a VER at the free trade level only constrains foreign supply for prices above P^F. Thus, an outward shift in demand, and hence in residual demand, makes the VER bind.

Diagrams such as figure 4C.1 show that when the price (y-axis) intercepts are the same, the VER always binds if $R < R^F$, independent of their relative slopes, and does not ever strictly bind if $R \geq R^F$, even when demand shifts outward. If the U.S. supply has a higher intercept, then outward shifts in demand do not make a VER at the free-trade level bind. If the opposite is true, as depicted in figure 4C.1, outward shifts in demand do make the VER bind. This suggests that the result that an outward shift in demand makes the quota bind depends on the relative intercepts of the supply curve and is *independent* of their relative slopes.

The argument given by the authors in the appendix is that, when *starting* from the free trade equilibrium, the VER is ineffective when demand shifts outward. This gives them the result in equation (1). However, as this expression is only valid *at* the free trade equilibrium, it is only valid if R is set *at* the trade level. Using their linear model, it can be shown that at free trade

$$\frac{1 - R}{R} = \frac{b^*(m - a) - K(a - a^*)}{b(m - a^*) + K(a - a^*)} \tag{2}$$

From this it is easy to show that for $R \in (0,1)$ equation (1) holds if $a > a^*$.

This odd result, even for the linear case (homogeneous goods) and competition, suggests that with market share restrictions, the whole shape of the

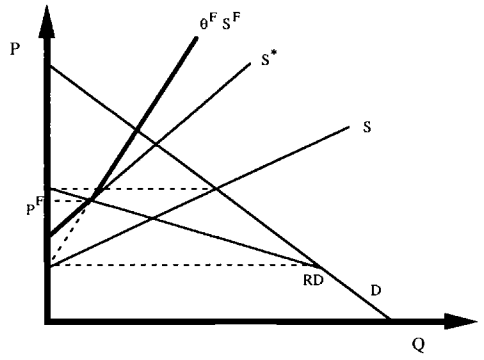

Fig. 4C.1

domestic and foreign supply curves is likely to be relevant and points out the need for care in the analysis.

The third, and most serious, reservation I have about the paper has to do with the econometric specification used. What is the regression of price on a constant and unit labor costs for each country meant to capture? It is *not* a supply curve assuming that marginal costs are upward sloping as quantity supplied does not enter. If it is assumed that marginal costs are constant and equal to price, and products are homogeneous, then only the lowest cost country would be producing, so this interpretation also fails.

A possible interpretation might be that it is the reduced form of the simultaneous equation system. It is clear that a simultaneous equation model is needed here, as a simple supply function cannot be estimated. This is because exchange rate changes affect the foreign supply curve, shifting it around, while at the same time demand shocks shift demand around so that equilibrium prices and quantities trace out neither demand nor supply.

As this regression is run for each country separately, a differentiated product model seems to be what is being used. In such a model the marginal cost (i.e., the inverse supply) from each country would depend on factor prices in the supplying country converted into dollars, as well as the *total* amount supplied by the country. Demand for each country would depend on all prices charged and on the aggregate demand conditions in the U.S. Thus, a reduced form equation system would involve not only unit industry labor cost of the supplying country and the bilateral exchange rate but also the unit costs of all other countries, their bilateral exchange rates, and aggregate demand in the United States at the very least. It would be worthwhile specifying such a system carefully and implementing it to cover the kinds of questions their paper addresses. Since their specification lacks a number of elements, it is hard to take their results on implicit quota rents very seriously.

Fourth, other pieces of evidence they look at are worth mentioning. They

suggest that there was a decline in import share in 1985–87. This could be due to the high yen, so that Japanese supply shifted inward rather than because of the VER. The evidence presented in table 4.7 of the paper is also interesting and suggests that there *were* some effects of the VER. This kind of analysis, given the limited data available to the authors, is very worthwhile. Also, if data is really so limited, it might be worthwhile to use the structure imposed by calibration models in addition to the econometric models that are, of course, to be preferred in ideal circumstances.

To conclude, the authors look at interesting policy relevant issues. For this reason, if no other, it is to be hoped that this study will be improved on in subsequent work.

Comment Thomas O. Bayard

This is an excellent and valuable study. The case of machine tools is fascinating because it is one of only two industries (the other is oil) where imports have been found to "threaten to impair national security" under the terms of section 232 of the Trade Expansion Act of 1962. This study is the first rigorous, independent empirical analysis of the impact of the VER that was negotiated to reduce the threat to national security. It will be valuable to policymakers because they are likely to face industry demands to renew the VER when it expires in late 1991. The authors' methodology is the best available, given data limitations, and their results can be readily updated if the question of renewing the VER arises.

As valuable as the paper is, I was disappointed that it did not address two central policy questions: (1) Did machine-tool imports really pose a significant threat to national security? (2) If so, was the VER the best policy instrument to reduce the security threat? I am not an expert on this case and cannot answer these questions definitively, but I would like to provide some factual information and sketch an approach that will help answer these questions.

Did Imports Pose a Threat to National Security?

Richard Hooley has written an invaluable case study of the government's decision to seek a VER for machine tools.[1] Based on his description, it appears to me that there was a valid national security concern in this case.

In planning for war, the Department of Defense (DOD) seeks assurance that

Thomas O. Bayard is deputy director and a research fellow at the Institute for International Economics.

1. R. Hooley, "Protection for the machine tool industry: Domestic and international negotiations for voluntary restraint agreements," Graduate School of Public and International Affairs, University of Pittsburgh, Case Studies in International Negotiation no. 13 (1987).

it can acquire the additional equipment it needs, when it needs it. This ability to acquire military goods quickly is called surge capacity. The usual military planning scenario assumes two simultaneous conflicts—for example, a major war in Europe and a smaller conflict in the Middle East. DOD runs its production requirements through a detailed input-output matrix to find input needs, which are compared with existing input supplies and productive capacity.

DOD planners did this exercise for machine tools and found that the domestic industry did not have adequate surge capacity. They then calculated how much consumption could be supplied by imports from Europe, Taiwan, and Japan. Much of the debate over whether to assist the industry revolved around the reliability of import supply during wartime. In the end, it was the joint chiefs of staff who swung the decision in favor of assisting the machine-tool industry on the grounds that the military could not guarantee adequate import supplies during war.

Based on the available information, there appears to be a reasonable national security argument for somehow maintaining domestic capacity. The next issue to be considered is the selection of the best policy instruments to achieve this objective.

How Is the National Security Goal Best Achieved?

The optimal form of policy intervention to achieve a desired surge capacity will probably depend on specific characteristics of the industry. In general, however, we know from studies by Bhagwati and Srinivasan that the most efficient way to achieve the policy objective is to select policies that affect the goal most directly.[2] In what follows, I pose a series of questions that seek to identify the appropriate policy objective and hence optimal policy.

First, what is the binding constraint on surge capacity? In the machine-tool case, for example, was the constraint the availability of tools for production of military goods, or was it the availability of skilled machinists to produce machine tools?

If the binding constraint was the availability of machine tools, a second-level question needs to be answered. How much substitutability is there between machine tools used to produce civilian and military goods? If there is substantial civilian-military substitutability, optimal policy would be an investment subsidy, perhaps a special investment tax credit, for imported and domestically produced machine tools used in the United States. Apparently, direct investment subsidies were not considered, but the president did provide technical assistance and modest ($5 million per year) support for research and development in the machine-tool industry. If, however, there is little dual use

2. See J. N. Bhagwati and T. N. Srinivasan, "Optimal intervention to achieve non-economic objectives," *Review of Economic Studies* 36 (1969): 27–38, and T. N. Srinivasan, "The national defense argument for government intervention in foreign trade," in *U.S. Trade Policies in a Changing World Economy*, ed. R. M. Stern (Cambridge, Mass.: MIT Press, 1987).

of machine tools, optimal policy would be to stockpile tools for military production. Stockpiling of machine tools has occurred in the past, but apparently was not considered an option in this case. It takes several years to train a skilled machinist. If the constraint on surge capacity is the availability of skilled labor, optimal policy would be a wage subsidy for machine-tool operators.

On the surface, at least, the VER appears to be a very costly way to maintain surge capacity, since it taxed industrial users of machine tools and thus raised production costs throughout the economy. There are several possible reasons the VER was chosen. First, while subsidies and stockpiling are more cost effective than export restraints, their costs would be included in the military budget. VERs, by contrast, are "off budget" since their costs are borne by consumers. The military and the industry would undoubtedly prefer to keep the costs off budget and less visible to taxpayers, albeit at higher social cost.

A second possible explanation for the VER is suggested by the authors' remark that the export restraint may have ceased to be binding by the second year due to increased foreign direct investment (FDI) in the machine-tool industry. It is possible that the decision to employ a VER was intended to encourage FDI in the industry. As Graham and Krugman point out, protection does not necessarily induce FDI.[3] But, to the extent that it biases the economy toward the production of goods in which foreign firms have a competitive advantage, it may encourage foreign investment. American policymakers had the experience of VER-induced foreign investment in the television and auto industries and may have hoped for the same result in the machine-tool industry. In any event, the VER may well have been a reasonably cost-effective way to increase surge capacity, since it encouraged efficient and innovative foreign producers to quickly invest in the United States. Moreover, as in the case of autos, the presence of foreign-owned machine-tool producers in the United States may provide a valuable demonstration effect for U.S.-owned firms on how to become more efficient.

Although national security cases have been rare in the past, there may be more in the future, despite the reduction in East-West military competition. The most likely future cases are in the high technology area, particularly in super computers and high definition television. If so, the Dinopoulos/Kreinin study will be a valuable model of how national security policy toward imports can be subjected to rigorous economic analysis.

3. E. M. Graham and P. R. Krugman, *Foreign Direct Investment in the United States*, (Washington, D.C.: Institute for International Economics, 1989).