Economics of Arms Reduction and the Peace Process
W. Isard and C.H. Anderton (Editors)

Chapter 5

ON MODELING THE IMPACT OF ARMS REDUCTIONS ON WORLD TRADE

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[The basic work of Polachek focusses on fundamental aspects of the general relation between trade and political conflict. But at any particular point of time, major shocks in the world economy may occur which can lead to drastic change in trade among many countries. Such was the oil shock of 1973 Today, the shock is the demise of the Warsaw Pact Organization and the economic collapse and democratization (political demise) of the old Soviet totalitarian regime.

As we have seen, Klein/Gronicki/Kosaka have addressed the impact of arms reduction in Eastern European countries and the Soviet Union upon their internal economies. But it is also important to examine the impact of major arms reduction in a number of Western powers upon trade in general While neoclassical and Keynesian theory suggest several different kinds of effects that may come about, Bergstrand looks to empirical materials to identify: (1) the relation of arms trade to aggregate trade; (2) the relation to nonarms trade of the share of real GDP going to military expenditures in importing and exporting countries; and (3) the economic determinants of arms trade. (eds.)]

5.1 Introduction

The historic opening of the Berlin Wall in East Germany in 1989 and subsequent developments in Eastern Europe and the Soviet Union in 1990 have motivated proposals for future substantive reductions in military expenditures in the United States and the USSR, as well as in many of their respective allies. The potential economic implications of large changes in the volume of arms spending are extensive and complex. For instance, the 9.0 percent and 7.6 percent increases in real military expenditures in the United States in 1982 and 1983, respectively, have been given some credit for raising the U.S. economy from the trough of the 1981-1982 recession, and the strength of the subsequent U.S. economic expansion. But these military expenditure increases have also been partially credited for the substantive enlargement of the U.S. federal budget and international trade deficits.

Military expenditures have long been considered to be economically intertwined with world trade. The *SIPRI* (Stockholm International Peace Research Institute) *Yearbook* reports regularly on arms trade. Recent yearbooks note that the total world volume of arms transfers have flattened in the past decade. This flattening was not attributed to international detente but rather to "serious economic problems currently experienced in the world, particularly in the Third World." (SIPRI 1984; p. 175, italics added). Thus, political and economic factors jointly influence the amount of military spending and arms trade.

The purpose of this paper is to offer one approach toward modeling the impact of arms reductions on the volume of world trade. Section 5.2 describes the motivation for the methodology pursued. Section 5.3 briefly outlines some theoretical issues underlying the methodology, although technical details will be omitted here. Section 5.4 summarizes the methodology. Section 5.5 describes the data. Section 5.6 details the empirical results for aggregate and non-arms trade. Section 5.7 details results for arms trade. Section 5.8 provides conclusions and policy implications of the results.

5.2 Motivation

Recent events in Eastern Europe and the USSR have generated proposals for substantive reductions in military spending by the United States, the USSR, and their allies. Both the Bush Administration and the U.S. Congress have proposed cuts in defense spending over the 1990s, with the latter proposing significant decreases in real terms. NATO has revamped its defense strategy in light of these events. On the assumption that there is no reversal of such developments, what implications do these potential arms spending reductions portend for world trade? At first, one might expect that fewer resources devoted to arms implies more resources available to produce and export non-arms commodities, including consumer and investment goods. Such an argument suggests a decrease in world arms trade but an increase in world non-arms trade; aggregate world trade need not change. To the extent that resources are diverted to investment in non-military plant and equipment, the possibility for enlarging world production and aggregate world trade is enhanced. Also, to the extent that uncertainty and economic and political trade barriers are reduced, world trade should be enhanced.

However, consider the alternative argument. If defense spending reductions are concentrated in research and development (R & D), such cuts could have a negative impact on private commercial research and development, such as high-definition television and x-ray lithography (see *N.Y. Times*, November 16, 1989).

Reductions in military spending of this type would induce declines in nonmilitary production and investment in plant and equipment, would tend to reduce world production, and might well diminish world trade.

Empirical evidence on the benefits to (nonmilitary) productivity of military expenditures is mixed. Henderson (1990) notes that cross-country comparisons of industrialized economies suggest that military spending and productivity growth are negatively related, supporting the notion that defense cuts could spur world production and trade in the long run. However, time-series studies have shown that the slowdown in productivity growth and the decline in military expenditures' share of output have coincided, using data prior to the 1980s, suggesting that defense cuts might curtail world production and trade in the long run.

Recognizing that political and economic influences on trade might well be highly "complementary," Summary (1989) estimated the effect on U.S. non-arms trade of certain political factors -- namely, actual arms transfers with each trading partner, an index of the degree of political freedom in the trading partner, the number of civilian U.S. government employees in the trading partner, and the number of foreign agents of the trading partner registered in the United States -- after taking into account important economic considerations. The economic factors expected to influence U.S. non-arms exports to (imports from) country j were j's gross domestic product (GDP), j's population, and the distance between the economic center of the United States and country j -- economic variables that typically compose a "gravity equation" in international trade, which will be discussed in Section 5.4.

Summary (1989) found that U.S. non-arms exports to country j in 1978 and 1982 were significantly related to economic variables that typically explain trade flows, but were also significantly related to some of the political variables. On the economic side, U.S. non-arms exports to j were (significantly) positively related to j's GDP as a proxy for j's expenditure capability and negatively related to the distance between the United States and country j as a proxy for transportation costs. On the political side, U.S. non-arms exports were positively related to arms trade between the two countries, the number of civilian U.S. government employees in j, and the number of j's agents registered in the United States, reflecting the "complementarity" between political and economic interests shared by the countries.

Summary (1989) found that U.S. non-arms imports from country j in 1978 and 1982 were also significantly related to both traditional economic and the novel political variables. On the economic side, U.S. non-arms imports from j were (significantly) positively related to j's GDP as a proxy for j's production capacity and

negatively related to the in distance as a proxy for transportation costs. On the political side, U.S. non-arms imports from j were positively related to arms trade between the two countries and the number of j's agents registered in the United States, reflecting again the "complementarity" of political and economic interests shared by the countries.

The results in Summary (1989) imply that the volume of world trade may be significantly reduced by a decline in arms trade. These results also *suggest* that reductions in military expenditures may well lower the volume of non-arms, as well as arms, trade flows.

As a first step toward evaluating the potential impact of arms reductions on world trade, consider the relative magnitudes of world arms and world aggregate (merchandise) trade. According to the SIPRI (1984), the value (in current prices) of world exports of major weapons in 1983 was estimated at $34 billion. However, the value (in current prices) of world exports of all goods in the same year was estimated by the IMF at $1682 billion. According to these estimates, arms trade makes up only 2 percent of world trade.

Consider also the relative magnitudes of world military expenditures and world GDP. Because of an absence of reliable data on world GDP, consider the 24 countries composing the Organization for Economic Cooperation and Development (OECD), most of which are also in NATO. OECD military expenditures in 1981 (in current prices) were estimated at $320 billion. OECD nominal GDP in 1981 was $7617 billion. Thus, military expenditures make up only 4 percent of OECD total expenditures.

Such figures are considerably below comparable U.S. magnitudes. U.S. major-weapons exports in 1983 (in current prices) were estimated by SIPRI at $13.4 billion, which was almost 7 percent of its aggregate merchandise exports of $201 billion. U.S. military expenditure of $225 billion in 1983 estimated by SIPRI was also almost 7 percent of its gross domestic product of $3356 billion. Thus, studying U.S. exports and imports alone as in Summary (1989) might bias somewhat the effect of arms spending reductions on arms and non-arms trade.

5.3 Theoretical Issues

One approach to consider in analytically understanding these ramifications is a conventional synthesis of (short-run) Keynesian and (long-run) neoclassical frameworks. In the short run, arms spending reductions would (ceteris paribus) reduce aggregate demand in the U.S. economy. The fall in aggregate demand for military goods would tend to reduce employment and prices in this sector (or, in a

dynamic context, slow their inflation rate). The fall in employment and national income in the short- and medium-run would tend to reduce aggregate demand for consumption and investment (non-military) goods. Prices for these goods would tend to fall, tending to lower the general level of prices in the U.S. economy. Real and nominal GDP would tend to be depressed. Some firms producing military goods and others producing non-military goods would go out of business. Interest rates would decline as the supply of Treasury securities to the market is curbed, as money demand slows due to the slowing of national spending, and as the real money supply expands as prices (or the inflation rate) fall.

In the long run, however, the fall in interest rates will stimulate aggregate demand, tending to restore employment and output. The interest rate decline will make consumer durable purchases and investment in plant and equipment cheaper by lowering the cost of capital. Real GDP will tend to be restored to its level preceding the military expenditures cut, with a smaller share of output in military-goods-producing industries.

The reason for ambiguity surrounding the new long-run real GDP level is the uncertain impact of the changed composition of real GDP on its level. The lower cost of capital should raise private investment in plant and equipment. The additional capital available to each worker should make each laborer more productive, enlarging world production (i.e., non-arms production rises more than proportionately to the fall in arms production).

However, as noted earlier, if most military spending cuts are on R & D which has strong "spillover" effects on the civilian economy, long-run real GDP could decline. Military (and space) R & D have made important contributions to the commercial jet aircraft, computer, semiconductor, communications, and nuclear power industries. These contributions have taken the form of spillover of the research itself as well as cost reductions generated by economies of scale in the application of the R & D, the sharing of manufacturing facilities for civilian and military products, and learning curves. Consequently, large military R & D expenditure cuts could tend to raise private production costs, such that non-arms world production would rise less than proportionately to the fall in arms production, decreasing world production on net.

Consider now the international trade implications of reduced military spending in a major arms producer and exporter, such as the United States.[1] Exports of arms will likely decline, as the level of military spending in a major arms supplier is probably an important determinant of its arms exports. However, the volume of non-arms exports is likely to rise. There are several reasons for this. Foremost, the consequent lower cost of capital (discussed earlier) will tend to raise non-arms production and their potential export supply. Second, as private investment

enlarges the capital stock, raising the capital available to each worker, the production and export supply of non-arms goods will tend to increase, if such goods are capital intensive in production. Third, the defense industry is widely believed to be more "concentrated" than most other industries. A smaller share of national output in defense is likely to lower the costs of production in the exporting country, making the costs of non-arms production less relative to foreigners, expanding non-arms exports. If less military spending lowers the relative costs of production vis-a-vis other nations, this is tantamount to a real depreciation of its currency, or an increased international competitiveness. Complementing this last channel, suppose military spending is largely on nontradable items. Some economists view the real exchange rate as the relative price of tradables to nontradables. Reduced military spending by the exporter will lower the relative demand for nontradables, raising the relative price of tradables to nontradables, which is tantamount to a real depreciation of the exporter's currency, tending to increase non-arms (tradables) exports. Moreover, to the extent that the exporter's interest rate declines, this would generate a net capital outflow, a nominal depreciation of its currency, and a further real depreciation. All of these influences suggest reduced military spending will tend to augment non-arms exports.

On the other hand, some factors suggest non-arms exports might decline as military spending is cut. First, in the short run, military spending reductions diminish arms and, via the multiplier, non-arms output, tending to contract non-arms export supply. Second, if military spending cuts curtail important spillovers for civilian production, the rise in non-military production costs will tend to reduce production and export supply of non-arms goods. Third, as arms exports decline, the "tie-in" with non-arms goods will tend to reduce non- arms exports.

Note that this Keynesian/neoclassical framework ignores the dynamic potential for "free trade pacts" arising as an outgrowth of reduced political-military uncertainty. In fact, some trade pacts have already been signed to reduce artificial trade barriers between Western and Eastern European economies. Two years ago, the European Community (EC) signed trade pacts easing trade barriers bilaterally between members and Hungary and Czechoslovakia. Such an agreement was reached in November 1989 with the USSR. Since these pacts are similar to the pact between EC members and members of the European Free Trade Association (EFTA), it is likely that trade flows will be enhanced significantly as such pacts proliferate at the same time that arms reductions spread. There exists strong empirical evidence that custom unions and free trade areas significantly enhance trade flows.

Now consider the import side. The seemingly most prominent importers of arms are Third World countries. Almost 70 percent of USSR arms exports are to these

countries. But only half of U.S. arms exports are to the Third World; the other half is supplied to other industrialized countries. Reductions in military expenditures will reduce the imports of arms by these countries from the major suppliers.

The impact of military spending reductions in a country on its non-arms imports is also ambiguous, although there are several reasons to suggest that such reductions will diminish non-arms imports. Foremost, the consequent decline in interest rates and the cost of capital from lower aggregate demand will tend to raise non-arms production in the long-run, thus decreasing import demand for non-arms goods. Second, as military spending reductions curtail the relative costs of production vis-a-vis trading partners, due say to less "concentration" in the importer, relatively cheaper domestic non-arms production will be substituted for foreign non-arms production, lowering non-arms import demand. Complementing this channel, if military spending is largely on nontradables, military expenditure cuts will lower nontradables prices, raising the relative price of tradables to nontradables. This real depreciation of the importer's currency will tend to curtail non-arms import demand. Moreover, to the extent that the importer's interest rate declines, this would generate a net capital outflow, a nominal depreciation of the importer's currency, and a further real depreciation. Also, as arms imports are curbed, "tie-ins" will lead to accompanying reduction in non-arms import demand. All of these influences suggest reduced military spending will tend to diminish non-arms imports.

However, non-arms import demand could rise with reduced arms expenditures. If non-arms production rises more than proportionately to the fall in arms production, say because of greater productivity of workers, import demand for non-arms goods may rise on net, if the "income effect" dominates the "substitution effect."

As before, however, arms reductions will likely be accompanied by the creation of more "trade pacts." The proliferation of such preferential trading arrangements will tend to enhance the volume of non-arms world trade by stimulating import demand.

5.4 Methodology

The effects of arms reduction on world trade are estimated here with a frequently used empirical approach, like in Summary (1989). World trade flows between pairs of countries in any given year have long been explained empirically in the international trade literature using a reduced-form function commonly referred to as a "gravity equation." Walter Isard (1954a,b) first suggested the suitability of a gravity-like model for analyzing international trade flows. Tinbergen (1962) first

applied a gravity equation to cross-sectional bilateral trade flow data; Linneman (1966) extended Tinbergen's work.

The typical gravity equation in international trade is estimated using the formula:

$$PX_{ij} = (\beta_0)Y_i^{\beta 1}Y_j^{\beta 2}(Y_i/N_i)^{\beta 3}(Y_j/N_j)^{\beta 4}D_{ij}^{\beta 5}R_{ij}^{\beta 6}e_{ij} \qquad (5.1)$$

where PX_{ij} is the U.S. dollar value of aggregate imports of country j from country i, Y_i (Y_j) is the U.S. dollar value of gross domestic product in country i (j), N_i (N_j) is population in country i (j) so that Y_i/N_i (Y_j/N_j) is per capita GDP, D_{ij} is the distance from the economic center of i to that of j, R_{ij} is any other factor(s) either aiding or resisting trade between i and j, and e_{ij} is a log-normally distributed error term. The log-linear version of this equation is usually estimated by ordinary least squares (OLS).

Several authors recently have provided formal microeconomic foundations for this equation in the context of either a Cobb-Douglas expenditure system (cf., Anderson, 1979), a general equilibrium model of imperfect competion (cf., Helpman and Krugman, 1985), or a neoclassical factor-proportions model (cf., Bergstrand, 1985 and 1989). In my work, exporter and importer GDP's can be interpreted as exporter i's productive capacity and importer j's expenditure capacity, respectively. Exporter i's per capita GDP can be interpreted as i's capital-labor endowment ratio[2], a higher exporter per capita GDP will tend to be associated with a higher (lower) level of exports from i to j if the bundle of goods is capital (labor) intensive in production on average. Importer j's per capita GDP influences its demands; a higher importer per capita income will tend to be associated with a higher (lower) level of imports to j from i if the bundle of goods are luxuries (necessities) on average. Distance between i and j can be interpreted as transportation costs. R_{ij} represents a number of factors that can aid or retard trade between the two countries, including measures of price competitiveness, custom unions or free trade agreements, and -- as Summary (1989) showed -- political factors that might enhance or deter trade.

In my previous work, I have emphasized that measures of relative price competitiveness can be important determinants of bilateral trade flows in cross-section gravity models of international trade, as relative wage levels have been found to be important determinants of migration flows in that literature. However, here such indices are suppressed to focus on these other issues and to be able to relate my results to those in Summary (1989). Yet, I will show how measures of the importance of military expenditures in countries may well be representing their relative cost structures, and hence their relative international competitiveness.

In this study, GDPs, per capita GDPs, military expenditures as a share of GDP, and some other minor variables are considered as factors potentially influencing arms and non-arms world trade flows. First, I reexamine the Summary (1989) hypothesis that the level of arms trade between two countries influences their level of non-arms trade. In light of the observation made earlier that world arms trade is a much smaller share of world trade than U.S. arms trade is of U.S. aggregate trade, I consider 272 bilateral trade relationships among 17 OECD countries. Summary (1989) found that U.S. non-arms exports to (imports from) various trading partners was significantly positively related to the level of arms transfers between them, implying that military and economic interests were tied. Ideally, one would want to consider whether this relationship between arms and non-arms trade held for a wide sample of bilateral trading relationships. Unfortunately, disaggregate bilateral trade data on arms shipments is unavailable for most of the world. However, the OECD publishes bilateral trade flows for members for Standard International Trade Classification (SITC) 95, War Firearms and Ammunition Therefor -- the only category reflecting arms trade. Thus, the first set of results examines this relationship for several OECD countries.

Second, I examine more directly the link between military spending and non-arms trade flows. Since previous empirical analysis of bilateral trade flows in cross section suggests that the level of exporter i's and importer j's real GDPs are key determinants of the trade flow from i to j, I examine whether the share of military expenditures in national expenditures as well as per capita income in the two countries might influence non-arms trading behavior.

Third, I examine the economic determinants of arms trade. While analysts have recognized that economic factors influence arms trade, I formally estimate how much variation in arms trade flows can be explained by purely economic factors, using a gravity equation. Surprisingly, as much as a quarter of the variation in these flows across countries can be explained by economic determinants.

5.5 Data Considerations

Since data on bilateral arms trade flows is reported only by OECD countries, I limit the analysis here to 17 OECD countries for the years 1975 and 1985. The 17 countries were chosen based upon already compiled data on other economic variables, including real GDPs, populations, distances between countries' economic centers, and dummy variables for adjacency and preferential trading arrangements. The countries examined include Canada, the United States, Japan, Belgium, Denmark, France, (West) Germany, Italy, the Netherlands, the United

Kingdom, Austria, Greece, Norway, Portugal, Spain, Sweden, and Switzerland. The list, of course, maintains no illusion of being comprehensive. Rather, it should be viewed as an extension of the data examined in Summary (1989), but preliminary to further research in this area. Yet, as one-half of U.S. arms exports are shipped to other industrialized countries, the sample is representative to a large extent.

Bilateral arms and non-arms trade flow data, measured in nominal U.S. dollars, are from the OECD's *Foreign Trade by Commodities - Series C.* Real GDPs are measured in "international" dollars, and are extracted from the Heston and Summers International Comparisons Program (ICP), cf., Heston and Summers (1988). Work by Kravis, Heston and Summers in the ICP has shown that cross-country comparisons of gross domestic products using exchange rate conversions are misleading. For instance, in 1985 the price level in Greece was three-fifths that of the United States for the same basket of goods. Using purchasing-power conversions, the ICP has calculated real GDPs for most countries that are internationally comparable, measured using "international" dollars. Populations are also from Heston and Summers (1988). Military expenditures as a share of gross domestic product are from the *SIPRI Yearbook* (1984, 1988).

For distance, sea distances are from U.S. Naval Oceanographic Office's *Distance Between Ports* and land distances are from the *Rand McNally Road Atlas of Europe.* Land distances were multiplied by a factor of two following Gruber and Vernon (1970). On this adjustment, see further supporting evidence in Isard (1989).

Several dummy variables were also appended. Dummy variables captured the presence or absence of a common land border, common membership in the EC, common membership in the EFTA, and membership in either the EC or EFTA to represent the benefits of the EC-EFTA free trade pact.[3]

5.6 Empirical Results

Table 5.1 presents the results of regressing aggregate and aggregate non-arms bilateral trade flows among numerous OECD countries on several economic variables for 1975 and 1985. First, columns (2) and (3) provide the results from estimating a typical gravity equation, such as described by equation (5.1). The gravity model explains about 85 percent of the cross-country variation of their aggregate bilateral trade values. All of the right-hand-side (RHS) variables are statistically significant at conventional levels with anticipated signs for trade among primarily industrialized countries. Exporter i's and importer j's real GDPs are positively related to the aggregate trade flow from i to j. A higher exporter GDP

expands the productive capacity of i to export to j; a higher importer GDP expands the expenditure capacity of j to import from i.

For a given level of national output in exporter i, a higher exporter per capita income raises the trade flow from i to j. In the context of a two-factor world, this might be interpreted as a higher capital-labor endowment ratio in the exporter (see footnote 2), tending to expand the export supply of relatively capital-intensive products from i to j, for a given level of national output.

TABLE 5.1

Coefficient Estimates of Cross-Sectional Determinants of Aggregate and Non-Arms Bilateral Trade Flows

	Aggregate Trade		Non-Arms Trade	
(1)	(2)	(3)	(4)	(5)
RHS Variables	1975	1985	1975	1985
Exporter Real GDP	0.79	0.90	0.79	0.90
	(20.96)	(24.60)	(20.95)	(24.40)
Exporter Per Capita Real GDP	0.75	0.70	0.75	0.71
	(5.84)	(5.91)	(5.83)	(5.92)
Importer Real GDP	0.65	0.86	0.65	0.86
	(17.31)	(23.29)	(17.30)	(23.07)
Importer Per Capita Real GDP	0.37	0.71	0.37	0.72
	(2.86)	(5.97)	(2.85)	(6.05)
Distance	-0.45	-0.55	-0.45	-0.55
	(-6.47)	(-8.85)	(-6.46)	(-8.77)
Adjacency Dummy	0.77	0.67	0.77	0.66
	(5.95)	(5.35)	(5.96)	(5.28)
EC Dummy	0.83	1.04	0.83	1.04
	(5.52)	(8.14)	(5.51)	(8.09)
EFTA Dummy	0.98	1.33	0.98	1.33
	(5.75)	(7.52)	(5.74)	(7.45)
ECEFTA Dummy	0.71	1.01	0.71	1.00
	(6.10)	(8.42)	(6.10)	(8.31)
Constant	-11.19	-17.02	-11.17	-17.21
	(-7.08)	(-10.73)	(-7.07)	(-10.76)
Adjusted R-squared	0.84	0.87	0.84	0.87
Standard Error	0.618	0.589	0.618	0.594
No. of Observations	272	272	272	272

Notes: t-statistics are in parentheses. Critical t values are 1.65, 1.96, and 2.58 for the 10, 5, and 1 percent significance levels, respectively (two tails).

For a given level of national expenditures in importer j, a higher importer per capita income raises the trade flow from i to j. In the context of a two-good world, this might be interpreted as the trade flow containing largely "luxury" goods, assuming a nonhomotheticity of tastes causes industrialized countries' income elasticities of import demand for other industrialized countries' products to exceed unity.

The other RHS variables are statistically significant as well. Distance, as a proxy for transportation costs, deters trade. Adjacency, as a proxy for cross-border trade, enlarges trade. All three preferential trading arrangements significantly enhance trade, with the trade volume gains from common membership in EFTA being the greatest. Moreover, the enhancement to the volume of bilateral trade from such common memberships increases from 1975 to 1985.

Second, the same economic variables have virtually identical impacts on the volume of aggregate non-arms bilateral trade flows, as shown in columns (4) and (5). This is not surprising since arms trade composes only 2 percent of world merchandise trade.

Table 5.2, columns (2) and (3), reveal that the addition of bilateral arms trade flows to the model significantly enhances the volume of non-arms trade. This result confirms the finding in Summary (1989) that political and economic foreign interests appear "complementary." However, the coefficient estimate in columns (2) and (3) for the arms-trade variable is only one-twentieth that found in Summary (1989). Thus, the impact of reducing arms trade on non-arms trade might not be as severe as suggested in that study. One possible explanation for the larger coefficient estimate in Summary (1989) is the absence of dummy variables for preferential trading arrangements, the effect of which might have been captured by arms trade in that study.

When the shares of military expenditures in the GDPs of the exporting country are appended to the model, several interesting results emerge, as columns (4) and (5) of Table 5.2 show. First, consistent with most of the literature on defense spending and the macroeconomy, the results for exporter's military share of real GDP are mixed. The coefficient estimate for exporter's military share of real GDP is negative in 1985 and positive in 1975.

As suggested under theoretical issues, the expected effect of exporter's military share of real GDP on non-arms trade was ambiguous. For 1985, the negative coefficient estimate is consistent with the neoclassical notions that a reduction in defense spending's share of real GDP will augment non-arms production as the cost of capital falls and will lower the relative cost of non-arms goods vis-a-vis trading partners (improving the exporter's international non-arms price

competitiveness), both effects tending to raise export supply. For 1975, the positive coefficient is consistent with: (i) the Keynesian notion that reduced defense spending will have a multiplied impact upon non-defense production, curtailing export supply, (ii) the spillover notion that reduced military expenditures will curtail important technology and cost spillovers to non-arms production raising their relative cost, curtailing exports, and (iii) the tie-in notion that reduced arms production will diminish arms exports, and consequently decrease non-arms exports because of "tie-in" arrangements discussed in Summary (1989).

Although stability of this coefficient across the two years might first seem desirable, there are two feasible explanations for the instability of the coefficient estimate of exporter's military share of real GDP on non-arms bilateral trade. First, 1975 was a year of worldwide economic recession and extreme excess capacity among industrialized countries following the first OPEC oil crisis of 1973-74. In the presence of excess capacity and high unemployment, it is conceivable to expect that the Keynesian explanation would have more relevance. A higher share of real GDP on military spending would have the typical Keynesian multiplier impact on non-arms production and export supply. By contrast, 1985 was three years after the previous recession and the degree of excess capacity and unemployment was much less worldwide than in 1975. One might expect the neoclassical explanations to be more relevant in 1985 than in 1975. Second, "spillovers" to civilian productivity from military R & D expenditures have been documented to have been much greater in the mid-70s (fifteen years ago) than more recently; see Rosenberg (1987). Consequently, the spillover hypothesis could be expected to have been more relevant for 1975 than for 1985. These explanations are consistent with a positive coefficient estimate for exporter's military share in real GDP in 1975, but a negative estimate in 1985.

While both of these explanations are plausible, the empirical result remains that the effect of a reduction in the exporter's military share of real GDP was associated with a decline in non-arms bilateral trade in 1975, but a rise in non-arms bilateral trade in 1985. Nevertheless, two empirical points are worth emphasizing. First, the more recent data (1985) are consistent with military spending reductions being associated with non-arms trade expansion. Second, the positive coefficient estimate for 1975 is not statistically different from zero at the 5 percent significance level. The negative coefficient estimate for 1985 is statistically different from zero at the 5 percent and 1 percent significance levels.

The effect of importer's military share of real GDP on non-arms bilateral trade is consistently positive for 1975 and 1985. This greater stability, relative to the previous coefficient estimate, perhaps reflects a greater "compatibility" of various

explanations for this relationship. Unlike previously, the neoclassical and Keynesian explanations suggest the same, not opposite, relationships. In the neoclassical view, reduced military spending in the importing country will lower the cost of capital, raising production of non-arms goods in the importer, which would

TABLE 5.2

Coefficient Estimates of Cross-Sectional Determinants of Non-Arms Bilateral Trade Flows

(1) RHS Variables	(2) 1975	(3) 1985	(4) 1975	(5) 1985
Exporter Real GDP	0.76	0.88	0.74	0.92
	(19.12)	(21.92)	(19.24)	(22.88)
Exporter Per Capita Real GDP	0.73	0.68	0.82	0.54
	(5.64)	(5.67)	(6.14)	(4.47)
Importer Real GDP	0.62	0.83	0.58	0.82
	(15.62)	(21.03)	(15.19)	(20.75)
Importer Per Capita Real GDP	0.36	0.75	0.62	0.84
	(2.82)	(6.23)	(4.71)	(6.90)
Distance	-0.42	-0.54	-0.34	-0.55
	(-6.01)	(-8.53)	(-4.86)	(-9.03)
Adjacency	0.76	0.65	0.88	0.63
	(5.88)	(5.19)	(7.00)	(5.19)
EC Dummy	0.86	1.04	0.93	1.06
	(5.71)	(8.12)	(6.46)	(8.38)
EFTA Dummy	0.94	1.28	0.97	1.28
	(5.56)	(7.10)	(6.02)	(7.42)
ECEFTA Dummy	0.69	0.97	0.75	0.98
	(6.04)	(7.90)	(6.78)	(8.26)
Arms Trade Flows	0.01	0.01	0.01	0.01
	(2.19)	(1.72)	(2.22)	(1.11)
Exporter's Military Share of Real GDP	–	–	0.04	-0.09
			(1.77)	(-3.84)
Importer's Military Share of Real GDP	–	–	0.13	0.06
			(5.17)	(2.35)
Constant	-10.35	-16.68	-14.09	-16.42
	(-6.42)	(-10.27)	(-8.14)	(-10.18)
Adjusted R-squared	0.84	0.87	0.85	0.88
Standard Error	0.614	0.592	0.585	0.570
No. of Observations	272	272	272	272

Notes: t-statistics are in parentheses. Critical t values are 1.65, 1.96, and 2.58 for the 10, 5, and 1 percent significance levels, respectively (two tails).

tend to reduce import demand for such goods. Moreover, reduced military spending -- either by lowering relative demand for skilled workers or reducing "concentration" in the economy -- could lower the cost of non-arms production in the importer relative to other countries, improving the importer's international competitiveness, and lowering non-arms import demand. In the Keynesian view, reduced defense spending will lower income, aggregate demand, and demand for non-arms, as well as arms, imports. Moreover, if tie-ins are present, reduced military spending, by lowering arms import demand, will tend to curtail non-arms import demand. All these explanations are consistent with the estimated relationship that a reduction in the importer's military share of real GDP lowers non-arms bilateral trade volume.

An interesting consequence of the change in these two coefficients between 1975 and 1985 is that a one percent reduction in both countries (exporter's and importer's) shares of real GDP spent on military reduces the volume of non-arms bilateral trade in 1975, but increases this trade in 1985. A one percent reduction in both countries' military shares in real GDP -- using 1975 estimates -- lowers non-arms trade by 0.17 percent, but -- using 1985 estimates -- raises non-arms trade by 0.03 percent.

As noted earlier, military spending reductions do not likely occur in a vacuum. The reduction of potential conflict may well occur simultaneously with establishment of preferential trading arrangements or granting of "most favored nation" status. Thus, to the extent that political-military uncertainty is reduced, trading pacts will likely emerge as arms reductions spread. While the formation of customs unions might seem overly optimistic, free trade pacts -- such as the European Free Trade Association (EFTA) -- might become prominent, as recent pacts signed between Hungary and the EC and between Czechoslovakia and the EC demonstrate.

To allow for this, we consider the effect of reduced military spending in both countries along with the creation of an EFTA-like pact. In the case of 1985, the impacts are complementary; a reduction of both countries' military shares of real GDP raises non-arms trade and the institution of a free trade pact (like EFTA) raises non-arms trade. In the case of 1975, even though the impacts are opposite, the net impact of arms reduction on non-arms trade is likely positive. Using the coefficient estimates in column (4) in Table 5.2 for 1975, even if any two countries were to reduce their shares of military spending by three percentage points -- which was their average shares in 1975 -- the resulting negative effect on non-arms trade (-0.51) would be less than the positive impact on such trade of the creation of a free trade pact (0.75).[4]

Note also for 1985 that the inclusion of exporter and importer military shares of real GDP erode the statistical significance of the arms trade coefficient estimate.

Since, as will be shown, arms trade flows are statistically significantly related to military shares, the arms trade flow variable in Summary (1989) perhaps reflected the exporter's and importer's military shares of real GDP.

TABLE 5.3

Coefficient Estimates of Cross-Sectional Determinants of Non-Arms Bilateral Trade Flows with Military Expenditures as Variables

(1) RHS Variables	(2) 1975	(3) 1985
Exporter Non-Military Real GDP	0.58 (6.83)	1.15 (12.39)
Exporter Military Expenditures	0.16 (2.23)	-0.24 (-3.21)
Exporter Per Capita Real GDP	0.79 (6.24)	0.57 (4.80)
Importer Non-military Real GDP	0.19 (2.29)	0.61 (6.72)
Importer Military Expenditures	0.40 (5.58)	0.21 (2.84)
Importer Per Capita Real GDP	0.54 (4.26)	0.82 (6.87)
Distance	-0.31 (-4.39)	-0.55 (-8.82)
Adjacency	0.90 (7.13)	0.64 (5.16)
EC Dummy	0.89 (6.23)	1.05 (8.39)
EFTA Dummy	0.96 (5.94)	1.29 (7.43)
ECEFTA Dummy	0.72 (6.57)	0.98 (8.27)
Arms Trade Flows	0.01 (2.30)	0.01 (1.19)
Constant	-10.83 (-7.03)	-16.63 (-10.63)
Adjusted R-squared	0.86	0.88
Standard Error	0.584	0.570
No. of Observations	272	272

Notes: t-statistics are in parentheses. Critical t values are 1.65, 1.96, and 2.58 for the 10, 5, and 1 percent significance levels, respectively (two tails).

The empirical results in Table 5.2 might be interpreted as constraining world production unrealistically. That is, the effect of a unit reduction (one percentage point) in the exporter's military share of real GDP is estimated holding constant exporter real GDP; that is, the effect is estimated assuming exporter non-arms production rises endogenously to maintain a constant level of real GDP. I also estimated the effects on non-arms trade of arms reductions holding constant only the levels of non-arms national outputs. Table 5.3 presents the results of reestimating the model separating (exporter and importer) real GDPs into components non-military GDP and military expenditures. The results are generally consistent with those in Table 5.2. Notably, a reduction in exporter military expenditures lowers the level of non-arms trade in 1975, but raises the volume of non-arms trade in 1985. A reduction in importer military expenditures lowers non-arms trade flows in both years. And for 1985, a one percentage point reduction in exporter and importer military expenditures raises the volume of their non-arms trade flow by 0.03 percent, as in Table 5.2.

5.7 Economic Determinants of Arms Trade

Given the relative success of the gravity equation for explaining across country pairings aggregate and non-arms bilateral trade flows, the model was considered for gaining insight into the economic determinants of arms trade flows. A priori my expectations were limited; I anticipated that the model would fare poorly with arms trade, expecting such trade to be determined largely by political, military or other non-economic factors. Surprisingly, the gravity framework explained about 25 percent of the variation across countries in bilateral arms trade flows.

Table 5.4, columns (2) and (3), present the results of using the basic gravity specification (equation 5.1) for estimating variation in the value of arms flows across country pairings. At the 5 percent significance level, exporter GDP, importer GDP and distance are statistically significant with the anticipated positive, positive and negative, respectively, coefficient estimate signs in 1975. In 1985, exporter and importer GDPs and per capita GDPs are statistically significant (along with distance). The positive coefficient estimate for exporter per capita GDP, interpretable as a proxy for its capital-labor endowment ratio (see footnote 2), suggests that arms exports tend to be capital intensive in production, which is feasible. The negative coefficient estimate in 1985 for importer per capita income suggests that arms tend to be "necessities" in consumption, i.e., that their income elasticities of import demand are less than unity.

Column (3) in Table 5.4 also reveals for 1985 that common membership in the EFTA, or if one country was in the EC and the other in the EFTA, would significantly increase arms trade flows, but not so for common EC membership. The lack of statistical significance for adjacency suggests that cross-border trade does not contribute much to the volume of arms trade.

TABLE 5.4

Coefficient Estimates of Cross-Sectional Determinants of Bilateral Arms Trade Flows

(1) RHS Variables	(2) 1975	(3) 1985	(4) 1975	(5) 1985
Exporter Real GDP	2.62	2.69	-	-
	(5.81)	(6.79)		
Exporter Per Capita Real GDP	2.39	2.68	-	-
	(1.54)	(2.10)		
Importer Real GDP	2.67	2.45	-	-
	(5.92)	(6.17)		
Importer Per Capita Real GDP	0.63	-2.45	-	-
	(0.41)	(-1.91)		
Exporter Military Expenditures	-	-	2.23	2.12
			(5.83)	(6.39)
Importer Military Expenditures	-	-	2.15	1.86
			(5.62)	(5.58)
Distance	-2.46	-1.32	-1.07	-0.74
	(-2.96)	(-1.98)	(-1.30)	(-1.07)
Adjacency	1.22	1.30	3.25	2.67
	(0.79)	(0.97)	(2.08)	(1.95)
EC Dummy	-2.37	-0.03	-1.08	-1.17
	(-1.31)	(-0.02)	(-0.59)	(-0.83)
EFTA Dummy	2.91	5.15	2.41	3.94
	(1.43)	(2.70)	(1.17)	(2.03)
ECEFTA Dummy	0.99	3.82	1.40	2.70
	(0.71)	(2.95)	(1.00)	(2.07)
Constant	-72.70	-53.98	-30.85	-27.45
	(-3.84)	(-3.15)	(-3.94)	(-3.70)
Adjusted R-squared	0.23	0.25	0.19	0.19
Standard Error	7.405	6.363	7.622	6.617
No. of Observations	272	272	272	272

Notes: t-statistics are in parentheses. Critical t values are 1.65, 1.96, and 2.58 for the 10, 5, and 1 percent significance levels, respectively (two tails).

Finally, I replaced exporter and importer real GDPs in these regressions by exporter and importer military expenditures, respectively (and deleted per capita GDPs). The results are presented in columns (4) and (5) of Table 5.4. While I anticipated improvement of the results, in fact the adjusted R-squared values deteriorated in both years. Yet the coefficient estimates did not change noticeably.

Thus, while earlier sections of the paper indicate that military expenditures and arms trade appear to significantly influence the volume of aggregate non-arms trade between countries, this section reveals that about 25 percent of the variation across country pairings in their arms trade can be explained by economic factors.

5.8 Conclusions and Implications

Events in Eastern Europe and the Soviet Union over the past year have raised widespread expectations of reductions in military spending by the United States, the USSR, and their allies, as well as reductions in economic and political trade barriers among all these countries. This paper attempted to offer an analytical framework for understanding the potential implications of these dramatic changes for the path of world trade.

Using 1975 data, the empirical model suggested that reductions in military expenditures would tend to reduce exporters' supplies of *non-military*, as well as military, products and reduce importers' demands for non-military, as well as military, products. However, to the extent that arms reductions will likely be accompanied by trade liberalization -- witness bilateral trade pacts last year signed between Hungary and Czechoslovakia with the European Community and a recent similar pact signed between the USSR and the EC -- the volume gains to world trade from such liberalization would tend to offset the losses because of military cuts.

Yet using 1985 data, the empirical results suggested that reductions in military expenditures by exporting countries would tend to *increase* the volume of non-arms trade, by enhancing non-arms export supply. And even though military reductions in importing countries, by enhancing the share of those countries' national production in non-military goods, would tend to reduce non-military import demands, this effect was estimated to be small. Combined with an even larger estimated effect of trade liberalization on trade creation in 1985 relative to 1975, the 1985 data suggest that *the long-run implications for world trade from arms reductions and consequent trade liberalization are quite favorable.*

Footnotes

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[1]The following is intended neither to be an exhaustive nor a formal discussion of how military spending affects arms and non-arms world trade flows. The presentation is intended to be illustrative, to motivate the inclusion of the military's share of national output in a well-established empirical model of trade flow determinants. For a more thorough summary, see, for example, Adams and Gold (1987).

[2]In a cross-country regression of 34 countries' per capita GDPs on their respective capital-labor endowment ratios, the capital-labor ratio explained 96 percent of the variation in the per capita incomes.

[3]The use of dummy variables to capture the presence or absence of a preferential trading arrangement is common, and its precedent was set in Tinbergen (1962) in the first estimation of an international trade gravity equation. By contrast, recent work in the "conflict resolution" literature of international relations hypothesizes that the level of conflict between a pair of countries is inversely related to its bilateral trade volume. To the extent that a preferential trading arrangement between two countries reflects a low level of conflict, this literature suggests that the presence of a preferential trading arrangement is a function of the level of bilateral trade. Such causality is, of course, the converse of that suggested by the typical gravity model. In reality, these two variables are both endogenous and influenced by common (unspecified) exogenous variables, and suggests the use of a simultaneous equation system. However, addressing this issue is beyond the scope of this paper. On this issue, see Polachek (1988).

[4]This conclusion was drawn by summing the coefficient estimates for the exporter and importer shares of military expenditures in national GDP, multiplying the sum (0.17) by negative three to arrive at an estimated impact on trade of -0.51, and comparing it to the estimated effect of creating an EC-EFTA- like trade pact on trade (0.75).

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