Effects of Reductions in NATO Military Expenditures on US Employment by Sector/ Occupation/Region

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1. INTRODUCTION

WITH the end of the 'Cold War' and attendant fragmentation of the former Soviet Union, Soviet military influence no longer poses a grave threat to international security. The destruction of Iraq's military capabilities and the opening of the Israeli-Arab dialogue may also have served to reduce the potential for large scale conflict in the Middle East. The confluence of these remarkable changes suggests that there may now be considerable scope for reduction in military expenditures in the NATO member countries. There is interest accordingly in the aggregate and the sectoral/occupational/regional employment impacts that might be experienced in the United States if significant reductions in military expenditures were indeed proven to be possible.[1]

Using the computational general equilibrium (CGE) Michigan Model of World Production and Trade, we investigate the impact of a 25 per cent multilateral reduction in military spending in all of the NATO countries combined. Results are presented for the overall effects for each of the fourteen NATO countries.

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[1] As will become clear from the discussion that follows, we can use our modelling framework to analyse increases as well as reductions in military spending.

We then present sectoral employment results for the individual NATO countries. Using a special feature of the Michigan Model, the sectoral employment results for the United States are decomposed according to nine broad occupational groupings and nine regions. Then, based upon US data on the wage and employment experiences of displaced workers for 1989, we calculate the wage losses for US workers associated with the reduction in NATO country military expenditures for a number of different measures of labour market dislocation.

An important advantage in using the Michigan Model to analyse the effects of changes in military expenditures is that the model incorporates the effects of international trade and allows for price and exchange rate responses as well as primary input substitution possibilities. The Michigan Model thus provides a richer insight into the sectoral effects stemming from changes in military expenditures than has been provided by earlier research.[2]

Previous research has generally compensated for changes in military expenditures by changing nonmilitary government purchases. However, as discussed in Haveman, Deardorff and Stern (1992), prior episodes of substantial reductions in US military expenditures did not follow this path. It was therefore assumed in the aforementioned work that reductions in government military spending were compensated by shifting expenditures to various components of final demand, including: (1) nondefence government spending; (2) private consumption; (3) investment; and (4) a proportional reallocation across all the foregoing expenditure components. In this paper, we adopt the last of these expenditure shifts.

Our paper is structured as follows. In Section 2, we present a brief description of the Michigan Model and discuss elements of it that are of particular importance to our study. In Section 3, we discuss some assumptions underlying our computational experiment. The computational results are presented in Section 4. Our conclusions and implications of the results are discussed in Section 5.

2. OVERVIEW OF THE MICHIGAN MODEL

The theoretical structure and equations of the Michigan Model are described in detail in Deardorff and Stern (1986, pp. 9–36 and 235–47; and 1990, pp. 9–35). For our purposes here, we present a brief overview of the model and call attention to some of its features that are pertinent to the present analysis.

[2] See, for example, Congressional Budget Office (1992). There may of course be other effects at both the micro and aggregate levels that our modelling approach cannot capture. These effects include the dynamics of adjustment in goods and factor markets, and possible impacts working through financial markets and changes in aggregate savings and invesmtent behaviour. This suggests the need for a broader and more integrated modelling effort, which is unfortunately something beyond our capability at present.

In designing the Michigan Model, the objective was to take into account as many of the microeconomic interconnections among industries and countries as possible. This disaggregated general equilibrium framework permits examination of a variety of economic issues that most other computational models cannot address, either because they are too highly aggregated or because they are specified only in partial equilibrium terms.

a. Data and Parameters

The version of the model used here includes 23 tradeable and 6 nontradeable industries in 18 industrialised and 16 developing countries, plus an aggregate sector representing the rest of the world.[3] We use a base of 1980 data on trade, production and employment for all 34 countries, plus constructed measures of the coverage of nontariff barriers (NTBs) for the 18 industrialised countries.

The import and export data are adapted from United Nations trade tapes, with concordances that relate the Standard International Trade Classification (SITC) to our version of the International Standard Industrial Classification (ISIC) categories. Information on the gross value of production and employment by ISIC sector is directly calculated or estimated from the United Nations *Yearbook of Industrial Statistics*, Organisation for Economic Cooperation and Development (OECD) publications on national accounts and labour statistics, and various national statistical sources.

Our input–output coverage currently includes national tables for all of the industrialised countries of the model except Switzerland. They are taken from various years ranging from 1975 for Japan and members of the EC-9 to 1982 for Finland. The 1977 table for the United States is applied to Switzerland. For the developing countries, our coverage currently includes separate tables for Brazil (1975), Chile (1977), India (1973), Israel (1977), Korea (1980), Mexico (1980), Portugal (1981), Singapore (1973), Spain (1980), Taiwan (1986), Turkey (1973) and Yugoslavia (1976). The Brazilian table is applied to the remaining developing countries. The use of national tables allows for differences in technology among the countries included in the model.[4]

In general, the coefficients of explanatory variables that appear in the model are calculated from data on production, trade and employment by sector in each country, from the input–output matrices and from relevant published estimates of demand and substitution elasticities.

[3] The industries are listed in Table 2.

[4] Our sector aggregates may obscure technological differences in the production of military and nonmilitary goods in certain sectors.

b. US Employment by Occupation and Location

The Michigan Model has been adapted for present purposes to permit a breakdown of US employment by occupation or location as well as by sector. The occupational data were based on the 'national matrix tape' of the US Department of Labor and concorded to the sectoral classification used in the Michigan Model. Employment by state and region was calculated for 1988 on the basis of a data sample of workers obtained from the Census Public Use Tapes. The percentage distributions for employment by occupation and state/region were then used to apportion the sectoral employment totals generated by the model. The results reported below have been calibrated to the level of US employment in 1989, which is the year used for the data on military expenditures.

c. Wage Losses Due to Labour Market Dislocation

Information on wages before worker displacement and the duration of unemployment for 1989 was drawn from the January 1990 Displaced Worker Survey. The average wages lost by sector, occupation and location, which are to be reported below, were calculated to correspond with the categories used in the sectoral/occupational/locational employment change calculations.

d. The Model Structure

The model is best thought of as composed of two parts: the country system and the world system. The country system contains separate blocks of equations for the individual tradeable and nontradeable sectors for each country, and the world system contains a single set of equations for individual tradeable sectors for the world as a whole. The country blocks are used first to determine each country's supplies and demands for goods and currencies on world markets as functions of world prices, exchange rates and exogenous variables. The supply and demand functions for each country are then combined to provide the input to the world system that permits world prices and exchange rates to be determined.

The world system is the less complicated of the two systems. We start with the export supply and import demand functions from the country equations, which depend on world prices and exchange rates. To get world prices we add these supplies and demands across all countries and set the difference equal to net demand from the rest of the world. To obtain exchange rates, where these are flexible, we add the value of excess supply across all of the industries in a country and equate the resulting trade balance to an exogenously given capital flow. Once we obtain the world prices for each tradeable industry and the exchange rate for each country, we enter them back into the separate country blocks in order to determine the rest of the relevant country-specific variables.

e. Description of the Exogenous Change Variables

The Michigan Model can be used to analyse price and quantity responses to a number of exogenous changes in the world trading environment. These changes can be represented through the use of some 18 exogenous variables, each referring to a different change in the trading environment. These variables include, for example, changes in import tariffs, changes in export taxes, changes in exchange rates where they are exogenous, and changes in the aforementioned capital flows.

For the current analysis, however, we use only two exogenous change variables, both representing particular kinds of shifts in demand. One is an inter-industry shift variable, denoted $e\alpha$, that describes a reallocation of final demand across industries. The other is an intra-industry shift variable, denoted $e\beta$, that captures a shift of demand within an industry from home-produced goods to imports. A formal statement of the role that these two shift parameters play in the Michigan Model is available from the authors on request.

3. COMPUTATIONAL EXPERIMENTS AND ASSUMPTIONS

In periods when military expenditures are reduced, the question which naturally arises is what happens to nonmilitary expenditures. There are principally three macroeconomic policies that could accompany a reduction in military expenditures: (1) increase other spending; (2) reduce taxes; or (3) reduce government borrowing.[5] That is, first, policy makers could redistribute the expenditure to other forms of government spending, for example on human or physical resources. Second, the reduction in expenditure could be matched by a reduction in government receipts, thus increasing civilian consumption. Finally, the reduced expenditure could be used to reduce a budget deficit (or increase a surplus), reducing interest rates, and thereby stimulating investment. As Steuerle and Wiener (1990) have noted, in the case of the United States the three postwar periods after 1945 reflected each of these policies, but in rather different combinations.

Given that there may be a variety of macroeconomic responses to reductions in military expenditures, it is difficult to determine what the appropriate strategy should be in modelling such expenditure reductions. The reason this is important is that the effect on the sectoral composition of trade and employment due to a reduction in military spending depends crucially on the assumptions one makes about the accompanying macroeconomic policies. Since the Michigan Model does

[5] A fourth possibility is that the government could contract the money supply (or reduce its rate of expansion). The results would then depend on what accompanying changes maintain full employment. If there were a general deflation of prices and wages, this would increase the real value of all components of spending across the board, similar to the proportional expansion assumed here.

not formally allow for changes in interest rates or domestic taxes, the scenarios chosen for analysing reductions in military expenditures are implemented by exogenously altering the composition of final demand. Thus, as already mentioned, in Haveman, Deardorff and Stern (1992), shifts in military spending were allocated to several categories of final demand, including consumption, investment, non-military government spending and a proportional shift across all sectors of nonmilitary final demand. For present purposes, we consider only the latter case of the proportional shift.

We assume a 25 per cent *multilateral* reduction of military expenditures in all of the NATO countries combined at a single point in time, based on the level of 1989 military expenditures in each country.[6] These reductions are taken as a uniform percentage of military expenditures allocated to each of the 29 sectors being modelled in each country. The reduction in military expenditures is pro-rated proportionally to all three sectors of final demand, namely, consumption, investment and nonmilitary government expenditure.

In interpreting the computational results presented below, it is important to note the following assumptions that have been made:

1. The level of aggregate expenditure is constant.
2. Capital stocks are fixed for each industry, on the grounds that the time period under investigation is too short for changes in investment to be realised as additions to the capital stock.
3. Economy-wide real wages are assumed to be flexible, i.e. labour markets are permitted to clear.
4. Wages across sectors, occupations and locations are held fixed relative to one another.
5. All defence expenditure is assumed to have been allocated to domestic industry.
6. Exchange rates are modelled as flexible, except for a number of developing countries.

Some of these assumptions are in need of further explanation or justification. First, the assumption that aggregate expenditure is held constant is necessary because the microeconomic orientation of the Michigan Model makes it inappropriate for discussing macroeconomic phenomena such as the determination of aggregate expenditure or employment. A further consequence of the microeconomic nature of the model is assumption (3). Our results are all dependent on constant aggregate employment, which is assured by allowing for flexibility in real wages. There are alternative methods of maintaining constant employment, such as allowing the

[6] See Haveman, Deardorff and Stern (1993) for a comparison of the sectoral effects of multilateral and unilateral reductions in military expenditures in the NATO countries.

composition of final demand to adjust appropriately, but these adjustments would de-emphasise the role played by the differences in the distribution of military spending and other sources of final demand.

Assumption (4) refers to the distribution of US employment across sectors, occupations and locations. In modelling the labour market, it is assumed that labour market adjustments consist first of changes in disaggregated demands for labour that then require labour to move from sectors/occupations/locations where demand falls to sectors/occupations/locations where demand rises. In fact these movements may be ameliorated somewhat by market adjustments — changes in relative wages that bring supplies and demands together without the need for such movement. However, these possible wage changes and their effects are much more uncertain and difficult to ascertain than the quantitative changes they connect.[7] In any case, the substitutions in demand are likely to be limited, while those in supply are likely to be large. Therefore, it is expected that most of the labour market adjustments take the form of movements of labour across these various dimensions. Attention is thus focused on the changes in labour demands that occur at constant relative wages.

Assumption (5) is designed to reflect the preference that most countries give to domestic manufacturers and suppliers when contracts are signed and purchases are made. Given this preference, we believe that the average propensity to import of the national defence establishment is significantly less than that of final and intermediate demand in the aggregate. Unfortunately, however, we do not have systematic information on imports of defence related products. We have assumed therefore that zero imports of defence products is a more accurate representation of reality than is the aggregate average propensity to import for all final and intermediate goods.

Implementation of our policy experiment is conceptualised as a shift in the final demand for the output of each of the 29 sectors. The first step is to appropriately redistribute the reduction in military spending. This redistribution of final demand is represented in the Michigan Model as changes in the demand share parameters of the consumers' utility function. In what follows, α_j will be used to represent the share of final demand attributable to purchases from sector j. Given the nature of the model, the proportional change in these parameters is needed to reflect the shift in final demand. The proportional change variable is obtained by calculating the actual share of each sector in final demand (α_{0j}, $j = 1, \ldots, 29$) and the final

[7] Such connections through relative wages depend on the abilities of both workers and firms to substitute among sectors, occupations and locations of employment. What are needed are measures of elasticities of substitution — quantitative estimates of how quantities supplied and demanded respond to price — in these various dimensions. Unfortunately, no reliable information exists on these substitution elasticities.

demand share of each sector once the defence spending has been redistributed (α_{1j}, $j = 1, \ldots, 29$). The proportional change is then calculated as:

$$e\alpha_j = \frac{d\alpha}{\alpha} = \frac{\alpha_{1j} - \alpha_{0j}}{\alpha_{0j}}, \quad j = 1, \ldots, 29 \tag{1}$$

In order to calculate inter- and intra-industry shift parameters that are needed for each sector in each country, five pieces of data are required: gross national product (GNP) for each country; the volume of defence purchases; the distribution of GNP and defence procurement across sectors; and the share of imports in final domestic demand for each sector. Data on the share of imports in final demand were obtained from data already present in the model. The sources for the remaining data are detailed below.

The calculation of $e\alpha$, which is the per cent change in demand for each sector, requires the distribution and levels of defence spending and final demand for each country. Data on aggregate military expenditures for each country for 1989 were obtained from the 1990 US Arms Control and Disarmament Agency (ACDA) publication. In order to calculate the demand shift parameters for each of the 29 industries in each country, it was necessary to distribute the aggregate military expenditure and GNP data across the industries modelled. The distribution of GNP was accomplished through the use of the input–output tables already employed in the model. The aggregate obtained was distributed to replicate the share in final demand for each of the 29 sectors.

Disaggregated estimates of the distribution of defence spending were employed for the United States, Canada, the United Kingdom and West Germany, and are from *The Survey of Current Business* (1990), Herring (1989), Barker et al. (1990) and Filip-Kohn et al. (1980), respectively. For the remaining countries, we relied on Leontief and Duchin (1983), who provide estimates of the proportion of the ACDA data on aggregate military expenditures that correspond to 12 categories. We in turn concorded the categories in each of the aforementioned publications to our industrial classification.

As noted above, defence purchases are assumed to be made entirely from domestic production. The shift of expenditure away from defence will therefore be accompanied by an exogenous increase in imports. As a result, we need to adjust the fraction of new expenditure that now goes towards the purchase of imported goods. We assume that each category of total demand in an industry purchases imports in the same percentages as that of final demand in that industry as a whole.[8] More precise estimates could be made if a breakdown of imports by consumption, investment and government purchases could be used but, unfortunately, such data are not available.

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[8] See Haveman, Deardorff and Stern (1992) for further elaboration of the procedure used here.

TABLE 1
Aggregate Effects on NATO Countries due to 25 Per Cent Reductions in Military Spending

	Change in Exports		*Change in Imports*		*Per Cent Change in*		
	$ Million	*Per Cent*	*$ Million*	*Per Cent*	*Terms of Trade*	*Effective Ex. Rate**	*Prices***
Belgium/Luxembourg	138.3	0.2	124.0	0.2	−0.03	0.1	−0.1
Canada	−261.4	−0.4	−206.6	−0.3	0.10	0.1	0.0
Denmark	12.7	0.1	27.7	0.1	0.09	0.2	−0.1
France	314.8	0.3	260.1	0.2	−0.05	0.1	−0.1
Germany	341.9	0.2	108.9	0.1	−0.12	0.1	−0.2
Italy	205.7	0.3	173.6	0.2	−0.05	0.0	−0.2
Netherlands	78.6	0.1	87.8	0.1	0.01	−0.2	0.1
Norway	65.3	0.4	49.4	0.3	0.05	0.0	0.1
Portugal	4.6	0.1	5.0	0.1	0.02	0.0	−0.1
Spain	−82.2	−0.4	−96.6	−0.3	−0.05	0.0	0.0
Turkey	−17.0	−0.5	−8.0	−0.1	0.25	0.0	0.3
United Kingdom	−414.0	−0.4	−459.1	−0.4	−0.05	−0.5	0.5
United States	−823.3	−0.4	−565.7	−0.2	0.06	0.1	0.1

Notes:
*Positive = appreciation.
**Index of import and home prices.

4. COMPUTATIONAL RESULTS

The Michigan Model produces results for a wide range of endogenous variables that emerge from the calculations as percentage changes for each of the 29 sectors. Base year data, 1980 in this study, are then used to compute absolute changes for selected variables.

a. Aggregate Results

The aggregate results for the individual NATO countries are presented in Table 1. It appears that a 25 per cent reduction in defence spending is fairly painless in the aggregate for all NATO countries. For the United States in particular, there is a marginal reduction in both exports and imports. The effects on the US terms of trade, effective exchange rate and prices are also quite small.

The reduction in US exports is not surprising. The underlying data show domestic demand increasing in a majority of the tradeable sectors when military expenditure is reduced. This increase in demand will cause an increase in the home price for that industry, leading to a substitution from production for export to production for home use, thus reducing total exports. The change in aggregate imports is somewhat less intuitive. Recall that defence expenditure is assumed to be spent entirely in home sectors and that the shift of expenditure therefore involves an exogenous increase in imports. Given this assumption, it is somewhat surprising

that imports decline in the aggregate. The explanation is that the fall in the home price for a sector experiencing a reduction in demand is large enough to cause sufficient substitution away from imports in that sector so as to overwhelm the exogenously imposed increase.

There are some other countries in addition to the United States where both exports and imports decline, and the explanation noted would apply to these countries. There are also instances in which both exports and imports rise, reflecting changes in home prices that are opposite to those for countries whose trade declines. The aggregate results for the non-NATO countries, which are not shown in Table 1 but are available on request, indicate that those countries would not be particularly affected by the reductions in NATO-country military expenditures.

b. Sectoral Results

The results in Table 1 are aggregates of the changes that take place in the underlying sectors of each country. Table 2 contains the sectoral employment results.[9] It appears that US employment decreases significantly in net percentage terms in basic metal industries (371 and 372), durable goods sectors (381, 382, 383, 384 and 38A), and community, personal and social services (ISIC 9, which includes government employment).[10]

The sectoral results for the other NATO countries are qualitatively similar to those for the United States in the sense of being relatively small on the whole and being concentrated in metal products, durable goods, and community, social and personal services. The results are by no means uniform, however, and apparently reflect some noteworthy differences in the sectoral incidence of military spending and technological differences in input–output structures.

c. Occupational Results

While the economy-wide effects just discussed are useful in identifying the sectors that would be most impacted by a reduction in military expenditures, it is also desirable and important for policy purposes to have more detailed information concerning the occupational characteristics of the workers involved. With this in mind, as mentioned above, a procedure has been incorporation into the Michigan Model that permits the employment changes to be broken down by major occupational groupings.

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[9] The sectoral changes in exports and imports are available from the authors on request.

[10] It should be noted that military personnel are included in sector 9, which means that we assume the military employs workers in the same proportion as all other components of sector 9. The results presented will thus be under- or overstated depending on the difference in labour as a fraction of spending in each component of sector 9. Nonetheless, correction for these inaccuracies would not change the qualitative nature of the results.

TABLE 2
Net Percentage Changes in Employment by ISIC Sector in the NATO Countries due to 25 Per Cent Reductions in Military Expenditures

	SITC	*Belg./ Lux.*	*Canada*	*Denmark*	*France*	*Germany*	*Italy*	*Netherlands*	*Norway*	*Portugal*	*Spain*	*Turkey*	*United Kingdom*	*United States*
Traded Industries														
Agr., For. & Fishing	1	0.75	0.64	0.71	1.14	0.88	0.47	0.64	2.66	0.79	0.41	0.37	0.29	1.42
Mining & Quarrying	2	0.28	−0.45	0.50	0.77	0.28	0.40	1.34	5.48	0.16	−0.02	−0.42	−0.34	0.20
Food, Bev. & Tobacco	310	0.48	0.39	0.65	1.00	0.86	0.48	0.30	0.24	0.89	0.35	0.26	0.49	1.50
Textiles	321	0.27	−0.24	0.00	0.78	0.34	0.50	−0.59	1.55	0.38	0.31	−0.02	−0.31	0.42
Wearing Apparel	322	0.67	0.28	−0.03	1.73	0.96	0.95	−1.10	1.50	1.71	0.48	0.08	−0.03	0.90
Leather Products	323	0.41	−0.34	−0.23	1.66	0.51	0.59	0.72	4.54	1.60	0.31	0.21	−0.17	0.60
Footwear	324	0.08	0.51	0.71	1.72	1.10	0.92	0.44	0.48	1.61	0.41	0.56	0.44	1.41
Wood Products	331	0.38	−0.18	0.51	0.52	0.71	0.42	0.47	1.14	0.52	0.43	−0.05	0.22	0.59
Furniture & Fixtures	332	0.78	0.39	0.70	1.06	1.05	0.77	0.31	0.77	1.22	0.51	0.35	0.32	1.40
Paper & Paper Products	341	0.67	−0.47	0.27	0.73	0.44	0.41	0.67	0.52	1.19	0.13	0.04	−0.37	0.51
Printing & Publishing	342	0.25	−0.12	0.22	0.12	0.15	0.05	0.40	0.34	−0.15	0.00	−0.04	0.03	0.59
Chemicals	35A	0.32	−0.55	0.10	0.40	0.22	0.28	0.27	0.41	0.20	−0.01	0.08	−0.23	−0.13
Petrol. & Rel. Prod.	35B	0.05	−0.30	−10.21	0.94	3.07	2.42	0.66	0.10	−0.31	−3.49	−0.85	−12.75	0.32
Rubber Products	355	0.20	−1.70	−0.02	−0.04	0.20	0.10	0.11	0.39	0.27	−0.29	−0.04	−1.57	−0.74
Nonmetallic Min. Prod.	36A	0.93	−0.26	0.46	0.93	0.77	0.95	0.61	0.70	0.91	0.32	0.00	−0.22	0.42
Glass & Glass Products	362	1.22	−0.95	0.11	0.61	1.13	0.75	0.32	0.24	0.46	0.03	0.19	−1.68	−0.39
Iron & Steel	371	0.30	−1.12	−0.03	0.13	−0.02	−0.04	0.02	0.77	0.33	0.03	−0.20	−0.96	−1.00
Nonferrous Metals	372	0.98	−1.05	−0.04	0.08	0.07	0.14	0.06	0.20	1.03	−0.06	−0.28	−1.71	−1.44
Metal Products	381	0.38	−0.66	0.37	0.41	0.31	0.32	0.34	0.69	0.75	0.14	−0.02	−0.56	−0.73
Nonelectric Machinery	382	−0.07	−0.96	0.09	0.09	0.50	0.37	−0.16	0.14	−0.66	−0.18	−0.35	−0.05	−0.54
Electric Machinery	383	−0.39	−1.57	−0.91	−1.34	−0.17	−0.57	−0.36	−1.24	−0.15	−0.38	−0.84	−2.07	−3.38
Transportation Equipment	384	−0.69	−2.63	−2.87	−2.03	−0.97	−1.77	−1.21	−1.05	−0.25	−0.44	−0.38	−2.32	−3.06
Miscellaneous Manufac.	38A	−0.11	−1.89	−0.41	0.10	−0.50	0.05	−0.10	−0.09	0.44	0.06	−0.13	−1.39	−2.67
Total Traded		0.28	−0.41	0.11	0.33	0.26	0.21	0.13	0.93	0.67	0.23	0.31	−0.69	−0.44
Nontraded Industries														
Electric, Gas & Water	4	0.63	−0.30	0.79	0.95	0.60	0.25	0.76	1.42	0.25	0.10	−0.12	−1.35	1.12
Construction	5	0.87	0.17	0.79	1.06	0.81	0.66	0.57	0.94	0.73	0.33	−0.04	0.40	0.70
Wholesale & Ret. Trade	6	1.24	0.24	0.93	1.37	0.73	1.15	0.93	1.53	1.83	0.64	0.23	0.56	1.29
Transp., Stor. & Com.	7	0.26	−0.49	0.26	0.40	0.24	0.21	0.41	0.63	0.47	0.12	0.18	−0.90	0.22
Fin., Ins. & Real Estate	8	0.61	0.50	0.95	1.21	1.18	0.38	0.72	0.72	1.13	0.79	0.42	0.17	1.48
Comm., Soc. & Pers. Serv.	9	−1.57	0.21	−0.89	−2.10	−1.18	−1.81	−1.06	−2.44	−3.74	−1.81	−2.15	0.56	−1.06
Total Nontraded		−0.10	0.14	−0.04	−0.16	−0.15	−0.13	−0.04	−0.35	−0.76	−0.18	−0.80	0.31	0.16

TABLE 3
Change in US Employment by Sector and Occupation due to 25 Per Cent Reductions in Military Spending in the NATO Countries
(Number of Workers)

Sector		*Occupation*									
ISIC	*Name*	*Executive*	*Professional*	*Technical*	*Mktg/Sales*	*Admin./Clerical*	*Service*	*Agriculture*	*Skilled*	*Semi-/Unskilled*	*Total*
1	Agr., For. & Fishing	1041	1115	328	336	1619	694	40266	1404	2818	49621
2	Mining & Quarrying	170	144	65	19	208	32	1	789	528	1956
310	Food, Bev. & Tobacco	2402	737	561	1754	3020	1295	280	5487	11631	27167
312	Textiles	264	116	77	73	462	113	83	673	2833	4692
322	Wearing Apparel	831	143	31	2956	1073	165	1	957	5572	11729
323	Leather Products	30	8	3	13	51	8	0	60	379	553
324	Footwear	89	16	3	57	222	42	0	329	1562	2320
331	Wood Products	277	53	33	79	291	75	60	639	1933	3441
332	Furniture & Fixtures	512	188	132	145	651	123	83	1594	3465	6894
341	Paper & Paper Products	292	111	83	96	420	81	13	680	1965	3741
342	Printing & Publishing	920	981	118	878	1644	107	6	878	2936	8467
35A	Chemicals	−154	−110	−73	−59	−213	−40	−1	−233	−543	−1426
35B	Petrol. & Rel. Prod.	49	31	21	10	74	14	1	133	199	531
355	Rubber Products	−156	−70	−50	−61	−204	−36	0	−841	−548	−1967
36A	Nonmetal Min. Prod.	218	60	47	70	232	55	1	381	1079	2144
362	Glass & Glass Products	−46	−24	−18	−10	−77	−21	−1	−135	−421	−753
371	Iron & Steel	−465	−222	−169	−99	−860	−233	−3	−1943	−4601	−8596
372	Nonferrous Metals	−378	−152	−79	−99	−559	−127	−2	−1016	−2464	−4877
381	Metal Products	−1088	−563	−415	−279	−1538	−213	−10	−2839	−5460	−12583
382	Nonelectric Machinery	−1737	−1703	−1116	−431	−2523	−244	−10	−3158	−4527	−15452
383	Electric Machinery	−6915	−5701	−3971	−1614	−10661	−1259	−56	−16719	−31083	−77980
384	Transportation Equipment	−5138	−5366	−2330	−1076	−8033	−1446	−38	−16767	−27693	−67887
38A	Miscellaneous Manufac.	−4904	−2473	−1717	−3889	−7164	−719	−42	−9152	−16151	−46211
4	Electric, Gas & Water	1338	1347	696	266	3661	483	33	5793	2029	15647
5	Construction	3072	1046	790	379	2957	340	56	24821	10196	43657
6	Wholesale & Ret. Trade	30539	6304	1120	80250	31922	53598	400	20769	33502	258403
7	Transp., Stor. & Com.	931	325	318	323	3752	399	840	1598	2826	11312
8	Fin., Ins. & Real Estate	24270	13856	4494	17523	47942	4905	1480	3890	4072	122433
9	Comm., Soc. & Pers. Serv.	−32296	−100845	−17519	−7778	−61405	−80692	−2244	−13383	−20810	−336973
	Total	13966	−90648	−18540	89832	6963	−22500	41197	4688	−24957	0

For this purpose, we have used US detailed occupational data that include 602 separate occupations. These have been aggregated into nine categories and concorded to the ISIC industry categories used in the Michigan Model. The percentage distributions for 1988 employment across these nine occupational categories were calculated and used to allocate the absolute sectoral employment effects. The results, measured in terms of 1989 US employment, are indicated in Table 3. It is evident that employment of professional, technical, service and semi-/unskilled workers declines, while there are increases in the remaining occupational categories. Within each occupational category, there are both increases and decreases in sectoral employment.

d. Regional Effects

The Michigan Model also includes a facility for breaking down the sectoral employment results by state and region, in addition to occupations. That is, the disaggregated occupational data available were classified into the nine occupational categories noted in Table 3, percentage distributions calculated for sectors by state and the states aggregated into nine major regions. The state results, which are too detailed to be reported here, are available on request. The regional results are reported in Table 4. It can be seen that there are employment declines in the New England, Middle Atlantic and East North Central regions, and there are employment increases in all the other regions. There are both increases and decreases in sectoral employment within each region.

e. Occupation and Region

The underlying data also permit the employment changes to be broken down by both occupation and region simultaneously. Summing the results over all sectors, the total changes in employment by occupation and region are obtained. They are indicated in Table 5. The totals along the bottom and side of Table 5 match those reported in Tables 3 and 4. It is evident that the absolute declines in professional workers are concentrated especially in the Middle Atlantic, East North Central, South Atlantic and Pacific regions. The largest declines in the employment of technical workers are in the East North Central and Pacific regions. The largest declines in service workers are in the Middle Atlantic, East North Central and South Atlantic regions. The declines in semi-/unskilled workers are most marked in the East North Central, Middle Atlantic and New England regions.

f. Labour Market Dislocation Measures

The effects of reductions in military expenditures indicate, as one would expect, that some sectors, occupations and locations will experience increases in employment

TABLE 4
Change in US Employment by Sector and Region due to 25 Per Cent Reductions in Military Spending in the NATO Countries

Sector		*Region*									
ISIC	*Name*	*New England*	*Middle Atlantic*	*East North Central*	*West North Central*	*South Atlantic*	*East South Central*	*West South Central*	*Mountain*	*Pacific*	*Total*
1	Agr., For. & Fishing	1419	3011	6947	8930	8027	3541	5704	3185	8856	49621
2	Mining & Quarrying	7	123	167	107	254	195	692	310	102	1956
310	Food, Bev. & Tobacco	1041	4145	5286	2935	4314	1885	2927	951	3684	27167
321	Textiles	349	574	196	67	2685	425	130	49	216	4692
322	Wearing Apparel	645	2828	1128	589	2412	1441	1108	296	1282	11729
323	Leather Products	35	146	41	22	120	83	45	9	52	553
324	Footwear	558	374	253	306	246	331	146	15	91	2320
331	Wood Products	203	335	471	208	553	360	311	178	822	3441
332	Furniture & Fixtures	394	703	1100	367	1318	653	594	308	1457	6894
341	Paper & Paper Products	373	621	868	201	646	307	299	38	387	3741
342	Printing & Publishing	605	1831	1842	701	1100	372	598	320	1097	8467
35A	Chemicals	−98	−354	−316	−85	−212	−93	−121	−29	−118	−1426
35B	Petrol. & Rel. Prod.	11	109	138	20	37	22	118	16	60	531
355	Rubber Products	−121	−313	−374	−134	−299	−148	−267	−73	−238	−1967
36A	Nonmetal Min. Prod.	65	318	446	182	315	152	273	127	265	2144
362	Glass & Glass Products	−26	−206	−189	−16	−135	−43	−53	−10	−75	−753
371	Iron & Steel	−384	−1794	−3524	−379	−613	−536	−531	−210	−626	−8596
372	Nonferrous Metals	−294	−765	−1539	−262	−476	−412	−425	−116	−589	−4877
381	Metal Products	−1049	−2194	−3576	−859	−1362	−722	−975	−356	−1490	−12583
382	Nonelectric Machinery	−1503	−2445	−3569	−1360	−1433	−634	−1309	−649	−2549	−15452
383	Electric Machinery	−6673	−14762	−19561	−4419	−8511	−3888	−5698	−2712	−11756	−77980
384	Transportation Equipment	−4583	−7527	−24599	−4725	−5896	−3088	−5069	−1392	−11087	−67887
38A	Miscellaneous Manufac.	−3810	−8558	−9497	−3389	−6469	−2621	−4078	−1773	−6015	−46211
4	Electric, Gas & Water	686	2270	2594	1157	2688	1456	1846	1034	1916	15647
5	Construction	1932	4906	5980	3288	8269	2895	6991	3221	6173	43657
6	Wholesale & Ret. Trade	13386	38722	46274	21186	41504	14508	27791	14710	40321	258403
7	Transp., Stor. & Com.	521	1932	1924	1100	1740	596	1199	630	1671	11312
8	Fin., Ins. & Real Estate	7268	22604	19669	8364	18800	5644	13356	6588	20140	122433
9	Comm., Soc. & Pers. Serv.	−19998	−55952	−57551	−25972	−58030	−19184	−32973	−17884	−49428	−336973
	Total	−9041	−9318	−28970	8129	11594	3574	12631	6780	4622	0

TABLE 5
Change in US Employment by Region and Occupation due to 25 Per Cent Reductions in Military Spending in the NATO Countries
(Number of Workers)

Occupation	*Region*									
	New England	*Middle Atlantic*	*East North Central*	*West North Central*	*South Atlantic*	*East South Central*	*West South Central*	*Mountain*	*Pacific*	*Total*
Executive	−147	2168	1118	1344	2584	930	2652	1262	2055	13966
Professional	−6457	−15180	−17337	−7214	−14111	−4729	−7621	−4430	−13570	−90648
Technical	−1490	−2786	−3844	−1430	−2821	−806	−1345	−885	−3133	−18540
Marketing/Sales	4907	13861	15627	7190	14490	5264	10106	4442	13946	89832
Administrative/Clerical	−391	1970	−1195	848	1204	339	2518	683	987	6963
Services	−1808	−5065	−4123	−1667	−3888	−1931	−2854	220	−1384	−22500
Agriculture	1053	2287	6008	8491	6407	2928	4862	2489	6672	41196
Skilled	−1570	−863	−4783	1476	4105	1278	3369	1992	−314	4688
Semi-/Unskilled	−3137	−5709	−20441	−908	3625	302	944	1005	−638	−24957
Total	−9041	−9318	−28970	8129	11594	3574	12631	6780	4622	0

TABLE 6
US Labour Market Dislocation Measures
(Number of Workers; Millions of Dollars of Lost Wages)

Labour Dislocation	*Number of Workers*	*Millions of Dollars of Lost Wages*
Across Sectors	574,703	2,261
Across Occupations	156,645	726
Across Regions	47,329	188
Across States	52,129	202
Across Occupation and Region	172,004	725
Across Occupation and State	178,347	744

while others will experience declines. This suggests that workers will need to move among these various segments of the labour force in order to remain employed and therefore, depending on how difficult or costly such movement turns out to be, that there could conceivably be considerable costs in terms of labour market dislocation.

Labour market dislocations can take several forms and it is difficult to know which are the most serious and how they can be compared. Some workers may lose their jobs in particular industries, but because they live in regions where employment is otherwise expanding, they may have no difficulty in finding work in another industry. Similarly, other workers in contracting sectors may possess skills that are in great demand elsewhere, and they too may be able to relocate quickly and easily. Since one cannot know how individual workers will experience these different effects, we report a variety of different measures of labour market dislocation. Each focuses on a different dimension of adjustment that workers may have to make. All of the measures are necessarily derived for the level of aggregation that is built into the model. The results are reported in Table 6.

The first measure reported focuses only on industrial sectors, that is, the numbers of workers who would have to move from one sector to another, at prevailing relative wages, to find work. This is calculated as the sum of the employment changes for those sectors where employment declines. This would be the best measure of labour market dislocation under the assumption that the most difficult transition for a worker to make is from one sector to another, while changes in occupation and/or location are relatively easy. Since the latter assumption is in fact implausible, several other measures of labour market dislocation are calculated to reflect alternative assumptions that occupations and/or locations are the most difficult to change.

The measure of labour market dislocation across sectors indicates that 574,703 US workers would have to shift their employment out of their present sector to some other sector. This shift amounts to about 0.5 per cent of 1989 total US employment. These workers would presumably find employment in the sectors

for which employment is expanded, but without regard to their particular occupation or region. Workers who would have to change occupation and possibly move across regions/states as well would probably experience the most severe dislocation. But it is interesting that the labour market dislocation measures across occupations, across regions/states, and across occupations and regions/states are all considerably smaller than the intersectoral employment shifts noted.

g. Wage Losses Due to Labour Market Dislocation

The various employment changes reported can also be used to calculate estimates of wage losses due to the reductions in military spending. As mentioned above, we have utilised data drawn from the January 1990 Displaced Worker Survey (DWS) that provides information for 1989 on the wage before displacement and the duration of unemployment. It is then possible to calculate the average wages lost by sector, occupation and location to correspond with the categories used in the employment change calculations. Assuming that this experience would be characteristic of the workers who would experience displacement due to the reductions in military expenditures, one can then multiply the number of displaced workers times the average wage loss.

The results are reported in the last column of Table 6. It can be seen that the total wage loss across sectors is $2.3 billion. The total wage loss across occupations is $726 million, across regions and states $188 and $202 million, respectively, and across occupation/region and occupation states $725 and $744 million, respectively. It should be noted that these wage loss calculations and the associated calculations of labour market dislocations are based on the assumed 25 per cent reduction of military expenditures across all NATO countries at a single point in time. If, instead, these reductions were carried out over a period of years, the calculated employment dislocations and wage losses would then be smaller on an annual basis as compared to those shown.[11]

6. CONCLUSIONS AND IMPLICATIONS

In the long run, a reduction in defence spending is generally regarded to have a positive impact on an economy. In the short run, however, a reduction in defence outlays could result in unemployment and adjustment pressures in at least some sectors of the economy. In order to facilitate a smooth transition, government assistance, if deemed necessary, should be pointed in the right direction.

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[11] Account would also need to be taken of worker attrition due to voluntary quits and retirement decisions. Further, allowance should be made for sectoral relative wage adjustments that would affect worker incentives for changing employment between sectors.

Our results suggest that, while the impacts of a coordinated 25 per cent reduction in military expenditures in the NATO countries do not appear to be large in the aggregate,[12] the negative sectoral net employment impacts in the United States and other countries appear to be concentrated in certain specific sectors, such as basic metals and metal products, durable goods industries, and community, social and personal services. The sectoral employment changes for the United States have been decomposed by occupation and location in order to provide some indication of the negative and positive effects across these various dimensions that reflect the changes in the demand for labour associated with the military expenditure reductions. Calculations of various measures of labour market dislocations and estimates of the associated wage losses provide some insight into the magnitudes of the labour market adjustments and adjustment assistance needed to effect the transition involved in shifting from defence to nondefence expenditures in the United States in particular. There may be adjustment problems in the other NATO countries as well, but the requisite data to assess the magnitudes are not readily available and must therefore await further research.

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[12] Dunne (1991) reaches similar conclusions to ours using an empirical analysis based on regression methods as well as citing the results of earlier studies based on input–output methods.

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