From Conscription to Volunteers: Budget Shares in NATO Defence Spending

Vincenzo Bove * Elisa Cavatorta †

October 29, 2010

Abstract

A growing number of NATO countries suspended compulsory military service during the past decade or are now phasing it out, moving to an All Volunteer Force (AVF). An AVF can free resources available for investment in up-to-date equipments, thus improving operational capabilities. Our paper investigates shifts in NATO military expenditure shares on personnel, equipment, infrastructure and other costs over the period 1970-2008 and explores the impact of the transition to AVFs on these shares of the defence budget. Results suggest that while the end of conscription did not reduce the share of spending on personnel, NATO forces are increasingly less reliant on soldiers and more on capital.

Keywords: Volunteer Forces, Defence Budget, Military personnel, NATO
JEL Classification : C33, H56, J20

*Corresponding author: School of Economics, Mathematics and Statistics, Birkbeck College, University of London, Malet Street, London, WC1E 7HX, United Kingdom. *E-mail*: vbove@ems.bbk.ac.uk. We thank Ron Smith for his help and expert guidance throughout this research. We are grateful to two anonymous referees for their comments, Yunus Aksoy, to the seminar participants at Birkbeck College and the participants at the 14th Economic and Security Conference, Izmir. The responsibility for any errors or omission is our own.

†School of Economics, Mathematics and Statistics, Birkbeck College, University of London, Malet Street, London, WC1E 7HX, United Kingdom. *E-mail*: ecavatorta@ems.bbk.ac.uk.

1 Introduction

Since the Cold War ended, sixteen of NATO's twenty-six member states have suspended compulsory military service, while others are phasing it out, joining the US, Canada, the UK and Luxembourg in the group of All-Volunteer Forces (AVF, see Table 1). The transition to smaller professional militaries has reduced the intake of troops and has forced military organisations to shift their cost structure to eliminate labour priced below the market.

This paper examines the effect of moving from conscription to volunteers on the shares of military budget devoted to personnel, equipment, infrastructure and other costs. To the best of our knowledge, a disaggregated analysis of NATO defence expenditure components has never been done before. Since ending conscription tends to have two effects that go in opposite directions, fewer soldiers paid higher wages, it is not obvious what is the net effect on personnel cost. This is something that has to be determined from the data. This is an important issue since recruiting an adequate number of young citizens on an annual basis is crucial for the armed forces, particularly for those actively deployed in operations abroad. NATO countries are among the main peacekeeping contributors and aspire to keep a global military presence around the world. The rising number of casualties and decreasing domestic support for ongoing operations underline the importance of volunteers' recruitment and high-technology equipment acquisition, if NATO is to maintain its military at the required level. Due to the high cost of weapons and the defence budget cuts, NATO members can no longer afford to fight today's wars while insisting on the acquisition of top-end equipment.

Although the economic, demographic, labour, and social context at the time All Volunteer Forces (AVF) policy is introduced varies among NATO countries, section 2 identifies some common factors determining the suspension of conscription. Section 3 describes the extent to which military personnel and physical inputs have been substitutable for each other in NATO armed forces during the transition to AVF. Section 4 sets up a simple model to determine the demand function of each component of military expenditure and to derive the econometric specification. We represent the military possibility frontier as a transcendental logarithmic production function with four inputs. This allows the indirect estimation of the drivers of the input prices through a translog cost function with symmetry. Section 5 describes our dataset. Section 6 presents and interprets the empirical results. They suggest that while the abolition of conscription did not lower personnel costs as a share of the defence budget, it has led to a more pronounced technological emphasis and an increased dependence on infrastructure. Section 7 draws some policy-relevant implications.

2 Moving to an All-Volunteer Force

Since the supply and demand for military personnel are subject to the forces of the labour market, economists played a key role in the conscription debate. For example, the decision to move to an AVF in the US was a policy reform supported by persuasive economic arguments. This is discussed in Altman & Barro (1971); Oi (1967); Altman & Fechter (1967). Moving to an AVF system has been justified by three main arguments: it is an inequitable tax on conscripts; a higher personnel retention rate; and a changing post-Cold War geostrategic environment.

Conscripts are usually paid less that their alternative wage plus compensation for loss of civilian life and it is costly to prevent evasion of conscription (Warner & Negrusa, 2005). Performance incentives under a conscription system are usually negative, often taking the form of punishment. Thus maintaining a minimum degree of compliance may become costly. The need to recruit volunteers usually improves the conditions of military life. AVF systems often provide benefits such as training and post-service education, health care and pensions to attract and retain high-quality staff.[1]

The second argument recognises that AVFs efficiency comes also from a higher personnel retention rate. Indeed, for the military, the employment of volunteers is more cost-effective due to longer terms of service (and thus higher skill levels, lower personnel turnover, less demand for new recruits and reduced training costs). Retention policies normally include a contractual commitment, usually a fixed-term contract that covers the initial training and a subsequent period of employment. NATO members are active contributors to peace and crisis management operations around the world. This requires cost-effective expeditionary capabilities and quick deployability to respond to crises. While conscripts may be precluded from out-of-area missions by law, the AVF model with a high retention rate is better suited to rapid response in crisis.

For the Central and Eastern European member states there are also geostrategic considerations playing into their decision to shift to an AVF system. In the new post-Cold War security environment, the prospect of collective defence and the integration into NATO for missions around the world made military downsizing possible. Moreover, alliance leaders considered sizeable conscript forces as a vestige of the Cold War.[2]

There are also arguments in favour of conscription, mainly budgetary considerations. Although the Cold War was followed by a reduction in military budgets and a cut in the number of uniformed troops serving, the level of military pay necessary to make the military career competitive and the costs to train longer-serving volunteer is higher than when conscription was in place. Attracting and keeping high-quality personnel has been a chal-

lenge for the military in Western countries, since the end of compulsory service. As a result of greater private-sector opportunities, the military has had to adjust salaries to match those in the private-sector (e.g. Williams, 2005; Hosek & Sharp, 2001). As the supply curve is not perfectly elastic, to attract or retain more people, remuneration has to be increased. Higher military compensations might eventually trade off with military research and development.

Moreover, a government budget under strain results in a decline in the personnel budget or a reduction in the force size. The Stability and Growth Pact has imposed limits on European countries, increasing the pressure to reduce the defence spending as well as the budget allocated for military personnel. This drop in military pay has three important effects. Firstly, it results in lower entry standards. Warner & Asch (1995) use post Cold-War market factors affecting the supply of military personnel (e.g. relative military pay, recruiting goals, enlistment incentives and unemployment) to estimate how those factors, and hence the state of the civilian economy, affect high-quality enlistment. They argue that high-quality military recruitment is sensitive to business cycles and to attendance to post-secondary education. More generally, recruiting and retention plummet during economic booms. Secondly, while conscription promotes social integration, in low remunerated AVF systems, social minorities are usually over-represented. As a result the social make-up of the armed forces do not present an accurate picture of society-at-large.[3] Finally, a drop in military pay can result in a decline in retention (Warner *et al.* , 2008).

3 Factor substitution

The end of the Cold War has dramatically reduced the number of new recruits. Figure 1 shows the drop in the number of military personnel as percentage of the national labour force. This remarkable reduction was particularly pronounced in the decade 1990-2000, due to a changing geopolitical situation. The end of the Cold War has also prompted a number of European countries to phase out conscription. The consequent decline in the availability of surplus troops has resulted in an increased cost of labour. Moreover, a long-term technological trend has reduced the demand for raw numbers and increased the premium for skills. As the technical skills required in the military organisations have become more demanding, more time and funding are invested to provide adequate training to a restricted number of personnel to operate high-technology equipments.

Factor substitution can be seen in the relative trends of the shares of the defence budget. We disaggregate the defence expenditure into four components. (i) The share of expenditures on personnel, which includes the com-

pensation of military and civilian personnel (e.g. basic pay, allowances for food and housing and the pension). Following the NATO definition, military personnel also includes paramilitary units (e.g. the French Gendarmerie). (ii) The share of expenditures on equipment (e.g. troop outfitting, armed equipments, research and development). (iii) The share of expenditures on infrastructure (e.g. military bases, airfield and communications). (iv) A residual shares of expenditures, which includes operations and maintenance (e.g. fuel).

Table 4 shows the evolution of these shares of the defence budget. Figures are five-year averages computed at the beginning and at the end of the period considered in this study: 1970-74 and 2004-08. The recent trend reveals more technological emphasis in the defence expenditure. With few exceptions, countries with an AVF model generally devote a smaller share of their budget to personnel expenditures and a larger share to the purchase of new equipments than countries still retaining a conscription model do. Germany has a compulsory 9-month conscription, resulting in a higher than average expenditure on personnel. Belgium and Italy are the only exceptions within the sample, their budget shows increasing shares devoted to personnel. However, Italy ended conscription in 2005 and is still in a transitional phase.

Anticipated savings from the suspension of conscription may not materialise as soon as predicted due to the presence of programs protecting civilian employees. These programmes delay the close-down of redundant military bases. Moreover, because the transition to an AVF system is gradual, it might show effects opposite to those expected. In the US, for example, during the first few years of the AVF implementation, the share of military spending devoted to personnel rose, despite a reduction in the size of the armed forces. However, it is difficult to draw clear conclusions, since the AVF transition for the US occurred during the withdrawal from Vietnam.[4] Netherlands and Belgium show the same pattern and suggest an increase in the spending on personnel after the AVF advent. Overall, Table 5 shows a reduction in military expenditures after the end of the conscription system.

4 Theoretical model

Dunne *et al.* (2008) group empirical studies on the determinants of military spending into arms race models and those studies focusing on a range of economic, political and strategic determinants of military spending. We are not concerned with explaining the level of military spending but with the choice of inputs into it.

We start with a twice differentiable aggregate military production function, relating a defence output Y to four inputs: personnel, x_P, equipment

x_E, infrastructure, x_I and other costs, x_O. We assume that the technological progress is Hicks-neutral (i.e. it does not affect the inputs' balance). The corresponding cost function may be written as $M = M(Y, p_P, p_E, p_I, p_O)$, where M is the total cost as a function of the four input prices and output. A sufficiently flexible specification can be envisaged as a nonhomothetic translog cost function following from a second-order Taylor's series approximation in logarithms to an arbitrary cost function (Berndt, 1991). In nonhomothetic specifications, the ratios of cost-minimising inputs demand are allowed to depend on the level of output. For our four inputs model, we write the translog cost function as

$$\begin{aligned} \ln M &= \ln \alpha_0 + \sum_j \alpha_j \ln p_j + \frac{1}{2} \sum_j \sum_k \gamma_{jk} \ln p_j \ln p_k \\ &\quad + \alpha_Y \ln Y + \frac{1}{2} \sum \gamma_{YY} (\ln Y)^2 + \sum_j \beta_j \ln p_j \ln Y \end{aligned} \tag{1}$$

with $j, k = P, E, I, O$.

The conditions for symmetry and homogeneity of degree one in the input prices are

$$\sum_j \alpha_j = 1, \;\; \sum_{jk} \gamma_{jk} = \sum_j \beta_j = 0, \;\; \gamma_{jk} = \gamma_{kj}, \;\; j \neq k \tag{2}$$

The translog cost function can be expressed in terms of the cost-minimising input demand equations transformed into cost share equations. If one logarithmically differentiates (1) with respect to input prices and then employs the Shephard's Lemma

$$x_j = \frac{\partial \ln M}{\partial \ln p_j}, \quad (j = P, E, I, O) \tag{3}$$

one obtains cost share equations of the form

$$w_j = \frac{p_j x_j}{M} = \alpha_j + \sum_{k=1}^{4} \gamma_{jk} \ln p_k + \beta_j \ln Y \quad (j, k = P, E, I, O) \tag{4}$$

where M is the total cost (i.e. $M = \sum_j p_j x_j$). w_j is the cost share of each input in the total cost of producing output Y, which we proxy by real military expenditure (M/p), where p is a general price index. The input prices are a particular problem in this context because they are not available from any source. However, since input prices are affected by some general costs (e.g. inflation, interest rates, labour cost), we can use these general drivers of input prices to determine the demand function. Assuming that any input price can be specified as:

$$\ln p_j = \sum_{h=1}^{n} \beta_{jh} C_h \tag{5}$$

where C_h is a cost driver, the shares of military expenditure will be expressed as:

$$\begin{aligned} w_j &= \alpha_j + \sum_{h=1}^{n} \delta_{jh} C_h + \beta_j \ln(M/p) \\ \delta_{jh} &= \sum_{k=1}^{4} \gamma_{jk} \beta_{kh} \end{aligned}$$

The dependent variables are the j shares ($j = P, E, I, O$) of the four components of military expenditure, C_h are the n drivers of input prices, M/p is the real defence expenditure. Notice that the price coefficients themselves are not recoverable, so we cannot impose homogeneity or symmetry. Adding up will hold automatically by the properties of least squares, i.e. $\sum_j \alpha_j = 1$, $\sum_j \delta_{jh} = \sum_j \beta_j = 0$, however the translog system does not guarantee that the predicted shares will lie between zero and one.[5] For estimation, we have data for countries $i = 1, 2, ...13$ for time periods $t = 1970 - 2008$. We add a disturbance assumed to be homoskedastic and serially uncorrelated; we assume that the intercepts, α_{ji}, differ by country, allowing the direct effect of prices to differ, but that the cross-price effects are similar across countries, giving homogeneous slopes and also allow for unobserved global cost or technology shocks, α_{jt}. This gives the 2-way fixed effect estimating equations

$$w_{jit} = \alpha_{ji} + \alpha_{jt} + \sum_{h=1}^{n} \delta_{jh} C_{hit} + \beta_j \ln(M/p)_{it} + \varepsilon_{jit} \tag{6}$$

Equation 6 is a static model, which can be interpreted as capturing the long-run equilibrium. Shocks, depreciation, slow adjustment and expectations would induce dynamic elements. Introducing dynamics into panel complete demand systems involves some complications and is left as topic for future research.

5 Data

We collected series of disaggregated military expenditures expressed as a share of the defence budget for 14 NATO countries. Using the shares adjusts for inflation changes and defence expenditure growth. Hence, the figures are directly comparable among countries. The shares also reflect national

governments' priorities for their armed forces and are a major source of debate in budget planning.

The shares of the defence budget on personnel and equipment originate from NATO reports and have been subsequently assembled and processed by the Division of Defence Analysis at the Swedish Defence Ministry.[6] The dataset provides also estimates of the real defence expenditure deflated by CPI (expressed in million USD, constant 1995 prices). The dataset is updated with figures from the Stockholm International Peace Research Institute (SIPRI) for the period 2002-2008.[7] The "residual" share of defence expenditure calculated from these sources includes infrastructure and other military expenditures. The International Institute for Strategic Studies (IISS) provides figures for the share of infrastructure in defence expenditure in annual issues of the Military Balance. Figures are available from 1980: the period 1980-1999 includes five-year averages; annual figures are available from 1999. The share on infrastructure is subtracted from the "residual" series from the NATO-SIPRI dataset and gaps years are filled in by the growth rates of the "residual" series. Whenever possible, we compare overlapping years from the NATO dataset, the Military Balance and SIPRI to check the consistency of our series across different sources. These are the best data available on the components of military expenditures, but because countries may not define the components in exactly the same way they are likely to be subject to measurement errors.

The cost drivers used are the nominal interest rate, inflation rate, log per-capita GDP (as a measure of labour cost). These data are taken from the the World Bank Development Indicators (WDI) database. The analysis is applied to 13 NATO members. Initially Turkey was included in the analysis, but the assumption of slope homogeneity proved much less plausible when Turkey was included. Turkey is a developing economy in which the economic and political weight of the armed forces differs from that of NATO's Western members. For these reasons, Turkey would require a separate analysis.

6 Empirical results

To investigate the impact of the transition to AVFs on the balance between military expenditure on personnel, equipment and infrastructure, we use a two-way fixed effect model (2-way FE), which is preferred among a variety of specifications according to the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) for model selection.[8] We compare the model with the 1-way FE model in Table 8. The 2-way FE estimates are shown in Table 6.

The time period considered in this analysis is 1970-2008, determined by available data. Clearly, Europe experienced important structural changes

during this period. Among these, the end of the Cold War triggered major readjustments in military expenditures in European armed forces. The time effects in the 2-way FE specification allows for specific year effects. However, the slopes may differ between the Cold War period and the subsequent period. We test this possibility by comparing models fitted over the whole period against those fitted over the two sub-periods (Table 8). We present the 2-way FE model estimated in the two sub-periods in Table 7.

In the baseline 2-way FE model over the whole period (1970-2008; Table 6) the AVF dummy has a significant impact on the share of equipment and infrastructure. The suspension of conscription seems to reduce the share of expenditure on equipment while it increases the share on infrastructure. Although not statistically significant, the AVF system has the effect of increasing the share of expenditure on personnel. The positive sign of the coefficient suggests that professional forces do not lower personnel costs.

There is evidence that real interest rate is an important driver of defence spending allocations. The estimates show that the share of expenditure on infrastructure and other costs are sensitive to real interest rate while the share on personnel is more responsive to inflation changes.

In Table 6, log per-capita GDP, the proxy for labour cost, despite not being statistically significant, has the expected sign. The lack of significance might be due to the choice of the proxy. Probably the most interesting finding is that, as labour cost increases, there is a greater emphasis on equipment and infrastructure and less reliance on soldiers.

The defence expenditure elasticity of personnel is significantly less than unity. As defence expenditure increases, the share on personnel rises less than proportionately. On the contrary, equipment and infrastructure show an income elasticity greater than one. High technological equipment and viable infrastructure are vital to NATO missions and operation efficacy. The results show that, as the defence budget increases, the emphasis on technology increases more than proportionately.

The model selection criteria suggest that there is evidence of a break in the relationship. The end of the Cold War triggered major changes in the strategic environment and in the structure and organisation of NATO forces. The fall of the Berlin Wall (1989) is commonly considered as the watershed to mark these changes. Certainly, some of the structural changes began before 1989; some others took place only later. Table 8 shows the values of the maximised log-likelihood (MLL), the AIC and the BIC considering a break in 1989. A 1-way fixed effect and a 2-way fixed effect specification are estimated for the whole period (1970-2008) and for two sub-periods split in 1989 (1970-1989; 1990-2008). For both specifications, the model accounting for the two sub-periods is preferred.[9]

We take into account the 1989 break by estimating a 2-way FE model over

two sub-periods, before the end of the Cold War (1970-1989) and after the end of the Cold War (1990-2008). The estimates are shown in Table 7. There are some major differences between the two periods. In the first period, there are stronger defence expenditure elasticities. The defence expenditure elasticities of equipment, infrastructure and other costs are greater than one, reflecting the arms races in technology and nuclear power typical of the Cold War period. In the second period, as budget increases, the emphasis on infrastructure and other costs persists, but the estimates of this sensitivity have smaller sizes. In the second period, the importance of the labour cost becomes more relevant. As labour cost increases, the share of expenditure on personnel decreases while the share on other costs increases.

In the first period, the AVF dummy is strongly significant for the share on personnel, infrastructure and other costs. This reflects the US move to AVF as no other transitions occurred in that period. In the second period, the AVF dummy has no significant effect on any of these shares. The pattern is the one emerging in the whole period and described above: the AVF model of recruitment does not lower personnel costs.

In the model presented in Table 6 there is an issue of endogeneity of military expenditure. The Durbin-Wu-Hausman test rejects the hypothesis of exogeneity of the defence budget for personnel and other costs when instrumenting military expenditure with one lag of military expenditure. There are several reasons why military expenditure might be correlated with the residuals of the demand system. A static system can be interpreted as a two stage budgeting, where the first stage determines the total military budget and the second stage determines the allocation of the budget among categories within the period. If intertemporal country preferences are correlated with individual shocks in the demand system, the residuals of the demand system will be correlated with the allocation of spending over time and hence with the budget variable. For instance, countries willing to project their power through the deployment of soldiers abroad, they might have a larger military budget as well as a high share of military personnel. Another reason for the possible correlation between the residuals and (log) military expenditure is the presence of measurement errors. Since data are taken from different sources, this possibility is likely to arise. Exogeneous variation in this context should come from a variable that explains the variability of the military budget while being uncorrelated with a country's shock (e.g. strategic considerations, organisational preferences) and/or measurement error. Addressing the issue of endogenous military expenditure is a topic for further research. The estimates can be interpreted as the best linear unbiased predictors of the expenditure shares conditional on military expenditures.

7 Conclusion

There is a tendency for NATO members to rely progressively more on volunteers to fill their military ranks. While in the past, conventional wars required mass conscript armies, modern peace operations require well-equipped, mobile, professional, rapid response forces. These forces should also be able to plan preventive actions, including intense combat operations. By seeking to reform their armed forces, NATO members are paying increasing attention to the procurement of new military technologies and to the development of special operations forces and light- and medium-sized military units. To this end, the AVF model is required for a flexible and high-technology military.

Our results suggest that NATO forces are increasingly less reliant on soldiers and more on capital. However, the end of conscription did not reduce the share of spending on personnel. Views of the appropriate balance between military personnel and physical inputs vary across the alliance. The personnel downsizing in the period 1989-2008 has created several challenges, resulting in severe staff imbalances and costs higher than planned. The existence of a transition period indicates that the expected improvements will not be visible for some years following the elimination of the conscription system. This might result in temporary higher costs of personnel, which might drain resources otherwise needed for the acquisition of new equipment and its maintenance. Certainly, the quality of new recruits will be fundamental to match the skills required to operate out-of-area missions and maintain increasingly high-technology equipments.

Military manpower is the primary instrument of military power, therefore understanding how the increasing cost of labour has affected the substitution of labour for capital and the retention of trained individual is fundamental to assess NATO capabilities in the near future. To this end, there is an increasing need of economic studies to inform policies related to the AVF in the future.

Notes

[1]In the US, money for post-service education (e.g. college, technical schools) helped to attract people with higher-than-average skills and cognitive aptitudes, who are likely to be more successful in the military (Williams, 2005).

[2]The Romanian Parliament, for example, voted to abolish conscription in October 2005, with the vote formalising one of many military modernisations that Romania agreed to when it joined NATO.

[3]Simon & Warner (2007), using US data over the 1988-2000 (a period of decreasing unemployment rate), find no disproportionate recruiting from minority groups.

[4]Nelson (1986) suggests that this increase was due to a rise in the number of first-term enlistees who left the service before the end of their contract.

[5]One could use a logit tranformation of the shares to ensure that predicted shares lay in the zero-one interval, but then adding up would be lost.

[6]The dataset is part of the Defence Expenditure Studies - Data on NATO Defence Expenditures and Economic Development 1949-2001 by the Department of Security Policy and Strategy - Division of Defence Analysis, Defence Ministry of Sweden.

[7] SIPRI provides estimates of real defence expenditures in million USD in constant 2005 prices and constant exchange rate. These are made compatible with the earlier series expressed in constant 1995 prices. Using a constant exchange rate assumes that PPP holds. To transform the series in constant prices, SIPRI deflates the military expenditure expressed in local currency by a local price index. Local price indexes might be poor approximations of the evolution of military prices. However, there is no available index for military prices.

[8]The 2-way FE model is superior to the Pooled OLS model and the 1-way FE model. The 2-way FE allows for more flexible estimates since it allows the constants to vary. However, it imposes the equality of slopes and variances. Heterogeneity in slopes might be an issue. If slopes are heterogenous, the fixed effect model produces unbiased estimates of the average effects, provided that the differences in coefficients are independent of the regressors.

[9]According to the BIC, estimating two separate sub-periods leads to the selection of the 2-way FE model. AIC selects the 2-way FE model for the share on infrastructure and other cost and the 1-way FE model for the share on personnel and equipment. Since the differences are very small, we select a 2-way FE specification and we estimate the relationship accounting for the break in 1989. The estimates are shown in Table 7.

References

Altman, S.H., & Barro, R.J. 1971. Officer supply: The impact of pay, the draft, and the Vietnam War. *The American Economic Review*, 649–664.

Altman, S.H., & Fechter, A.E. 1967. The supply of military personnel in the absence of a draft. *The American Economic Review*, **57**(2), 19–31.

Berndt, Ernst R. 1991. *The Practice of Econometrics: Classic and Contemporary*. USA: Addison-Wesley Publishing Company.

Dunne, J.P., Perlo-Freeman, S., & Smith, R.P. 2008. The demand for military expenditure in developing countries: hostility versus capability. *Defence and Peace Economics*, **19**(4), 293–302.

Hosek, J., & Sharp, J. 2001. Keeping military pay competitive: the outlook for civilian wage growth and its consequences. *RAND, Santa Monica CA*.

Nelson, G. 1986. The supply and quality of first-term enlistees under the all-volunteer force. *The All-Volunteer Force After a Decade, Washington, DC: Pergamon-Brasseys*, 23–51.

Oi, W.Y. 1967. The economic cost of the draft. *The American Economic Review*, **57**(2), 39–62.

Simon, C.J., & Warner, J.T. 2007. Managing the all-volunteer force in a time of war. *Economics of Peace and Security Journal*, **2**(1), 20–29.

Warner, J., & Negrusa, S. 2005. Evasion costs and the theory of conscription. *Defence and Peace Economics*, **16**(2), 83–100.

Warner, J.T., & Asch, B. 1995. The economics of military manpower. *Handbook of Defense Economics*, **1**, 347–398.

Warner, J.T., Miller III, J.C., & Asch, B.J. 2008. Economics and the All-Volunteer Force. *American Economic Association Meetings*.

Williams, C. 2005. From Conscripts to Volunteers: NATO's Transitions to All-Volunteer Forces. *Naval War College Review*, **58**(1), 35–62.

Table 1: NATO members with and without mandatory military service.

Country	Abolished/Suspended	Notes
Albania	Abolished Jan 2010	-
Belgium	Suspended Jan 1994	Under the "'Delacroix Bill"' of 6 July 1993
Bulgaria	Abolished Jan 2008	Last conscripts sent home Nov 2007
Canada	No Conscription	Never taken place in peacetime
Croatia	Abolished Jan 2008	Full conversion to AVF[1] by 2010
Czech Republic	Abolished Dec 2004	Last intake Apr 2004. No conscripts from Jan 2005
Denmark	Compulsory (ages 18-27)	4 - 12 months
Estonia	Compulsory (ages 16-60)	8 -11 months
France	Suspended 2001	Last intake 2001. Since 1954 never deployed abroad
Germany	Compulsory (ages 18-27)	9 months. Alternative service permitted.
Greece	Compulsory (ages 19-45)	12 months for all services
Hungary	Abolished Nov 2004	No conscripts serving from Aug 2005
Iceland	No Conscription	No Armed Forces
Italy	Abolished Jan 2005	No conscripts serving from Jan 2005
Latvia	Abolished Jan 2007	Every citizen is entitled to serve in the AF for life
Lithuania	Suspended Sept 2008	Before 2008 compulsory for 19-26, 12 months
Luxembourg	Abolished 1967	17-25 years of age for AVF
Netherlands	Suspended 1992	Last conscripts demobilized in 1996. 20 years of age for VMS
Norway	Compulsory (ages 19-44)	8-12 months. Seldom called to duty after age 30
Poland	Suspended Dec 2008	No conscripts serving from 2012
Portugal	Abolished Nov 2004	18 years of age for AVF
Romania	Suspended Oct 2006	18-35 years of age for AVF
Slovakia	Abolished Jan 2006	No conscripts serving from Jan 2007
Slovenia	Abolished in Sept 2003	17 years of age for AVF
Spain	Abolished Mar 2001	No conscripts serving from Jan 2002. 20 years of age for AVF
Turkey	Compulsory (ages 20-41)	6-15 months. Delays to complete higher education programs
United Kingdom	Abolished 1960	16-33 years of age (officers 17-28) for AVF
United States	Active con. ended in 1973	18 years of age for VMS. Obligation 8 years

[1] AVF= All Volunteer Force.
Source: CIA The World Factbook, United Nations High Commissioner for Human Rights, United Press International, BBC News, El Mundo, CPTI Bulletin, Albanian Times.

Table 2: NATO Operations, 1999-2009

Current Missions		Completed Missions	
Kosovo	1999 -	Bosnia and Herzegovina	1995 - 2004
Monitoring the Mediterranean Sea	2001 -	Republic of Macedonia	2001 - 2003
Afghanistan	2003 -	Pakistan earthquake relief op.	2005 - 2006
NATO Training Mission in Iraq	2004 -	Counter-piracy Gulf of Aden	2008
Supporting the African Union	2005 -		
Counter-piracy Gulf of Aden	2009 -		

Source: IISS Military Balance

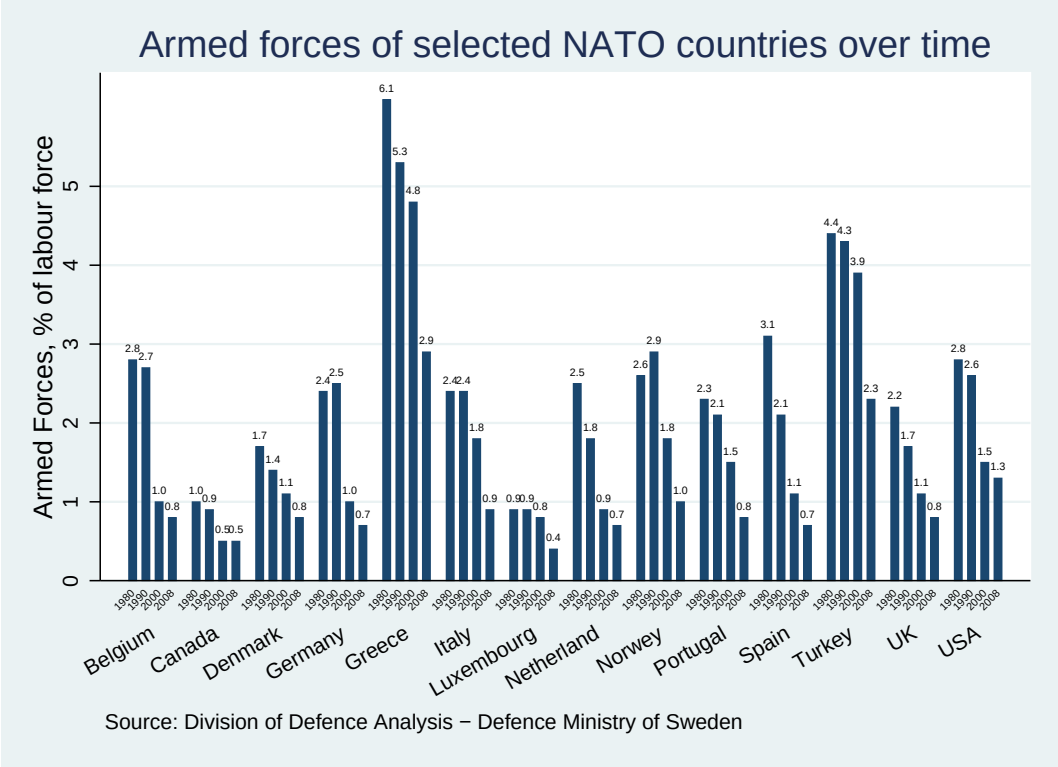

Figure 1: NATO Armed forces 1980-2008. Source: Defence Ministry of Sweden

Table 3: Forces of European NATO Members in Multilateral Peace Operations, 2008

Country	EU Operations	NATO and NATO-led	UN
Albania ∗	76	140	0
Belgium	64	609	329
Bulgaria	119	507	0
Croatia ∗	0	300	112
Czech Republic	2	819	0
Denmark	0	1069	4
Estonia	2	162	0
France	1859	4559	2068
Germany	114	5729	228
Greece	49	768	46
Hungary	159	705	128
Italy	370	4447	2325
Latvia	2	90	0
Lithuania	3	240	0
Luxembourg	3	31	0
Netherlands	145	1785	3
Norway	0	477	14
Poland	619	1434	829
Portugal	56	331	144
Romania	53	890	0
Slovakia	40	321	196
Slovenia	45	355	14
Spain	354	1412	1136
Turkey	232	1399	491
Ukraine	0	196	286
United Kingdom	13	8925	284

∗ Joined the alliance on 1 April 2009. Source: SIPRI database.

Table 4: Long-Run Trends of military shares

	Personnel		Equipment		Infrastructure		Other	
Country	1970-1974	2004-2008	1970-1974	2004-2008	1970-1974	2004-2008	1970-1974	2004-2008
Belgium	62.62	71.36	10.73	5.70	3.79	2.43	22.86	20.51
Canada	65.81	45.88	7.32	16.97	2.90	3.69	23.97	33.47
Denmark	58.96	52.21	16.41	10.77	1.71	2.77	22.92	34.25
Germany	50.80	57.41	16.50	14.22	6.23	4.82	26.47	23.56
Greece	67.71	62.82	8.33	10.60	2.59	1.26	21.37	25.33
Italy	60.34	68.72	15.41	11.77	1.30	1.60	22.95	17.91
Luxembourg	83.48	50.27	1.50	11.59	5.29	2.73	9.73	35.41
Netherland	65.53	47.70	12.83	18.37	2.44	3.76	19.21	30.17
Norway	52.13	45.35	15.19	23.77	4.40	5.45	28.28	25.43
Portugal	25.46	20.83	3.55	3.09	0.58	0.92	70.41	75.16
Spain	.	57.47	.	23.96	.	3.98	.	14.58
Turkey	96.34	39.65	3.73	29.71	.	7.93	.	22.72
UK	48.94	40.40	16.65	22.90	4.99	0.80	29.43	35.89
USA	32.92	32.58	21.48	21.58	2.42	1.67	43.19	44.17

Table 5: Defence Spending Before and After the AVF Transition - 5 years averages

Country		Personnel	Equipment	Infrastructure	Other	Military Exp
Belgium	before	67.86	8.24	3.40	20.50	5444.40
	after	69.44	6.11	3.48	20.96	4394.40
Italy	before	72.86	14.24	0.96	11.94	25169.26
	after	72.67	9.30	1.67	16.36	19101.11
Netherland	before	54.14	17.86	3.15	24.85	9711.00
	after	58.20	15.86	2.92	23.02	8434.20
Portugal	before	25.48	1.89	0.89	71.74	8166.00
	after	20.83	3.09	0.92	75.16	8512.22
Spain	before	66.16	12.68	1.64	19.53	8575.60
	after	63.12	23.72	2.42	10.73	9217.28
United States	before	31.51∗	20.56∗	2.54∗	45.38∗	298953.00∗
	after	39.35	19.76	2.17	38.73	254096.20

∗ US adopted the AVF model in 1973. Since data earlier than 1970 are unavailable, the average US shares before the AVF transition refers to the period 1970-1973.

Table 6: Two-way FE estimates (1970-2008)- Dependent variable: w_{jit}

	personnel	equipment	infrast	other
nominal interest	0.100	0.172**	-0.042**	-0.237**
	(0.118)	(0.079)	(0.019)	(0.105)
inflation	-0.474***	0.015	0.051***	0.416***
	(0.102)	(0.068)	(0.017)	(0.091)
labour cost$^{\flat}$	-4.604	4.044	0.327	-0.101
	(3.718)	(2.492)	(0.608)	(3.305)
milex	-8.149***	6.268***	1.384***	0.466
	(1.894)	(1.271)	(0.309)	(1.683)
AVF	1.911	-1.586*	0.666***	-1.007
	(1.263)	(0.848)	(0.206)	(1.123)
const	176.197***	-85.034***	-13.388**	25.914
	(41.270)	(27.663)	(6.744)	(36.687)
N	375	376	375	375
N groups	13	13	13	13
ρ	0.914	0.897	0.961	0.945
MLL	-1055.292	-908.412	-376.006	-1011.147
Time effect	1.616	1.592	1.663	2.291
p value	0.015	0.018	0.011	0.000
csd Pesaran	-4.747	-3.750	-2.884	-3.620
csd Friedman	3.026	1.217	15.097	2.058
AIC	2198.584	1904.823	840.012	2110.294
BIC	2371.369	2077.725	1012.797	2283.079

Notes: $\flat$ Labour cost is proxied by log GDP per capita; Milex is log of real military expenditure in constant US dollars. The CPI is used to adjust for inflation. AVF is a binary variable equal to 0 over the years in which conscription was in place, equal to 1 in the AVF years. ρ is the fraction of variance due to the country effect. MLL is the maximised loglikelihood. Time effect indicators are included but not reported. The test of their joint significance is reported in the row 'Time effect' followed by the test p-values. CSD is the test for cross-sectional dependence following the methods by Pesaran (2004) and by Friedman (1937). AIC is the Akaike information criterion; BIC is the Bayesian information criterion.

Table 7: Sub-period 2-way FE estimates (break in 1989)

1^{st} Period: 1970-1989				
	personnel	equipment	infrast	other
nominal interest	0.073	0.086	-0.021	-0.145
	(0.123)	(0.094)	(0.015)	(0.117)
inflation	0.001	-0.056	0.010	0.052
	(0.091)	(0.069)	(0.011)	(0.086)
labour cost$^{\flat}$	-3.635	1.267	0.697	1.509
	(4.198)	(3.215)	(0.524)	(3.978)
milex	-21.168***	10.934***	1.102***	9.038***
	(2.505)	(1.918)	(0.312)	(2.374)
AVF	11.965***	0.291	-0.959***	-11.267***
	(2.846)	(2.181)	(0.355)	(2.697)
const	284.285***	-100.265***	-14.007**	-67.484
	(46.828)	(35.829)	(5.841)	(44.370)
N	184	185	184	184
N groups	13	13	13	13
ρ	0.992	0.981	0.987	0.982
MLL	-441.706	-394.984	-58.691	-431.788
Time effect	2.332	2.251	3.806	4.202
p value	0.002	0.004	0.000	0.000
AIC	933.413	839.969	167.382	913.575
BIC	1013.786	920.478	247.755	993.948
2^{nd} Period: 1990-2008				
	personnel	equipment	infrast	other
nominal interest	-0.347*	0.317**	0.009	0.021
	(0.179)	(0.158)	(0.048)	(0.217)
inflation	0.026	-0.053	0.050	-0.023
	(0.216)	(0.190)	(0.057)	(0.262)
labour cost$^{\flat}$	-27.432**	1.464	-2.114	28.102**
	(10.640)	(9.383)	(2.828)	(12.911)
milex	-2.160	-1.556	2.137***	1.577
	(2.844)	(2.508)	(0.756)	(3.451)
AVF	0.064	1.895	0.429	-2.387
	(1.332)	(1.175)	(0.354)	(1.617)
const	355.951***	11.845	3.018	-271.007*
	(114.890)	(101.319)	(30.540)	(139.418)
N	191	191	191	191
N groups	13	13	13	13
ρ	0.969	0.919	0.976	0.965
MLL	-462.643	-438.635	-209.579	-499.602
Time effect	0.579	0.408	1.171	0.514
p value	0.910	0.985	0.292	0.948
AIC	973.285	925.269	467.159	1047.204
BIC	1051.340	1003.324	545.213	1125.258

Notes: see Table 6 for variable and apex description.

Table 8: Testing for structural Break in 1989

Model: 1-way fixed effect						
			Person	**Equipm**	**Infrast**	**Other**
T = 39	K =7	N_T	375	376	375	375
T_1= 20		N_{T1}	184	185	184	184
T_2 = 19		N_{T2}	191	191	191	191
	Complexity	**Parameters**	**Person**	**Equipm**	**Infrast**	**Other**
MLL_0		20	-1084.928	-939.525	-404.807	-1053.889
MLL_{T1}		20	-465.92	-417.251	-94.942	-470.988
MLL_{T2}		20	-468.414	-443.056	-221.213	-504.997
MLL_{T1+T2}			-934.334	-860.307	-316.155	-975.985
BIC_0	18.01	20	2211.345	1920.557	851.102	2149.267
BIC_{T1}	15.85	20	968.344	871.044	226.389	978.481
BIC_{T2}	15.96	20	973.595	922.878	479.191	1046.759
BIC_{T1+T2}	18.01		1910.156	1762.121	673.798	1993.458
AIC_0		20	-1104.928	-959.525	-424.807	-1073.889
AIC_{T1}		20	-485.92	-437.251	-114.942	-490.988
AIC_{T2}		20	-488.414	-463.056	-241.213	-524.997
AIC_{T1+T2}			-974.334	-900.307	-356.155	-1015.985
Model: 2-way fixed effect						
			Person	**Equipm**	**Infrast**	**Other**
T = 39	K = 6	N_T	375	376	375	375
T_1 = 20		N_{T1}	184	185	184	184
T_2 = 19		N_{T2}	191	191	191	191
	Complexity	**Parameters**	**Person**	**Equipm**	**Infrast**	**Other**
MLL_0		57	-1055.292	-908.412	-376.006	-1011.147
MLL_{T1}		38	-441.706	-394.984	-58.691	-431.788
MLL_{T2}		37	-462.643	-438.635	-209.579	-499.602
MLL_{T1+T2}			-904.349	-833.619	-268.27	-931.39
BIC_0	15.44	57	2371.369	2077.725	1012.797	2283.079
BIC_{T1}	13.58	38	1013.786	920.478	247.755	993.948
BIC_{T2}	13.68	37	1051.34	1003.324	545.213	1125.258
BIC_{T1+T2}	15.44		1844.259	1702.815	572.101	1898.341
AIC_0		57	-1112.292	-965.412	-433.006	-1068.147
AIC_{T1}		38	-479.706	-432.984	-96.691	-469.788
AIC_{T2}		37	-499.643	-475.635	-246.579	-536.602
AIC_{T1+T2}		75	-979.349	-908.619	-343.27	-1006.39

Notes: T indicates the whole period (1970-2008); T_1 refers to the period 1970-1989, T_2 refers to the period 1990-2008. N_T is the number of observations in period T; K is the number of regressors. The number of parameters to estimate appears in the column *Parameters*. MLL is the maximised log-likelihood. BIC indicates the Bayesian Information Criterion; AIC is the Akaike Information Criterion. BIC for model i is calculated as $-2(MLL_i) + ln(N_i) * K_i$. AIC for model i is calculated as $MLL_i - K_i$.

Table 9: Data Description and data source

Variable	Description	Source	Notes
Personnel share of defence budget	Payrolls, allowances and pensions	NATO reports (1970-2002) SIPRI (2002-2008)	millions USD, constant 1995 prices million USD, constant 1995 prices (change of base applied)
Equipment shares of defence budget	Troop outfitting and armed equipment	NATO reports (1970-2002) SIPRI (2002-2008)	millions USD, constant 1995 prices million USD, constant 1995 prices (change of base applied)
Infrastructure share of defence budget	Technical devices and common infrastructure	IISS Military Balance (annual issues)	million USD, constant 1995 prices (change of base applied)
Other costs share of defence budget	Operations and maintenance	Residual series from the above sources $(= 1 - \sum_j w_j)$	million USD, constant 1995 prices
Real military expenditure		NATO (1970-2002) SIPRI (2002-2008)	millions USD, constant 1995 prices
AVF	Dummy variable (1, if AVF in place; 0, if conscription)	NATO reports	
Interest rate	Continuous variable	WDI	
Inflation rate	Continuous variable	WDI	
Per-capita GDP	Continuous variable	WDI	