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National and Regional Economic Consequences of Swiss Defense Spending*

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The effects of defense spending on economic performance and, in particular, on economic growth have been studied extensively in the literature. The empirical findings have been ambiguous so far, partly reflecting the econometric difficulties involved in the estimation of this relationship. The authors study the implications of Swiss defense spending for economic growth and unemployment in Switzerland, using both national aggregate and cross-sectional (cantonal) data. Such analysis may be more informative than similar analyses that rely on time series for individual countries (due to spurious time effects) or averages for different countries (due to strong cross country variation in country characteristics). The findings indicate that although defense spending has had a positive effect on the rate of economic growth of Switzerland in the presence of an external threat (Cold War), the distribution of defense spending across cantons has not contributed to the dispersion of cantonal growth rates. Nonetheless, cantons in which military employment is a large share of total employment have enjoyed lower and more stable unemployment rates. These findings suggest that in order to uncover the full implications of defense spending, it is necessary to go beyond the defense spending–growth nexus. The findings seem relevant for many other countries because the allocation of national defense employment and spending is rarely uniform across the regions of any country.

Introduction

The impact of defense spending on economic performance has been the subject of a voluminous literature. Most of this literature has focused on economic growth. Theory predicts an ambiguous relationship between economic growth and defense spending.

The main arguments suggesting a positive relationship can be summarized as follows: (1) Defense spending produces security, which allows private economic agents to carry out productive economic activities without fear of foreign appropriation. (2) In many countries, part of defense spending is devoted to research and development (R&D) activities. Military R&D leads to innovations that

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subsequently lead to applications in the civilian sector, raising productivity and income. The phenomenal growth in the post-World War II period is often – partly – attributed to the significant military inventions that took place during the war. (3) Defense spending may produce positive externalities for human capital formation. Benoit (1973, 1978), for example, argues that the military contributes to the improvement of human capital by providing vocational and technical training, which might be used later in the private sector. And (4) the military's capital expenditures (e.g. for roads, bridges, airports) increase public capital and enhance the productivity of private capital, stimulating investment and growth (Benoit, 1973, 1978; Barro & Sala i Martin, 1995).

The main arguments suggesting a negative relationship can be summarized as follows: (1) Defense spending – like all other government spending – requires taxation. Taxes not only reduce the amount of resources available to the private agents but they also affect relative prices – for instance, real wages and the real interest rates – and thus distort economic decisions. Moreover, private investment, a key determinant of economic growth (Levine & Renalt, 1992), is adversely affected and this may have a negative effect on economic growth. (2) Defense spending may reduce – crowd out – other types of government spending that could be allocated to human capital formation, such as education and health, or to other sources of production externalities. This may lead to higher or lower growth, depending on which category of government spending generates the greatest production externalities (Shieh, Lai & Change, 2002). And, (3) military spending may create bottlenecks in the demand for highly qualified labor and take resources away from civilian R&D activity. Because of the governmental sector's low productivity, the diversion of these resources from civilian to military purposes can have a detrimental long-term effect on a country's productivity, technological position, and growth.

The empirical literature is also voluminous, but rather inconclusive. Researchers have employed a variety of methodologies – ranging from single equation, single country to pooled data analysis (time series in a cross-section of countries) – but have failed to establish convincingly the existence of a particular, general pattern (the main findings of the empirical literature are reviewed below). While studies with pooled data tend to be statistically more reliable than single-country studies, the strong variation in unobservable or unaccountable country-specific characteristics and the possibility that such characteristics may be systematically related to defense spending decisions make such studies vulnerable to biased estimates.

The effects of defense spending on employment have received less theoretical scrutiny. Holding *total* government spending fixed, changes in defense spending will affect total employment only to the extent that defense spending is associated with a different (Keynesian) multiplier and has a different effect on labor productivity than other components of government expenditure. The above arguments on output growth can be adapted to refer to the level of output and productivity instead and can thus be used to discuss employment effects.

The objective of this article is to examine the effects of defense spending on economic growth and unemployment in Switzerland. The data on the cantonal allocation of defense spending and defense personnel are available only for the period 2000–03. This means that for the study of the cross-sectional (cantonal) distribution of unemployment and growth, we have to restrict ourselves to this short sample. Nonetheless, we can also study the behavior of the growth rate of output *for the country as whole* for a longer period, as this only requires information on the total defense budget, which is available

for the period 1975–2003. For the latter part, our analysis is similar to other studies of the effects of defense spending in individual countries. For the former part, we rely on cantonal unemployment (and/or GDP) data, as well as the allocation of various categories of defense spending across cantons, to carry out a cross-sectional analysis within a broader, homogenous unit (Switzerland). The advantage of this approach is that: (1) the data are constructed in an identical fashion across the cross-sectional units. Hence, there is no – perhaps systematic – variation in measurement error across these cross-sectional units. Such errors often undermine estimations in cross-country samples. And (2) to the extent that cross-country heterogeneity is greater than cross-cantonal heterogeneity, our estimation is likely to produce more reliable results.

We find that Swiss military spending contributes to higher economic growth in periods of high external threat (that is, during the Cold War). We also find significant effects on cantonal unemployment. In particular, cantons where military employment is an important component of total employment tend to also experience a lower and more stable rate of unemployment. Interestingly, this finding only applies to personnel allocations, not defense spending. That is, the allocation of the defense *spending* is of no consequence. Thus, there seems to exist a direct effect (the unemployment rate varies with the size of employment in the military) but not an indirect effect (aggregate demand driven) through the size of expenditure.

We find this result informative even if its applicability to country level analysis needs to be qualified because countries do not experience as much labor mobility as cantons.[1] But in any case, such regional effects are likely to be found in other countries as well, owing to the fact that the allocation of defense spending tends to be asymmetric across regions.

The remainder of the article is organized as follows. We begin with a review of the empirical literature on the effects of defense spending on economic growth and unemployment. We then present the model on which the empirical analysis is based. The analysis follows, along with a discussion of the results and a brief conclusion.

Review of Empirical Literature

Defense Spending and Economic Growth

Despite the voluminous empirical research on the defense–growth relationship, conclusive evidence on whether military expenditure is associated with higher or lower growth rates has still to emerge. A few studies have shown positive effects of defense spending on economic growth (Benoit, 1973, 1978; Cappelen, Gleditsch & Bjerkholt, 1984; Murdoch, Pi & Sandler, 1997). Others have reported a negative relationship (Deger & Smith, 1983; Deger, 1986; Lebovic & Ishaq, 1987; Atesoglu & Mueller, 1990; Ward & Davis, 1992; Deger & Sen, 1995).

In contrast to these two sets of studies, a third one argues that: (1) defense spending neither helps nor hinders economic growth (Mintz & Huang, 1990; Alexander, 1990; Chowdhury, 1991; Kusi, 1994; Mintz & Stevenson, 1995; Heo, 1998); (2) defense spending helps economic growth in 'resource-abundant' but not in 'resource-constrained' countries (Looney & Frederiksen, 1986); and (3) the impact of defense spending on economic growth is neither universal nor constant over time (Ward, Davis & Lofdahl, 1995).

The inconsistency of empirical results[2] may be due to theoretical and methodological

[1] Note, though, that labor mobility is far from perfect even within Switzerland. There exists significant variation in wages and unemployment across cantons. The same pattern is true in many other countries, such as the USA and Germany. It is the lack of perfect labor mobility that underlies the differential effects of military allocations documented later on.

[2] Ram (1995) reviews the empirical research on the relation between defense spending and economic growth and also discusses some related methodological issues.

problems as well as to limited research designs with regard to the choice of the country sample (cross-section, times-series, and pooled), sample period, and the estimation technique (Granger causality test, ordinary least-squares (OLS), two- and three-stage least-squares (2SLS, 3SLS), and fixed effects). Recent work has suggested that a possible culprit for the inability to document a systematic relationship between defense spending and economic growth may have been the omission of the effects of non-linear interactions. Aizenman & Glick (2006) develop a model that allows for the dependence of economic growth on the severity of external threats. For a cross-section of countries over the period 1989–98, they show that military expenditure increases growth in the presence of such threats. Similar non-linearities are documented by Cuaresma & Reitschuler (2006). They show that the partial correlation between defense spending and growth appears robust and significantly negative *only* for countries with a relatively low military expenditure rate. Our results in this study confirm the Aizenman & Glick finding in the case of Switzerland.

Defense Spending and Employment

Although most of the research on the economic effects of defense spending focuses on GNP or GDP growth, some work has also studied its effects on employment.

Theoretically, if the aggregate supply curve is positively sloped (as it is the popular presumption in the short run), then higher defense spending that is not offset by a reduction in other components of public spending implies higher employment and output. If the aggregate supply is vertical (as it is presumed to be in the longer run), then higher defense spending does not affect the level of economic activity (output and employment).

The empirical evidence has been contradictory. On the one hand, Szymanski's (1973) analysis of 18 OECD countries in the 1950–68 period and Pivetti's (1992) study of the United States, 1948–88, find that higher military spending contributes to lower unemployment. On the other hand, Smith's (1977) study of 8 industrialized countries (USA, France, West Germany, Italy, UK, Sweden, Japan, and Australia) in 1973 reveals a high positive correlation (+0.79) between defense spending and unemployment. Abell (1990) and Dunne & Smith (1990) find no association between defense spending and unemployment.

Any study of the impact of defense spending on employment is incomplete without reference to the effects of military expenditure on regional and local employment.[3] For different reasons ranging from historical to military strategic requirements to economic policies, defense spending within nations tends to be unevenly distributed spatially, that is, it is concentrated in few regions rather than evenly distributed over the whole country. Thus, it is possible that military expenditure affects employment at the regional level, despite findings of no relationship between these two variables at the national level (washing-out effect).

For example, Bishop (1992) examined the regional economic impact of a major dockyard (and associated naval base) in the counties of Devon and Cornwall in the United Kingdom. He found that out of the 29,900 jobs that were supported directly or indirectly by the dockyard complex, some 6,900 jobs depended on local expenditure by base and dockyard facility employees. Moreover, the Devonport complex was estimated to generate about 5% of annual total income in the subregion. If the dockyard were closed and the base simultaneously contracted, it was estimated that the subregion would lose 3.7% of its income and 22,600 jobs. The regional unemployment rate might increase to 20% in that case.

[3] See Braddon (1995) for an excellent review of the literature on the regional economic impact of defense spending.

Battistelli (1991) examined defense-dependent occupational groups in the Rome region in Italy in 1987. He identified 52 defense companies in the region, employing about 12,000 workers, with a further 2,000 jobs in subcontractors also defense-dependent. He estimated that these defense-dependent jobs amounted to around 8% of all industrial employment in the Rome region. Huck (1991) studied the impact of defense expenditure on employment in the region of Munich (Germany) in 1986. He found that 8% of manufacturing employment and 11% of metalworking employment were dependent on defense spending.

Such case studies have obvious drawbacks. The regional allocation of defense spending will have an effect on the regional *composition* of employment. That is, regions that host large military bases or military industries will have a larger proportion of employment in defense-related activities. But there is no reason to expect that the composition of regional employment will be systematically related to the *level* of regional employment. It is the latter that is important from a macroeconomic viewpoint. This issue has not been investigated to date, owing to a lack of appropriate data. Switzerland is an interesting case for such an analysis because of the availability of data on the allocation of defense spending across cantons and cantonal unemployment data.

Swiss Defense Spending and Economic Performance

Research on Swiss defense spending is, compared to other countries, very scarce. To date, it has focused primarily on establishing the hidden costs of Swiss national defense[4] and on the determinants of Swiss military policy and defense expenditure. There is, however, some work on the impact of defense spending on economic growth.

Maneval, Rautsola & Wiegert (1991) studied the effects of defense spending on economic growth in four neutral European countries (Switzerland, Austria, Finland, and Sweden) in the period 1960–87. They employed a model using three structural equations (economic growth, manufacturing output, and investment) that had previously been developed and tested for 17 OECD countries by Cappelen, Gleditsch & Bjerkholt (1984). Contrary to Cappelen, Gleditsch & Bjerkholt findings that the net effect of military expenditure on economic growth was negative[5] for the whole sample and for two (large and small countries) of the three subgroups studied (the third one included Mediterranean countries), Maneval, Rautsola & Wiegert found a non-uniform trend across the four neutral countries. The coefficient for defense spending is insignificant in all four equations but its sign varies (negative in the case of Austria and Sweden, positive in Switzerland and Finland). In the investment equation, the defense coefficient is positive and significant for Switzerland, negative and significant for Finland, and positive and insignificant for Austria and Sweden. The authors concluded that 'it was not possible here to gather a clear pattern which would make the economic effects of defense spending empirically distinguishable in the four neutral nations …. Whether this group of nations indeed differs from other OECD countries, owing to their neutral status under international law, or especially from the NATO members in this set, could not be determined from the controversial results of both studies' (Maneval, Rautsola & Wiegert, 1991: 429–430).

Mintz & Stevenson (1995) applied a three-sector (private, military, and non-military) Feder-type model and used individual longitudinal data from 103 countries for 1950–85. Switzerland was one of the countries included

[4] VBS, 2000. *Couts de la défense nationale.*

[5] Defense spending had a direct positive impact on economic growth but a negative effect on investment.

in this analysis. They found that although nonmilitary spending has a positive and significant impact on growth in 39 countries (about 38% of the countries in the sample), the impact of military spending on growth is largely insignificant. The externality effect was found to be much smaller than the total effect. The analysis of Switzerland showed that both direct and indirect (externality effect) impacts of both military and nonmilitary government spending on economic growth were insignificant.

Finally, Heo (1998) used a nonlinear defense-growth model that includes technological progress and tested it with longitudinal data for 80 countries in 1961–90. Contrary to Mintz & Stevenson, Heo's findings indicate that increased defense spending is more likely to hamper economic growth and that increased nonmilitary government spending reduces economic growth in even more countries. His results for Switzerland show that while an increase in the non-defense share of GDP decreases economic growth (the elasticity is –0.169), an increase in the defense share of GDP increases economic growth (the elasticity is 0.269). According to Heo, the difference in the results between his analysis and Mintz & Stevenson's might be due to 'the different modeling structure (linear versus nonlinear) and the inclusion of technological progress in the defense-growth model' (Heo, 1998: 648).

The Model

Defense Spending, National Security, and Economic Performance

Our main interest is in establishing the properties of the empirical relationship between defense spending and economic performance (growth, unemployment) rather than testing a particular theory. Nonetheless, it is helpful to provide a theoretical background for this relationship in order to *motivate* the choice of the empirical specification. We have opted for a simple version of the standard neoclassical model.

Let the economy consist of two sectors. The first sector produces a good called national security, S, according to the production function

$$S = S(M, E) \quad dS/dM > 0 \quad dS/dE < 0 \qquad (1)$$

where M is goods and services produced from military spending and E is the external threat faced by the country. For a given value of the defense budget, an increase in the level of external threat reduces the level of national security. M is produced according to the equation

$$M = M(K_m, L_m) \qquad (2)$$

where K_m and L_m are the capital stock and level of employment used to produce M. The function M has the standard, neoclassical production properties.

The second sector, C, comprises the rest of the economy. As such it includes both civilian and government non-military goods. The distinction between civilian and government non-military goods can be introduced but at the cost of additional complexity.

$$C = C(K_c, L_c, S) \quad dC/dS > 0 \qquad (3)$$

where K_c and L_c are capital and employment in the rest (non-military sector) of the economy. The idea behind this formulation is that national security is a vital input that enhances the productivity of the factors of production. The effect of national security is modeled as an externality as far as the firms in the non-military sector are concerned.

The sectoral allocations of capital and labor satisfy the aggregate resource constraints

$$K_c + K_m = K \qquad (4)$$

$$L_c + L_m = L. \qquad (5)$$

In this formulation, the total labor force is fixed, so the effects of defense spending on employment cannot be studied.

Total output in the economy is simply the sum of the *outputs* produced in the two sectors.

$$Y = C + M. \tag{6}$$

Note that we are assuming that the relative price of military in terms of non-military goods is set equal to unity. While this is probably unrealistic, the lack of a reliable price index for military goods makes this assumption necessary. In any case, it is always valid as a local approximation, that is, under the assumption that the changes in defense spending considered are small.

Differentiating totally (1)–(6) and assuming that the marginal productivity of labor (capital) is the same across the two sectors[6] leads to the following equation:

$$Y' = t_{xL} L' + t_{xk} K' + n_{cs} n_{sm} (C/Y)M' + n_{cs} n_{se} (C/Y)E'. \tag{7}$$

A prime, $'$, denotes growth rate. Y' is the growth rate of output, L' is the growth rate of employment, and K' is the growth rate of capital (the investment rate); t_{xL} is the share of labor income in aggregate income (= wL/Y, where w is the wage rate) and t_{xk} is the share of capital income in aggregate income; n_{cs} is the elasticity of the output in the non-military sector with regard to the level of security (that is, $n_{cs} = (dC/dS)/(S/C)$. The other elasticities, n_{sm} and n_{se}, are defined similarly. Note that $n_{cs} > 0$, $n_{sm} > 0$ and $n_{se} < 0$. This specification has several important properties. First, it implies that multifactor productivity (the left hand side of Equation (7) minus the first two terms of the right hand side) is affected by the share of defense spending as well as by the level of external threat. Second, it implies that an increase in the level of external threat that is met with an insufficient response of the domestic military capabilities (budget) compromises the rate of economic growth. And third, to the extent that the elasticities entering Equation (7) depend on the level of existing military capabilities and/or the level of external threat, the effect of military spending on economic growth may involve an interaction term between the level of external threat and the level of spending. This is precisely the argument advanced by Aizenman & Glick (2006),[7] who condition on the level of external threat. A related argument has been advanced by Cuaresma & Reitschuler (2006) with the conditioning done on the share of defense spending.

To study the effects of military spending on total employment it is necessary to modify Equation (5) above in the following empirically plausible way. Assume that the population is fixed and that there is an endogenous labor force participation decision. In particular,

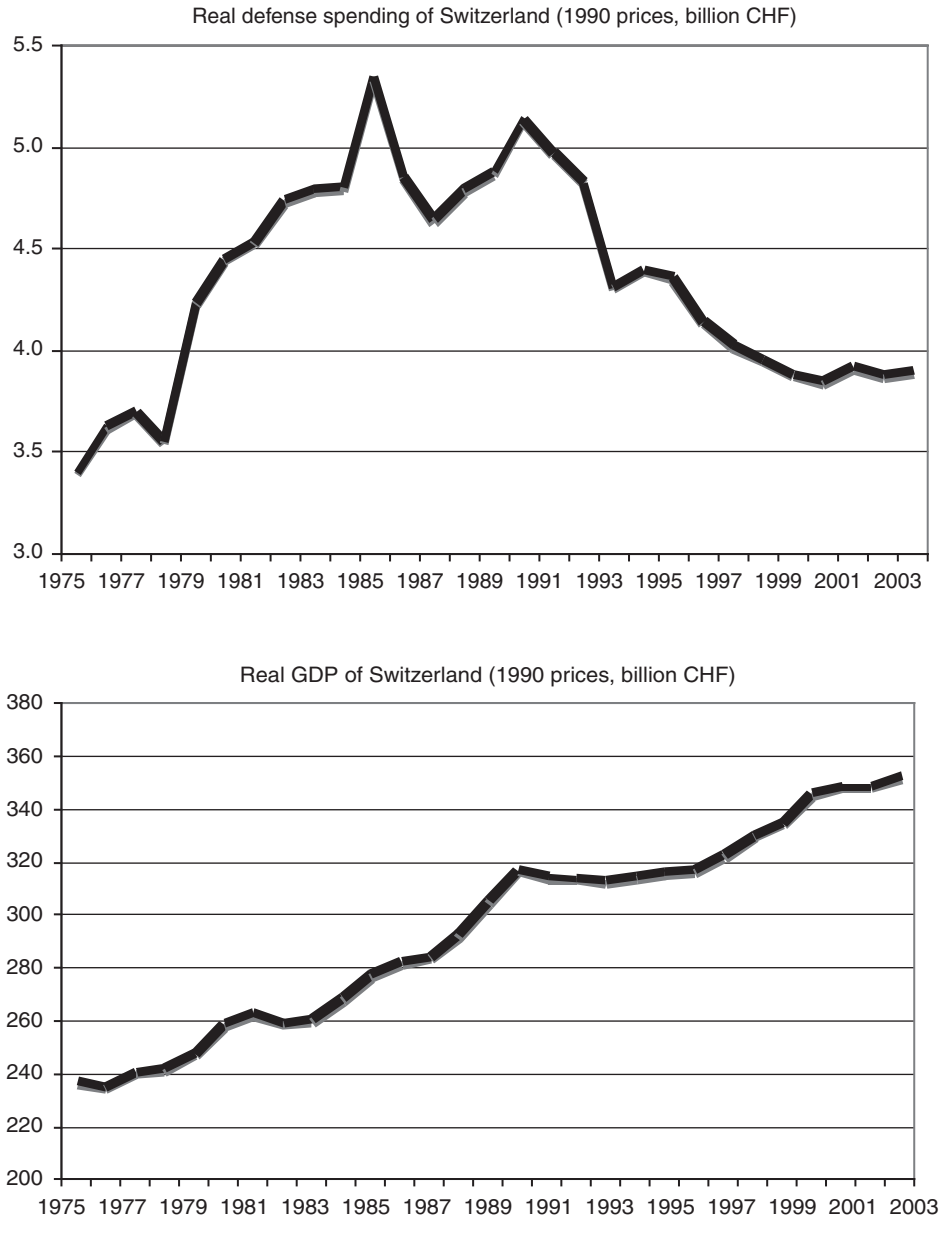
$$P = L + N \tag{8}$$

where P is the total population of working age, L is the labor force, and N are those work-able individuals who are out of the labor force. It is reasonable to assume that $L/P = g(w)$, that is, higher wages (w) encourage higher labor participation. Because of the external effect of defense spending, the productivity and hence wages are higher when defense spending is higher (even when taxation is taken into account, as long as defense spending is below its optimal – output maximizing – level) and hence so is employment.

[6] This assumption differentiates our model from the Ram model (Ram, 1986), which has been frequently used in the literature to study the effects of military spending. In the Ram model, it is typically assumed that marginal productivities differ across the two sectors. Dunne, Smith & Willenbockel (2005) have recently criticized the work that has been conducted within the context of the Ram model because this work interprets such cross-sectional productivity differentials as representing cross-section differences in efficiency. Such interpretation is not justified because, in the Ram model, both sectors are technically efficient. We prefer the assumption of similar productivity across sectors for an additional reason, namely, it does not seem plausible to assume that properly measured wages (and hence marginal productivity) for comparable jobs differ between the military and the non-military sectors.

[7] Aizenman & Glick (2006) derive these interactive terms within the neoclassical model.

Figure 1. Swiss Real Defense Spending and Real GDP



Empirical Analysis

Before presenting the results from the estimation, we briefly discuss the long-term properties of real defense spending and real GDP in Switzerland. Figure 1 plots real GDP and defense spending. As can be seen, there is a clear upward trend in real GDP but no clear trend in defense spending. Nonetheless, standard unit root tests indicate that the hypothesis of a unit root cannot be rejected for either series. We now turn to the short-run relationship between these variables.

Country Analysis

The estimated equation of the impact of defense spending on economic growth will be loosely based on Equation (7) of the theoretical model[8]

$$y(t) = b_1\, l(t) + b_2\, k(t) + b_3\, m(t) + b_4 E(t)^* m(t) + b_5 x(t) + u(t) \quad (9)$$

where t indicates year t, y is the growth rate of real per capita output, l is the growth rate of the labor force, k is the share of investment in GDP, m is the share of defense spending[9] in GDP, E is the level of external threat, x is the share of civilian federal government spending in GDP, and u is the error term of the regression. We relate E to the Cold War and code it as a binary variable with the value of 1 before 1991 and 0 afterwards. Following Aizenman & Glick (2006), we include the interactive term E^*m in order to capture the possibility of the existence of non-linearity in the relationship between y and m, namely, the fact that defense spending may play a productive role (safeguard higher growth) during a period of high external threat while it may represent a waste of resources in the absence of such threats.

We include the share of federal civilian spending in GDP, x, in order to examine the economic effects of other categories of government spending when holding the defense share constant. Note that this specification does not capture the guns vs. butter considerations, as total government spending as a percentage of GDP varies with changes in either m or x. That is, the relevant experiment for interpreting b_3 is the following: What are the consequences for the rate of economic growth of a 1% increase in the share of total government spending that is allocated to defense spending? Finally, in the regression we have also included a lagged term of the dependent variable in order to deal with autocorrelation.

We also examine the individual effect of each of the four major components of the defense budget (personnel expenditures, operation and maintenance, investment (procurement), and research and development) on economic growth, by replacing the total defense spending variable in the estimation equation with the individual components. While operational spending may have a direct positive effect on economic growth and spending on research and development an indirect one through the technological spillovers into the civilian sector, it is not clear how spending on maintenance of weapons systems can contribute directly to, or increase, growth. Note that we use contemporaneous values for m and E in the regression. We do not think that simultaneity is a problem in this regression. First, E (the Cold War) is purely exogenous. Second, m_t is predetermined in period t with regard to the rate of economic growth in that period, because the defense budget is determined (voted by parliament) during the previous fiscal year. And third, while m is endogenous with regard to E, the inclusion of E in the regression takes care of possible bias problems.

[8] Note that the equation used here is similar to the equation derived and estimated by Aizenman & Glick (2006), who develop an extended version of the endogenous growth model of Barro & Sala i Martin (1995).

[9] Note that we use a budgetary instead of the theoretically correct value-added measure of M. But it is not feasible to compute the latter, as we lack the data needed to estimate the production function for defense services.

Defense Spending and the Swiss Macro-Economy

We investigate the effects of military spending on economic growth and investment (a precondition for economic growth). The data on Swiss defense spending were provided by the Swiss Defense Ministry and cover total national defense spending over the time period 1975–2003. The data for the other variables were compiled by the authors from open sources. See the Appendix for the definition and the data sources of the variables. Tables I and II summarize the key results.

As shown in Table I, total defense spending enters with a negative but statistically insignificant coefficient. This result is consistent with the finding of Maneval, Rautsola & Wiegert (1991) that Swiss defense spending does not have a significant effect on economic growth. The same is true for all of the subcategories of military spending. Private investment enters all equations with the expected positive sign and is always statistically significant. The coefficient on the labor input is negative as expected, because the dependent variable (per capita GDP growth) is – by construction – inversely related to the labor input. The coefficient on civilian government spending is positive but statistically insignificant. Finally, the coefficient of the interactive

Table I. Defense Spending and Economic Growth

	Total defense spending	*Operational spending*	*Personnel spending*	*Procurement spending*	*R&D spending*
Constant	–0.29*	–0.41**	–0.34**	–0.32 **	–0.38***
t-statistic	(–1.85)	(–3.03)	(–2.18)	(–2.05)	(–2.95)
Defense spending to GDP	–4.29	–0.02	–0.08	–0.03	–0.66
	(–1.22)	(–0.03)	(–0.64)	(–0.79)	(–1.17)
Defense spending to GDP × external threat	3.58***	3.65**	3.76***	3.02**	3.93***
	(3.06)	(2.63)	(2.87)	(2.36)	(3.16)
Lagged real GDP growth	0.46**	0.53***	0.51***	0.44**	0.49**
	(2.50)	(2.73)	(2.81)	(2.18)	(2.77)
Investment to GDP ratio	0.59***	0.56**	0.48**	0.55**	0.62***
	(2.98)	(2.62)	(2.26)	(2.79)	(3.00)
ΔLabor force	–0.88***	–0.89**	–0.93***	–0.79**	–0.87***
	(–2.96)	(–2.72)	(–2.85)	(–2.51)	(–2.99)
Civilian federal government spending to GDP ratio	1.75	2.56**	2.33**	1.82	2.23**
	(1.67)	(2.65)	(2.55)	(1.53)	(2.49)
No. of obs.	28	28	28	28	28
R-sq	0.49	0.46	0.47	0.48	0.49
Adj-R-sq	0.35	0.31	0.32	0.33	0.35
Durbin-Watson	1.96	1.97	1.99	1.94	1.99
F-statistic Prob > F	3.48	3.06	3.15	3.22	3.45
	0.01	0.02	0.02	0.02	0.01

Dependent variable in all models: real GDP per capita growth rate (1975–2003).
*** significant at the 1% level; ** at the 5% level; * at the 10% level.

Table II. Defense Spending and Investment

	Total defense spending	*Operational spending*	*Personnel spending*	*Procurement spending*	*R&D spending*
Constant	0.19	0.15**	0.42***	0.20**	0.08
t-statistic	(1.57)	(2.15)	(3.23)	(2.55)	(0.92)
Defense spending to GDP	–0.33	0.05	–0.21*	–0.01	0.80
	(–0.10)	(1.02)	(–2.02)	(–0.30)	(1.66)
Investment share of GDP*t*-1	0.58***	0.57***	0.35*	0.59***	0.57***
	(4.00)	(3.94)	(1.99)	(3.97)	(4.12)
Civilian federal government spending to GDP ratio	–0.78	–0.56*	–1.61***	–0.84	0.07
	(–1.08)	(–1.72)	(–3.08)	(–1.66)	(0.14)
No. of obs.	28	28	28	28	28
R-sq	0.66	0.67	0.71	0.66	0.70
Adj-R-sq	0.62	0.63	0.67	0.62	0.66
Durbin-Watson	1.50	1.48	1.73	1.52	1.47
F-statistic Prob > F	15.94	16.98	20.01	16.03	18.69
	0.00	0.00	0.00	0.00	0.00

Dependent variable in all models: investment share of GDP (1975–2003).
*** significant at the 1% level; ** at the 5% level; * at the 10% level.

term is positive. This indicates that spending on defense may have enhanced economic growth in Switzerland during the Cold War (a high level of external threat), but it has not contributed to growth in the post-Cold War era. Aizenman & Glick (2006) report a similar result regarding the interaction of defense spending and the level of external threat in a cross-section of countries.

Many theories identify private investment as the key channel linking defense spending to growth.[10] Is there a relationship between these two in Switzerland? In additional to its theoretical and practical importance, this question is also of econometric relevance. If there is a contemporaneous relation between investment and the share of defense spending, then the coefficient b_3 does not fully capture the effect of military spending on economic performance, as this effect depends on the sum $b_2 + b_3$. It is thus conceivable that b_3 is statistically insignificant, yet military spending does matter for growth (b_2 is statistically different from zero). This scenario would correspond to the case where military spending affects growth exclusively through private investment (for instance, when human capital and other effects are absent). In order to investigate these possibilities, we have carried out a regression of investment on defense spending.

Table II indicates that the net effect of defense spending on private investment is nil.[11]

[10] Shieh, Lai & Change (2002) identify two types of externalities. Higher defense spending increases the level of national security, making domestic investment more profitable (in expected terms). At the same time, it may crowd out public spending on infrastructure, which decreases the return to private investment. Both effects, thus, operate through private investment.

[11] This does not necessarily mean that defense spending does not influence economic decisions. For instance, in the model of Shieh, Lai & Change (2002), it may be the case that the two conflicting influences present exactly cancel each other out.

This result is to be contrasted to the finding of Cappelen, Gleditsch & Bjerkholt (1984) that higher military expenditure in *OECD countries* crowds investment out.

Cantonal Analysis

We now turn to the economic effects associated with the distribution of Swiss defense spending and defense department employment across cantons. The measure of defense spending used in the cantonal analysis is a subset of that used in the analysis of the country as a whole (it is the only one that contains cantonal information). It comes from ArmaSuisse (the Swiss Department of Defense's Procurement and Technology Agency) and that is why we call it ArmaSuisse defense spending. It measures what ArmaSuisse spends in individual cantons for operational purposes (e.g. construction and maintenance of infrastructure, maintenance of weapons systems), procurement (e.g. weapons, ammunition, vehicles, telecom, IT, clothing), and R&D. It absorbs around 30–50% of total Swiss defense spending, with the remainder going to weapons procurement from abroad, military personnel paid from the central budget, etc. With the exception of personnel spending (which is dealt with separately below), the ArmaSuisse budget is, therefore, from a cantonal point of view, the most relevant component of the overall Swiss defense budget.

We construct two indicators for the distribution of defense spending: one indicator measures 'per capita' ArmaSuisse defense spending for each canton relative to the national average, 2000–03; the other indicator measures per capita defense department employment located in each canton relative to the national average, 2001–04. Note that the latter variable essentially measures the share of military to total employment (population) in an individual canton. This information is reported in Columns 2 and 3 of Table III. Additionally, Table III contains information on the absolute share of military spending for each canton (Column 1) as well the cantonal unemployment rate (Column 4). The large variation in the last variable suggests that labor mobility within Switzerland is limited. Similar variability in regional unemployment is present in other countries (such as the USA and Germany).

As can be seen, there exists strong heterogeneity in the distribution of military spending and employment across cantons. This heterogeneity appears even more pronounced when one compares absolute shares to relative shares per capita. For instance, the canton of Uri attracts 3% of the total ArmaSuisse defense spending in Switzerland. In per capita terms, this translates into a share of 640% above the average cantonal allocation. The canton of Bern, to take another example, receives 35% of ArmaSuisse spending, whereas its share relative to the national average is 276%.

We are interested in determining how this allocation of defense spending and defense employment across cantons has affected cantonal economies. We focus on the unemployment rate and on GDP growth. The cantonal allocation of defense spending is available only for the period 2000–03 and the allocation of defense employment for 2001–04. Tables IV and V show the results of regressions of cantonal unemployment on cantonal defense allocations. Note that in addition to the defense variables, we also include two standard determinants of unemployment: the existence of unemployment assistance benefits in the canton under consideration (dummy variable, which takes the value of 1 if unemployment assistance exists and 0 otherwise); and the average rate of real economic growth in the canton during the previous six years (1995–2000). One should expect to find a positive effect for the former variable and a negative effect for the latter one. That is, while unemployment insurance benefits encourage unemployment, robust economic growth should improve employment conditions.

Table III. Cantonal Shares in Defense Spending and Defense Employment (2000–03 and 2001–04 respectively)

Canton	*Cantonal share of ArmaSuisse spending (%)*	*Ratio of cantonal share of ArmaSuisse spending to Swiss average*	*Ratio of cantonal defense employment to Swiss average*	*Cantonal unemployment rate*
Aargau	8.48	1.11	0.74	2
AppenzellAR	0.06	0.08	2.57	1.35
AppenzellIR	0.00	0.00	0.00	0.7
Basel Land	0.52	0.14	0.09	1.9
Basel Stadt	0.33	0.13	0.00	2.9
Bern	35.86	2.76	4.72	1.77
Fribourg	0.34	0.10	1.49	1.82
Geneve	0.53	0.09	0.07	4.92
Glarus	0.03	0.06	0.78	1.37
Graubuenden	0.12	0.04	1.29	1.35
Jura	0.35	0.37	0.66	3.07
Luzern	22.56	4.68	2.23	1.9
Neuchatel	0.29	0.13	0.48	3.02
Nidwalden	0.24	0.45	2.49	1
Obwalden	0.01	0.02	5.11	0.87
Schaffhausen	0.23	0.23	0.01	2.17
Schwyz	0.08	0.048	0.93	1.15
Solothurn	0.19	0.05	0.03	2.15
St. Gallen	1.18	0.19	1.06	1.95
Thurgau	6.26	1.99	1.35	1.82
Ticino	0.19	0.04	1.67	3.35
Uri	3.09	6.42	8.62	0.67
Valais	0.15	0.04	1.73	2.57
Vaud	1.13	0.13	1.65	3.37
Zuerich	17.22	1.01	0.96	2.42
Zug	0.43	0.31	0.09	2.2

Ratio of cantonal share of ArmaSuisse spending to Swiss average = average 2000–03 defense spending by ArmaSuisse (Swiss Defense Procurement Agency) in each canton per 1,000 cantonal population divided by average 2000–03 defense spending by ArmaSuisse for all cantons per 1,000 Swiss population. This measure indicates each canton's share in defense spending relative to the national average (the national average is 1).

Ratio of cantonal defense employment to Swiss average = average 2001–04 defense ministry employment per canton per 1,000 cantonal population divided by the average 2001–04 defense ministry employment for all cantons per 1,000 Swiss population. This measure indicates each canton's share of defense ministry employment *relative to its population* in comparison to the national average.

An interesting finding emerges. Both the level of cantonal unemployment and the variability of unemployment (measured in terms of standard deviations) are significantly negatively related to the cantonal allocation of defense employment. That is, the larger the share of defense employment located in a canton (the larger the share of defense employees in its total population), the lower and also the more stable its rate of unemployment. Interestingly, this relationship applies to military employment but not to defense spending allocations. This indicates that there is a direct effect stemming from military employment on unemployment. The military, by hiring locally, keeps unemployment low and stable. On the other hand, the indirect effect (the effect working through the boost on the cantonal aggregate demand

Table IV. Cantonal Unemployment

Variable		*Coefficient*	*t-Statistic*
Cantonal defense employment 2001–04		–0.13**	–2.34
Unemployment insurance benefits		1.35***	4.99
Cantonal GDP growth 1995–2000		–0.20*	–1.86
Constant		1.93	7.87
Observations: 26			
R-squared: 0.58	Adjusted R-squared: 0.53		
F-statistic: 10.50	Prob(F-statistic): 0.00		
Variable		*Coefficient*	*t-Statistic*
Cantonal defense spending 2000–03		–0.04	–0.49
Unemployment insurance benefits		1.44***	5.16
Cantonal GDP growth 1995–2000		–0.13	–1.25
Constant		1.61	7.59
Observations: 26			
R-squared: 0.53	Adjusted R-squared: 0.47		
F-statistic: 8.58	Prob(F-statistic): 0.00		

Dependent variable: cantonal unemployment rate (2000–03 average).
Method: Least Squares, White Heteroskedasticity-Consistent Standard Errors & Covariance.
*** significant at the 1% level; ** at the 5% level; * at the 10% level.

Table V. Variability in Cantonal Unemployment

Variable		*Coefficient*	*t-statistic*
Cantonal defense employment 2001–04		–0.05**	–2.81
Unemployment insurance benefits		0.15	1.49
Cantonal GDP growth 1995–2000		–0.01	–0.32
Constant		0.83	7.94
Observations: 26			
R-squared: 0.37	Adjusted R-squared: 0.29		
F-statistic: 4.45	Prob (F-statistic): 0.01		
Variable		*Coefficient*	*t-Statistic*
Cantonal defense spending 2000–03		–0.00	–0.18
Unemployment insurance benefits		0.19**	1.75
Cantonal GDP growth 1995–2000		0.01	0.33
Constant		0.67	8.18
Observations: 26			
R-squared: 0.22	Adjusted R-squared: 0.12		
F-statistic: 2.18	Prob(F-statistic): 0.11		

Dependent variable: standard deviation of cantonal unemployment rate (2000–03 average).
Method: Least Squares, White Heteroskedasticity-Consistent Standard Errors & Covariance.
*** significant at the 1% level; ** at the 5% level; * at the 10% level.

supported by higher military spending) is not operational. Note also that the effect is present even after accounting for the effects of the other determinants of unemployment, namely, cantonal unemployment insurance benefits and lagged economic growth. These two variables have the expected signs and are both statistically significant.

The fact that unemployment is more stable in areas that receive a larger allocation of defense employment is not surprising. It is a well-known empirical fact that public employment is among the most stable components of aggregate employment.

Table VI repeats the analysis of Table IV but uses average cantonal GDP growth rates over 2000–03 as the dependent variable in place of the unemployment rate. As can be seen, the estimated coefficients on the defense variables are statistically insignificant (the same is true for the variability of GDP growth rates, not reported here). The cross-section analysis of Table VI echoes the findings from the time-series analysis of Switzerland as a whole (Table I).

Conclusion

The literature on the effects of military spending on economic performance (economic growth and unemployment) is quite voluminous. Nonetheless, no conclusive evidence has emerged so far about the existence of a particular relationship. This may reflect the possibility that this relationship varies both across countries and over time. Or, that there exist serious data and econometric problems that hinder the identification of robust patterns. The first possibility makes it desirable to study as many countries and time periods as possible as a means of identifying particular country and time characteristics that are responsible for particular patterns. The first part of this article, which studies the relationship between defense spending and economic growth at the national level, aims at contributing to this objective. We found that variation in the share of defense spending in GDP has been a positive contributor to economic growth in Switzerland during the periods of high external threat (the Cold War). A

Table VI. Cantonal GDP Growth

Variable		*Coefficient*	*t-Statistic*
Cantonal GDP growth rate (1995–2000)		0.21	1.60
Cantonal defense employment 2001–04		0.01	0.25
Constant		0.74	2.99
Observations: 26			
R-squared: 0.14	Adjusted R-squared: 0.06		
F-statistic: 1.90	Prob(F-statistic): 0.17		
Variable		*Coefficient*	*t-Statistic*
Cantonal GDP growth rate (1995–2000)		0.21	1.48
Cantonal defense spending 2000–03		0.02	0.21
Constant		0.76	3.12
Observations: 26			
R-squared: 0.14	Adjusted R-squared: 0.06		
F-statistic: 1.91	Prob(F-statistic): 0.17		

Dependent variable: cantonal GDP growth rate (2000–03 average).
Method: Least Squares, White Heteroskedasticity-Consistent Standard Errors & Covariance.

similar finding is reported by Aizenman & Glick (2006) in a cross-section of countries.

The second possibility means that 'better' data may be required to identify the actual relationship. We have taken advantage of the fact that the federal structure of Switzerland makes it possible to study how the regional – cantonal – allocation of overall defense spending affects cantonal economic performance (unemployment and GDP growth). Thus, the sample is free of variation in cross-country characteristics that are related to both economic performance and the defense budget. Consequently, our results may have better econometric properties. We find that cantons that draw a larger allocation of defense employment as a percentage of their labor force enjoy lower and more stable unemployment rates. However, drawing a larger allocation of defense spending is of no consequence for unemployment variation across cantons, and GDP growth at the cantonal level is not related to the defense allocations.

Appendix

Table AI. List of Variables

Variable definition	*Source of data*
Total Swiss defense spending as % of GDP, 1975–2003	Swiss Defense Ministry (VBS) Swiss Statistical Office
Real GDP per capita Switzerland, 1975–2003	Penn World Table
Growth of real GDP per capita Switzerland, 1975–2003	Penn World Table
Unemployment rate, 1975–2003	Swiss Statistical Office
General operating costs in Swiss defense spending as % of GDP, 1975–2003	VBS
Personnel costs in Swiss defense spending, as % of GDP, 1975–2003	VBS
Procurement costs in Swiss defense spending as % of GDP, 1975–2003	VBS
R&D costs in Swiss defense spending, in current CHF, as % of GDP, 1975–2003	VBS
Investment share of GDP, 1975–2003	Penn World Tables
Total labor force, 1975–2003	OECD Economic Outlook, various years
Total federal government spending minus total military spending as % of GDP, 1975–2003	Swiss Finance Ministry, VBS
Cantonal defense spending, as measured by ArmaSuisse (Swiss Defense Procurement Agency) in current CHF, 2000–03	VBS
Cantonal defense employment (number of employees of the defense ministry/armed forces located in a particular canton), 2001–04	VBS
Cantonal unemployment assistance (above and beyond national unemployment insurance benefits) (1=yes/0=no), 1999	Adrian Vatter, Markus Freitag, Christoph Müller, and Marc Bühlmann. Politische, soziale und ökonomische Daten zu den Schweizer Kantonen 1983–2000.
Cantonal unemployment rates, 2000–03	Swiss Statistical Office
Cantonal real GDP growth rates, 1995–2003	BAK, Basel Economics

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