

Example 8.3

Defense Expenditures and the Samuelson Rule^{1*}

National defense is the paradigmatic example of a pure public good. As such, the efficient allocation of defense is described by the Samuelson rule: The sum of individuals' marginal rates of substitution (MRS) between defense and a reference private good should equal the marginal rate of transformation (MRT) between the two goods. It is doubtful that any country has achieved the efficient allocation of defense, however, because of the free rider problem associated with public goods. People have an incentive to conceal their preferences for defense if they believe that there is any link between their stated preferences and the amount the government will ask them to pay to finance defense expenditures. Nonetheless, the Samuelson rule suggests three factors that are likely to be important in determining a country's expenditure on defense: its population, its per capita income, and its perceived need to defend itself against foreign enemies.

Population: Since the sum of the individuals' MRSs determines the demand for defense, the larger the population the greater is the demand. True, the individual demand curves are added vertically to determine the overall market demand, rather than horizontally as for a private good. Nonetheless, the higher the overall market demand curve, the farther to the right is its intersection with the upward sloping market supply curve for defense, and the higher the equilibrium output.

Per capita income: Since defense is surely a normal good, a higher per capita income would lead to a greater demand for defense. Another way to think about this is that the MRS is the ratio of the marginal utility of defense to the marginal utility of the reference private good. $MRS_{\text{defense, private good}} = MU_{\text{defense}}/MU_{\text{private good}}$. The higher people's incomes, on average, the more private goods they consume and the lower the $MU_{\text{private good}}$, which increases the $MRS_{\text{defense, private good}}$. Intuitively, the opportunity cost of paying taxes for defense is lower the lower is the marginal utility of private goods.

Need for defense: The MU_{defense} depends on the perceived need of a country's citizens to defend themselves. The greater the perceived need, the higher the MU_{defense} , and the higher the $MRS_{\text{defense, private good}}$.

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Table 1 Overview of Military Expenditures, Population, and GDP for Nine Countries

Country	Military Expenditures (\$billion)	Proportion of Military Expenditures to World Military Expenditures	Population (millions)	Percent of World Population (%)	Gross Domestic Product (GDP) (\$billion) (PPP)	Percent of GDP to World GDP	Per capita GDP ^c (\$ thousand PPP)	Proportion of Military Expenditures to GDP (%)	Per capita Military Expenditures (thousand \$)
Russia	50	4.5	143.3	2.3	1589	2.6	11.1	3.1	0.35
China	81	7.3	1304.2	20.7	8859	14.7	6.8	0.9	0.06
India	19	1.7	1065.5	16.9	3611	6.0	3.4	0.5	0.02
United States	518	46.4	290.8	4.6	12360	20.5	42.5	4.2	1.78
Netherlands	9	0.8	16.2	0.3	500	0.8	30.9	1.9	0.58
Israel	9	0.8	6.4	0.1	155	0.3	24.0	6.1	1.47
Korea, South	21	1.9	47.7	0.8	965	1.6	20.2	2.2	0.44
Korea, North	5	0.4	22.5	0.4	40	0.1	1.8	12.5	0.22
Cameroon	0.23	0.0	16.0	0.3	41	0.1	2.55	0.6	0.01
<i>Total world</i>	<i>1118</i>	<i>100</i>	<i>6291.7</i>	<i>100</i>	<i>60248</i>	<i>100</i>	<i>9.6</i>	<i>1.9</i>	<i>0.18</i>

Data source: CIA World Factbook 2006 (downloaded 11 July 2006); Population data from EIA World Population, Table B.1.

Table 1 presents data on military expenditures, population, and for nine countries. The entries in the table are generally consistent with the predictions of the Samuelson rule. For example, no one would be surprised to see that world defense spending is dominated by the USA; the U.S. accounts for 46.4% of world military expenditures (2nd column). All three factors that increase the demand for defense according to the Samuelson rule are present in the U.S. It has a large population, a very high per capita income, and a high perceived need for defense. Not only does the U.S. have to protect itself from direct attack, but it has also assumed the role of the world's policeman in preventing aggression and threats to freedom in other parts of the world, notably Central and South America, the Middle East, and certain parts of Asia.

China accounts for more than 7% in world military spending, largely because of its huge population and an increasing perception of the need to develop its military capabilities to have the kind of leverage it seeks in world affairs. Its military spending is held back only by its relatively low per capita income; the opportunity cost of defense spending is still very high in China. Consequently, it has a low defense burden, defined as the ratio of its military expenditures to its GDP. China's defense burden will almost certainly increase, though, if its rapid economic growth of the past 30 years continues.

Israel and North Korea are good examples of countries with a very great perceived need to defend themselves. The both have relatively high defense burdens (6.1 for Israel and 12.5 per cent for North Korea). Israel's demand for defense is also supported by a high per capita income, but not so North Korea. Its dictatorial leader Kim Jong-il simply commandeers a disproportionately high percentage of the country's resources for defense. Both countries are small in terms of world

income and population shares, however, so that their shares of world military expenditures are extremely small.

Finally, a small and poor country such as Cameroon, with no pressing military needs, spends almost nothing on defense.

The Theory of Alliances

The Samuelson rule also figures prominently in the economic theory of defense alliances.¹ Suppose a number of countries form a defense alliance to protect themselves against a common enemy. Suppose, also, that defense spending is a non-exclusive good within the alliance – a given amount of defense spending by any one of the countries has the same protective effect on all the countries. Finally, assume that the costs of providing defense are the same for each country. Under these baseline assumptions, the Samuelson rule applies alliance-wide. The amount of defense is efficient if the sum of the $MRS_{\text{defense, private good}}$ across all citizens within the alliance equals the common $MRT_{\text{defense, private good}}$. The alliance-wide rule suggests that both population and the perceived need for defense are irrelevant in allocating the payment for the defense expenditures within the alliance, because these factors are the same for all the countries. Consequently, the usual assumption is that each country should pay for the alliance's defense expenditures in proportion to its GDP. That is, the defense burden should be equal across the countries in the alliance.

This almost never happens, however. The defense burdens are usually unequal within alliances, with the more populous countries bearing the larger defense burdens. An example is NATO, in which the U.S. bears the largest defense burden. This unequal sharing of the defense burden is known as the exploitation hypothesis. In addition, the total amount of defense spending within alliances tends to be suboptimal. Both problems arise because of the incentive to free ride.

The driving force behind the suboptimal provision of defense is that each ally chooses its optimal military expenditures given the best-response level of expenditures of all other allies (the so called *spill-ins*). In doing so, each ally equates its private marginal benefits to private marginal cost, whereas the Pareto-efficient level of spending also incorporates the marginal benefits of defense conferred on other allies. "...[E]fficiency requires that marginal costs be equated across allies at their respective defense provision levels, and that each ally adjusts for the marginal benefits that their provision confers on itself and the other allies" (Sandler and Hartley, 2001: 872). But by following their private interests, the larger (more populous) countries end up spending more on defense than the smaller (less populous) countries and bear a disproportionately high defense burden. To minimize this effect, alliances tend to form between countries that are friendly towards one another and have tight linkages. This reduces the incentive of the smaller countries to free ride on the defense expenditures of the larger countries (Sandler and Murdoch, 2000: 301).

Sources

Sandler, T. and Murdoch, J. C. (2000) On Sharing NATO Defence Burdens in the 1990s and Beyond, *Fiscal Studies* 21(3): 297–327

¹ Sandler and Hartley (2001) offer an excellent overview of the literature on the economics of alliances.

Sandler, T. and Hartley, K. (2001) Economics of Alliances: The Lessons for Collective Action. *Journal of Economic Literature* **39**(3): 869–96