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Evaluating NATO Long Run Defense Burdens using Unit Root Tests

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This study evaluates NATO long run defense burdens by analyzing the time series properties of burden measures, namely growth of defense spending, defense share in national output, defense share in government spending, defense spending per capita, and defense share in total NATO spending for the time period 1949-2002. The study also compares the effect of using government Purchasing Power Parity conversion factors and Market Exchange Rates for defense share in total NATO expenditure conversions. The study also examines the implications of NATO expansion in light of the defense burden measures of the newer NATO members.

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This study evaluates NATO long run defense burdens by analyzing the time series properties of burden measures, namely growth of defense spending, defense share in national output, defense share in government spending, defense spending per capita, and defense share in total NATO spending for the time period 1949-2002. The rejection of the unit root and a reversion to a constant mean in the measure indicates an unchanging defense commitment by the NATO member over the time period tested. By the same token, the presence of a unit root in the measure indicates a change in the member's defense burden. Turkey emerges as the NATO country with the strongest long run defense burden. Canada, France, the Netherlands, and the UK are the countries with the weakest. The US long run defense burden, while not the lowest, falls in the lower range even though the US contribution is the highest in absolute levels. The study also compares the effect of using government Purchasing Power Parity conversion factors and Market Exchange Rates for defense share in total NATO expenditure conversions. The use of these two conversion factors has implications for expenditure rankings of the smaller NATO members but does not change the rankings of the larger contributors. The study also examines the implications of NATO expansion in light of the defense burden measures of the newer NATO members.

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I: INTRODUCTION

Since the inception of NATO in the late 40s, the appropriate sharing of the defense burden has been a recurring matter of contention. The larger NATO allies, especially the Unites States, continue to claim that they shoulder a disproportionate share of the defense burden. If as these members argue, defense burdens are vertically progressive, the calls for increased defense expenditures by the smaller members are justified. On the other hand, if these arguments are spurious, such calls are not only inappropriate, but, if realized might result in a regressive distribution.

Previous examinations of the NATO members' expenditure behavior have mainly focused on specific spans of time rather than each member's accession to NATO. The studies have addressed the relationship between defense burdens and defense benefits to explain the NATO model as a group while the behavior of each ally over time with respect to their commitment to NATO has not been addressed. While informative as to member's responses to evolution in official NATO doctrine[1], this approach also ignores the common trends and national policy that may underlie a member's response. The literature has not examined whether these long term trends in burden sharing exist, and, if they exist, the magnitude of the effects.

The primary purpose of this article is to examine NATO burden sharing in the long run, since the establishment of NATO in 1949 to 2002. The Dickey Fuller Generalized Least Squares (DF-GLS) test is used to determine if the various burden sharing measures have reverted back to a constant mean over the time period. If the measure did revert back to a mean, the ally's contribution to that measure has not changed. If the measure exhibits a unit root behavior, the contribution has changed. The burden sharing measures are then weighted to allow for a comparison across allies using all burden sharing measures. Purchasing Power Parity (PPP) and Market Exchange Rate (MER) conversions are used to generate the ally defense share in total NATO defense spending measure.

[1] NATO doctrine in the 50s and early 60s corresponds to the strategy of mutual assured destruction deterrence; The doctrine of flexible response in the 70s and 80s; Crises management from the 90s to the present. Sandler and Murdoch (2000) have an in-depth discussion of each period.

The results indicate that military expenditure growth has remained constant for all the members except for Luxemburg, the Netherlands, and Turkey. Luxemburg and the Netherlands exhibit a decrease in the rate of military expenditure growth while Turkey has a increase in growth. Of all NATO allies, Turkey's weighted burden sharing measures appear to have increased across the board. Turkey is closely followed by Greece. Even though in absolute terms, the US retains the largest burden measures, its contribution has steadily declined over time. The remaining allies appear to be clustered in groups, with Denmark, Germany, Italy, Norway, and Portugal in one group followed in ranking by France, Luxemburg, and the Netherlands, then the UK and lastly the US and Canada. Spain, Czech Republic, Hungary, and Poland have insufficient data to allow for time series analysis. However, looking at the averages of their contributions, it appears that Spain and Poland fall in the middle range of the allies. Hungary and Czech Republic fall in the lower end.

The remainder of the paper is structured as follows. In Section II we discuss the NATO burden sharing debate and measures of burden sharing. We review the empirical tests and data used in Section III. Section IV presents the results. The last section concludes and offers policy advice.

II: NATO AND BURDEN SHARING MEASURES

NATO

The North Atlantic Treaty signed in 1949, by Belgium, Canada, Denmark, France, Greece, Italy, Iceland[2], Luxemburg, Netherlands, Norway, Portugal, US, and the UK, established NATO as a cooperative defense organization with each ally contributing a share to the defense of the collective. Greece and Turkey joined NATO in 1952, West Germany in 1955, Spain in 1982, Czech Republic, Hungary, and Poland in 1999 and Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia, and Slovenia in 2004. However, with most of its members still recovering from the devastation of World War II, the burden of NATO defense fell on the United States with the expectation that the

[2] Iceland maintains no military but its strategic location allows it to host NATO bases.

allies would gradually increase their contribution. However with the allies not substantially increasing their contribution, NATO adopted in 1977 a policy that formally required each member to increase their defense spending by 3 percent per year after adjusting for inflation. This goal was rarely met by the allies. With the expansion of NATO, burden sharing has become a divisive issue with the larger allies alleging that they carry a disproportionately large share of the alliance burden.

NATO has adopted a number of distinct defense strategies over the years. The allies adopted a doctrine of mutual assured destruction in the early years between 1949-1966. This doctrine essentially relied on US superiority in strategic nuclear weapons as a credible deterrent and automatic threat to counter any Soviet territorial expansion by attacking preemptively. This could be done because the Soviet strategic weapons were thought to be vulnerable to a first strike. The reliance on strategic weapons meant that NATO's security rested primarily with the US strategic forces, and as a result, NATO's conventional forces were outnumbered by the Soviet Union's.

As the Soviet Union began to build its strategic forces in the late 60s and early 70s, NATO changed its doctrine to that of flexible response. This reduced the credibility of an automatic US nuclear response. The allies prepared to defend themselves against conventional forces. As a result, strategic forces were supplemented with tactical and conventional forces to allow for a flexible response that is commensurate to acts of aggression and could be escalated if needed. Reagan's procurement and strategic buildup of the US forces began during this time. In addition, the pressure was on all NATO allies to build up their conventional forces and support US troops and military installations in Europe.

With the fall of the Berlin Wall in 1989 and the end of the Cold War, NATO no longer faced a common threat. The allies began downsizing to take advantage of a peace dividend. NATO's roles and responsibilities evolved during this period. Security concerns extended beyond NATO's boundaries and new strategic doctrines were developed to deal with the emerging threats. The perceived challenges included managing crisis such as civil wars, disputes over natural resources, and natural disasters, peacekeeping missions, and nuclear, biological, and chemical arms control.

With the dissolution of the Soviet Union ethnic disputes have erupted in the former communist bloc requiring major intervention. NATO troops were deployed in Bosnia in 1995 as an Implementation force (IFOR) and became a stabilization force (SFOR) later on. In Kosovo, NATO forces were dispatched as part of a peacekeeping force (KFOR). Since the threat to economic stability and its consequences on the flow of oil in the early 90s in the Gulf, two wars have been fought in that region. Ethnic crises erupted in various part of Africa including Somalia, Burundi, Rwanda, and Sudan. Peacekeeping required the development of multilateral rapid deployment forces and NATO has become a force provider. In addition, the process of military transformation resulting from the R&D breakthroughs in military hardware and information technologies has created a technology gap in weapons between the large and small ally members. All this requires a rethinking and realignment of the forces.

NATO has undergone a rapid expansion during the last decade with a significant redrawing of the NATO border to the east. From an economic standpoint, the alliance should be expanded if the benefits of expansion are greater than the costs. When the new allies joined NATO it was assumed that they would eventually contribute to the security of the alliance and share in the costs of defense burden. [3] The costs of expansion include the costs of modernizing the new member's forces, the cost of intelligence, equipment, training, cost of projecting NATO power to the new borders, the cost of communication and control. While these additional costs are to be picked up by the new and current members, it is highly unlikely that the economies of the new members will allow them to undergo this tremendous investment. Their defense budgets are small, their economies are fragile and in transition and their populations do not appear to support an increase in the proportion of government spending devoted to defense. They are not in a position to increase their military budgets to meet NATO's military requirements. Quite likely, the costs will be underwritten by the wealthier NATO allies.[4]

Although the new allies are progressing along the same lines and facing similar challenges, their current security contributions to and security demands on the alliance

[3] Congressional Budget Office (CBO), 2000.

[4] Instead of the new alliance members fully integrating into NATO, proposals have been in the made where each NATO member would specialize and provide a niche capability. However, it appears that NATO is leaning toward integrating new members into its structure.

varies. Of all the new members, Poland brings in a large military that has a strong commitment to funding and seems to be better positioned to play a substantial role in the alliance. Even though no major threat exists to Poland, its terrain makes it vulnerable to attacks and hard to defend. The Czech Republic has few security concerns. It is bordered by three NATO states and neutral Austria. Hungary's security situation is problematic. It is mostly flat and borders unstable former Yugoslavian republics of Croatia and Serbia. In addition, Serbia has a Hungarian minority and the right of that group could become an issue in the future. The Baltic states of Estonia, Latvia, and Lithuania would be difficult to defend because they lack strategic depth to trade space for time and any NATO forces stationed there could be quickly overwhelmed by large Russian forces in the area. Slovenia could probably be defended by local forces until ground and air forces based in neighboring Italy could reinforce the country. Romania and Bulgaria are difficult to defend because of their flat territory but are large and close to NATO forces in Germany. All these nations have small GDPs and their precarious security situation could draw the alliance into conflict with Russia.

Burden Sharing Measures

Various indicators have been used to measure NATO defense burdens. The most common measures are the military expenditure measures combined with ability to pay measures where military expenditure is normalized by various country specific measures to define ability to pay. In addition, defense shares in total NATO defense spending is used as a defense burden measure. NATO allies have made selective use of the burden sharing measures choosing those that justify their position to their different constituencies. Some measures reflect the domestic burden of defense and the ability of a country to underwrite its defense expenditures. Others reflect the burden shared among allies and reflect each countries contribution to a common defense.

Sandler and Forbes (1980) use the joint product model to examine defense burden sharing and NATO's structure with respect to strategic, diplomatic, and technological developments for the period 1960-1975. They use the Kendall rank correlation test on a year by year basis to discriminate between the joint product and deterrence model arguing that the absence of a significant relationship between industrial size and defense

effort after 1966 favor the joint product model. The variables used for the Kendall test are the GDP and ratio of defense expenditures to GDP with per capita GDP and exposed border held constant. Using data for 1960, 1965, 1970, and 1975, they also find that average relative benefits remained largely unchanged and relative defense contributions appear to have shifted from the US to the European allies with Canada emerging as the greatest under contributor. They use the ratio of defense expenditures to GDP and each ally's share of total NATO military expenditures as a proxy for defense effort. Area, population, GDP, and exposed borders are the proxy for benefits, what can be saved in lives and industry.

Khanna and Sandler (1996) extend the time period examined from 1960-1992 using the same techniques as Sandler and Forbes (1980). Their results support the joint product model as the underlying paradigm of NATO burden sharing behavior. They also use the Wilcoxon test to statistically compare defense burdens and average benefit shares for six sample years. They conclude that for four of the six years actual defense burdens matched the proxy for benefits when using population, GDP, and exposed borders as proxys. When using area, population, GDP, and exposed borders as proxy for benefits for three years, they conclude that for two years the actual defense burdens equal the proxy for benefits. Khanna and Sandler (1997) update the results of their 1996 study by using conscription adjusted data and adding peace keeping expenditures and foreign assistance. They find that the conscription adjusted data and foreign assistance reaffirm their basic findings of a joint product model. However, peace keeping activities are more in line with a pure public good model. Sandler and Murdoch (2000) find that there is no evidence of disproportionate burden sharing between 1990-1999.

However, Solomon (2004) examines the impact of omitting the exposed border proxy. He argues that because of asymmetric threats, the stability of the NATO ally's borders, and the need to protect strategic assets the concept of an exposed border is irrelevant. He concludes that the equality of benefits and burdens was rejected using nonparametric tests for various time segments.

Our choice of burden sharing measures is motivated by Hartley and Sandler (1999).[5] Military expenditure (ME) is the cost of a nation's defense effort and the opportunity cost of defense. We make no assumptions about force effectiveness. [6] That is, no attempt is made to access and compensate for the efficiency with which expenditures are transformed by maintaining troops and purchasing equipment to outputs such as crises management or peacekeeping missions. We use ME annual growth as a normalized measure of a nation's internal defense burden.

Military expenditure as a share of GDP (ME/GDP), military expenditure per capita (ME/POP), and military expenditures as a share of government expenditures (ME/GOV), are burden sharing measures that reflect the ability of a country to underwrite its expenditures. Each of these measures represents a different aspect of ME cost or burden on a nation. ME/GDP represents the diversion of resources to defense – internal opportunity cost of defense. Since ME are a subset of government expenditures, ME/GOV indicates a nation's opportunity cost within the government budget. ME/POP is a proxy for the individual defense burden within a country. This measure explains the commitment to expenditures per citizen that is being defended.

Country specific military expenditure shares of the NATO total defense expenditure reflect the shared burden among allies and each country's contribution to the common defense. To calculate each country's military share in total NATO defense spending, the military expenditures for each country will be converted to a common

[5] CBO 2001 suggest three burden sharing measures that are identified as standard: ME/GDP, ME/POP, and the proportion of the labor force in the military. We opted not to use the latter since it is a component of military expenditure and using it would be a duplication of the information used to generate ME. CBO also identifies other burden sharing measures that apply to the post Cold War environment. These are contributions to NATO's rapid reaction forces, contributions to peacekeeping forces in Bosnia and Kosovo, and economic assistance to Central and Eastern Europe. We opted not to include these three additional measures for a number of reasons. The cost for the first and second measures are already reflected in each allies overall ME. The third measure is difficult to quantify as pointed out by CBO report. Economic assistance is a small part of the economic interaction between the allies and the countries of Central and Eastern Europe. The major interaction is due to foreign direct investment. In addition, since NATO is a military alliance, it can be argued that non military assistance should not be a measure of military commitment.

[6] We do not adjust ME for countries that rely on conscription based on Oneal (1992). The study indicates that the necessary cost inflation to adjust for conscription is sufficiently small so as not to affect the ordering of allies according to defense burdens. In addition, Khanna and Sandler (1997) establish that conscription adjusted data give the same conclusion as non adjusted data.

currency, the dollar.[7] According to the productivity model of price levels, tradable commodities are more likely to be nearly equal in price in different countries than services or other non-tradable commodities. A sounder approach to convert military expenditures would be to break down the expenditures into tradable and non-tradable commodities. MER would be used for the tradable commodities and PPP, which reflects the local price levels, would be used for the non-tradable commodities. For military expenditure data, this distinction would be between the equipment purchases which are commodities that are regularly traded, and personnel, infrastructure, and maintenance expenditures which are a function of the local price level. NATO does break down military expenditures into four categories, personnel, equipment, infrastructure, and other. The equipment would be converted using MER and the rest of the categories would be converted using PPP. However, the breakdown is only available for a limited number of years and the breakdown for France is not reported. Using this method of conversion would result in a value that is between the MER and PPP conversions. The extent of the difference would be a function of how different the national price level is from the US price level. To address this issue, we generate two values for the share measure, military expenditure share in total NATO defense spending. One is generated using MER (ME MER/NATO) and the other using PPP (ME PPP/NATO) conversions. [8] We use the government price level as a PPP conversion factor. The government price level reflects the price level of public goods using the public finance distinction between public and private goods. Since defense spending is a public good that cannot be divided for exclusive consumption without some benefits spill over to others or withheld from those who don't pay, the government price level was deemed to be a better measure than

[7] The conversion of military expenditures to US dollars is handled in a variety of ways. SIPRI converts by deflating to a common year and using average annual exchange rates reported by IMF. NATO currently uses the same methodology as SIPRI. NATO is considering using PPP conversions. The International Institute for Strategic Studies (IISS) uses exchange rates for some countries, lagged dollar values for countries with exchange rate fluctuations, and PPP for some former communist countries. The UN Group of Experts on the Reduction of Military Budgets recommends the use of PPP conversion factors and in their 1977 report "The Reduction of Military Budgets" recommend the creation of a military price index

[8] Figure 1 presents for graphs that illustrate the difference using the two conversion methods. Figure 1a presents total NATO Military Expenditures calculated using both MER and PPP. Figure 1b is the US share of total NATO spending using both PPP and MER conversions. The US share trends down over time for both conversion methods. Figure 1c is France share of NATO spending. France is the only country where the share is stationary using both conversion methods. Figure 1d is The Netherlands share of spending. The MER share trends up while the PPP share is stationary.

the consumer price level. The ME MER/NATO and ME PPP/NATO are considered as two different measures of burden sharing and are equally weighted with the rest of the burden sharing measure to generate a final comparison between the nations. MER conversions tend to understate the purchasing power of the military budgets of lesser developed countries because the MER is a reflection of world market prices and domestic price levels in these countries tends to be lower than those of developed countries. By the same token, PPP conversions may exaggerate the purchasing power of military expenditures by not taking into account the level of technology purchased from the developed countries. While this is may not be as serious of an issue within NATO as it would be if countries like Russia, China, or India were being evaluated.

III: EMPIRICAL TESTS

The question of interest in this study is what the long term behavior of the NATO allies is regarding their commitment to a common defense strategy. In order to answer this question, a univariate unit root test is used. The unit root test evaluates the time series using the null hypothesis of a unit root against an alternative of level stationarity. The DF-GLS test developed by Elliott, Rothenburg, and Stock (ERS 1996), is a univariate unit root test, where local to unity GLS detrending of the data is used to improve power over that of the ADF test. For a time series y_t, we define the quasi-difference as:

$$d(y_t \mid a) = \begin{cases} y_t & t = 1 \\ y_t - a y_{t-1} & t = 2,...,T \end{cases}$$

Next, we consider an OLS regression of the quasi-differenced data $d(y_t \mid a)$ on the quasi-differenced x_t defined as:

$$d(x_t \mid a) = \begin{cases} 1 & t = 1 \\ 1 - a & t = 2,...,T \end{cases}$$

$$d(y_t \mid a) = d(x_t \mid a)' \delta(a) + \eta_t$$

We let $\hat{\delta}(\alpha)$ be the OLS coefficient estimates from this regression.

ERS recommend using $a = \bar{a}$, where $\bar{a} = 1 - 7/T$

We now define the GLS detrended data y_t^d as:

$$y_t^d = y_t - x_t^{'}\hat{\delta}(\bar{a})$$

We finally estimate:

$$\Delta y_t^d = \alpha y_{t-1}^d + \sum_{i=1}^{k} \beta_i \Delta y_{t-i}^d + \varepsilon_{tk}$$

The DF-GLS statistic is the t statistic for testing $\alpha = 0$. The null and alternative hypotheses may be written as:

$$H_0 : \alpha = 0$$
$$H_1 : \alpha < 0$$

The null and alternative for this study can be interpreted as:

H_0: The ally commitment to NATO using a certain defense burden measure is not constant – does not revert back to a constant mean. The commitment is changing, either increasing or decreasing.

H_1: The ally commitment to NATO using a certain defense burden measure has been constant for the time period tested. The commitment is reverting back to a constant mean.

To provide an overall measure to compare each member's commitment to defense, we construct an index. All the burden sharing measures are included in the index and are weighted equally. We use a directional score for each measure. An upward trend in the measure is given a score of 1. A stationary measure is given a score of 0.5. A downward trend in the measure is given a score of 0. The higher the aggregate weighing number, the higher is the ally's defense burden commitment with the maximum being a 6. We consider each measure to be of equal importance in the burden sharing debate and we make no judgment as to the relative or absolute importance of one measure over the other. We are concerned with directional moves over time. Finally, we rank all the countries based on the aggregate index. A higher rank indicates a higher defense burden commitment.

Data

NATO figures on military spending are highly reliable and use a common definition for defense. NATO has gone through the process of producing standardized figures that reflect expenditures for comparable categories for each country. The attempt at standardization is to assist in the assignment of defense burden sharing among the member countries.

The data used to test the unit root hypothesis is annual data expressed in logarithms.

Data for NATO military expenditures are from *NATO Review* which reports them in current year national currency. Military expenditure data is available from 1949-2002 for Belgium, Canada, Denmark, France, Greece, Italy, Luxemburg, Netherlands, Norway, Portugal, Turkey, UK and the US. Data for Germany is from 1953-2002. Data for Spain is from 1985-2003. Czech Republic, Hungary, and Poland data is reported starting in 1999. We use current year prices instead of deflated prices to avoid biasing the data to the economic conditions of the reference year.

Defense expenditures as a percent of Gross Domestic Product are also from *NATO Review* for the years 1973-2003. For 1949-1972, they are calculated by using the defense expenditure data from NATO Review and GDP data from the International Monetary Fund's *International Financial Statistics* May 2005.

Population and government expenditure data used to calculate ME/POP and ME/GOV are from International Monetary Fund's *International Financial Statistics* May 2005.

The exchange rates used to derive the MER value for each country's military expenditure share of total NATO military expenditures are from the International Monetary Fund's *International Financial Statistics* May 2005.

PPP conversions are derived using the price level of the government as reported by the Center for International Comparisons at the University of Pennsylvania, October, 2002.

IV: Empirical Results

It is worth noting that two of the burden sharing measures, ME/POP and ME/GOV trend in the same direction for all countries. ME/POP is trending upward indicating an increase in military expenditures that is faster than the increase in population placing an ever increasing defense burden on individuals. This is understandable in light of the changing demographics in Europe. The defense burden ME/GOV is trending downward for all allies. The role of government has changed substantially over the past 50 years. ME used to be a significant portion of government expenditures overshadowing other commitments. However, due to the changing nature of the role of government in the social service sector and the increasing strain on government budgets by social services and despite the fact that the absolute amount dedicated to ME has increased, the ME/GOV ratio has declined substantially over the years an indication that the opportunity cost of ME expenditures over other government commitment is too high to sustain.

What emerges from analyzing the NATO burden sharing measures over the long run is a clear categorization of NATO countries into different levels. Table 1 presents the results of the DF-GLS unit root test for each burden sharing measure for all NATO countries. Table 2 presents the weighted results for the burden sharing measures.

Turkey emerges as a clear standout in analyzing the results of the stationarity tests. The growth rate of military expenditures over the long run is increasing. No other NATO ally exhibits an increased growth rate. ME/GDP is stationary. Greece is the other NATO nation that exhibits a stationary ME/GDP. Even though Turkey has experienced almost tripling of its population since the inception of NATO, military expenditures have grown by a much larger rate. This leads to ME/POP being not stationary and increasing rapidly. Even though this measure is not stationary and increasing for all NATO countries even for those that exhibit a lower population growth than Turkey. Had the population growth been more in line with the rest of NATO, Turkey would have an exploding ME/POP ratio.

Even more telling is Turkey's military expenditure growth converted to U.S. dollars. Using both, MER and PPP adjusted data, Turkey has increasing growth over the

long run. As a result, Turkey has the largest weighted sum for all measures, 4.5 on a scale of 6. Table 2 presents the weighted data for all countries with Turkey clearly by itself in the first rank. Table 5 presents the ME/GDP data for our observation period. Again, Turkey has one some of the highest percentages averaging about 4.5% for the entire period. Table 3 and Table 4 present the PPP and MER share of NATO military expenditures. Turkey's PPP share of NATO averages about 2.18%, double its MER average share of NATO spending at 0.99%.

Greece has the second largest weighted sum at 4 on a scale of 6. Its military expenditures are stationary indicating a constant commitment. In addition, similar to Turkey, ME/GDP is stationary. Greece's ME/POP is non stationary and increasing like all other NATO countries and its ME/GOV is decreasing. Similar to Turkey, its PPP and MER share of NATO spending are both increasing.

A possible explanation for the high levels of Turkish and Greek military expenditures has been their rivalry over Cyprus. However, Turkey appears to have a greater commitment than Greece to military expenditures. This suggests that Turkish military expenditures are influenced by factors other than Greece. Quite possibly, Turkey is concerned by its exposed borders to the East, its Kurdish militants, and other internal defense issues (Brauer 2002). The results obtained by Sezgin and Yildirim (2002) appear to substantiate this.

The third block of NATO countries with a weighted sum of 3.5 is Norway. To maintain a constant ME growth, Norway increased both the PPP and MER share of NATO expenditures. It is the only country, other than Turkey and Greece, to have an increase in both shares.

The fourth block with a weighted sum of 3 consists of Denmark and Portugal. While both countries maintained a stationary PPP share, they also maintained an increasing MER share.

The fifth block of nations with a weighted sum of 2.5 are Belgium, Germany, Italy, Luxemburg, and the USA. Even though in absolute values, USA military expenditures are the highest, both MER and PPP share of NATO spending is stationary. Belgium exhibits the same long run behavior as the US. It appears that both Belgium and the US have maintained a very consistent ME commitment to NATO over the period.

Germany and Italy exhibit similar behavior in that their PPP share is down while their MER share is up. This is probably a reflection of an increase in domestic price level, the strengthening of the exchange rate, and a reliance on non domestic sources for military equipment. Luxemburg demonstrates a decrease in ME while maintaining a stationary PPP share and an increasing MER share. This initially appears to be a contradiction. However, when the MER share data is examined, it increases from 0.01 to 0.04 just for 2002 a small change in absolute contribution and the by far the smallest in percentage contribution.

The last block of nations with a burden sharing weight of 2 are Canada, France, the Netherlands, and the UK. ME is stationary for this group. ME/GDP, ME/GOV have decreased for all countries and ME/POP increased. France and the UK both have a decreasing PPP share and a stationary MER share. This is probably a reflection of the increase in the domestic price level and the existence of a large domestic defense industry that supplies equipment to the forces in both these countries. Canada exhibits a stationary PPP share and a decreasing MER share. The Netherlands exhibits a decreasing PPP share and an increasing MER share which probably reflects an increase in domestic price level, the strengthening of the exchange rate, and a reliance on non domestic sources for military equipment.

Even though Spain, Czech Republic, Hungary, and Poland have insufficient data points for time series analysis, it is worth looking at the average of their MER and PPP share. Spain, using MER and PPP data, is in the middle range for NATO countries. Poland using PPP data is also in the middle range. However, using MER data it drops to being a low contributor. Spain is the NATO ally most similar to Poland. They both have a population of about 40 million and similar size military. Comparing Poland's contributions to that of Spain, we find that using PPP data they are quite similar. However, using MER data Spain's contributions far outweigh those of Poland. Hungary and the Czech Republic at a population of 10 million and a similar size military could be compared to Portugal. However, their contributions are more similar to those of the smaller NATO allies such as Luxemburg.

This is consistent with analyst expectations for these three nations. Of the three, Poland has the largest military and historically has spent the most on defense as a

proportion of GDP. The military is held in high esteem and regarded as defender of the nation. There appears to be strong public support for meeting the defense expenditures to carry out the obligations of NATO membership. This commitment to NATO is reflected in the data.

In contrast, there is little public support in both Hungary and the Czech Republic for increasing defense expenditures. The armed forces in both these countries have historically been held in low regard and widely viewed as complicit in the Soviet Union's domination of the countries. Interestingly, both the Czech Republic and Hungary are at the lowest end using MER data (only Luxemburg has a lower contribution) and they are both at about midrange using PPP data. Using MER data it would appear that Czech and Hungary are exhibiting free riding, but this point is less obvious using PPP data.

It is obvious that for lesser developed NATO countries the use of PPP or MER data makes a tremendous difference in levels of contribution such as for Poland, Hungary, and the Czech Republic. In the case of Turkey and Portugal, their PPP share is more than double their MER share. The other two countries with a noticeable difference between the two measures are Greece and the UK with about 40% difference.

Table 6 and Table 7 present the country rank of each ally based on MER share and PPP share of total NATO expenditures. Belgium, Canada, Denmark, France, Germany, Italy, Luxemburg, Netherlands, Norway, UK, and USA maintain similar rankings in both tables. Spain, unexpectedly, has a much lower rank using PPP adjusted data. The government sector appears to have had a substantial increase in its price level for a number of years leading to a decline in domestic purchasing power. The Czech Republic, Greece, Hungary, Poland, Portugal, and Turkey appear to have the greatest difference in rank between the two conversion methods. The ME for these countries is much higher using PPP adjusted data. This is no surprise due to the lower domestic price levels. Referring to Table 3 and 4 which present the share of MER and PPP military expenditures, it is clear that for countries like Turkey, Portugal, Poland, Hungary, and the Czech Republic, the difference in shares more than doubles using PPP conversions. For countries such as Luxemburg, Belgium, and Denmark, the difference between the two measures is negligible. For the remaining countries, there are some minor differences.

We reach the conclusion that Turkey and Greece have strongly increased their defense burden. Canada, France, the Netherlands, and the UK rate the lowest in their long run commitment to a shared defense burden. Norway, Denmark, and Portugal rank in the middle with a consistent long run commitment. The remaining countries, Belgium, Germany, Italy, Luxemburg, and the USA while not rating the lowest, have decreased their long run commitment to a shared defense burden. It is too early too make a judgment concerning the newer members.

V: CONCLUSION

This paper analyzes the long run characteristics of NATO burden sharing measures for the time period 1949-2002 by employing the DF-GLS test for stationarity and weighing each measure. Turkey emerges as the NATO country with the strongest long run defense burden followed by Greece.

Even though the USA contribution is the highest in absolute levels, it has decreased its long run commitment to a shared defense burden. Canada, France, the Netherlands, and the UK rate the lowest in their long run commitment to a shared defense burden. Norway, Denmark, and Portugal rank in the middle with a consistent long run commitment. The admittance of Spain, Czech Republic, Hungary, and Poland to NATO appears to have mixed results for the alliance. Since these countries have insufficient data points for time series analysis, a look at the averages indicates that Spain appears to be assuming a burden share that puts it in the lower middle range of NATO allies. The contribution of Czech Republic, Hungary, and Poland is less clear. Using MER adjusted data, these three countries fall at the lower end of the range of defense share of total spending with only Luxemburg having smaller contributions. However, using PPP adjusted data, Poland fares better ending up in the lower middle range.

It would be prudent to examine the new members' burden sharing measures critically. The newer members could make a strong case supporting a reduction in their contribution based on the long run behavior of the rest of the allies. NATO should be aware of the burden placed on the fragile economies of its newer members in setting their

contribution to NATO and quite possible reevaluate the demands placed on the newer members especially NATO's policy of "costs where they fall" in which allies pay their own way for conducting operations.[9]

Even though the concept of a military alliance would imply that NATO should have an integrated response over the long run to defense issues, it appears that regional issue are the main drivers of Military Expenditures. Turkey and Greece are on the upper end of the defense burden and are clearly responding to defense concerns that are not shared by the remaining allies.

Even though Turkey emerges as the country with the strongest long run defense burden, it is worthwhile noting the changes in the military landscape over the past three years. Unfortunately data collection lags and the data for these three years will not be available for some time. As a result of the wars in Iraq and Afghanistan and the ever increasing US defense budget, we may see changes in the end results. Turkey will certainly remain near the top of the list and the rest of the NATO allies should not see a major change in their rankings. However, since the data for the US is trending upwards this could result in a change in the stationarity of the US data.

A useful extension of this study would be the use of structural tests to determine whether NATO member countries are acting as an alliance. This would be done by examining structural breaks in the patterns of military expenditures. Since NATO is a military alliance whose nations are joining together for a common defense purpose, a public good, structural breaks should fall within the same time frame in response to a common defense concern. If not, the threats perceived by each nation differs and military expenditures are an ally specific private good.

[9] In Armed Forces Journal June 2005, Gen. James Jones the Supreme Allied Commander Europe expressed concern that small allies when forced to bear costs of operations would be reluctant to participate.

Figure 1: PPP and MER Share of Total NATO Military Expenditures

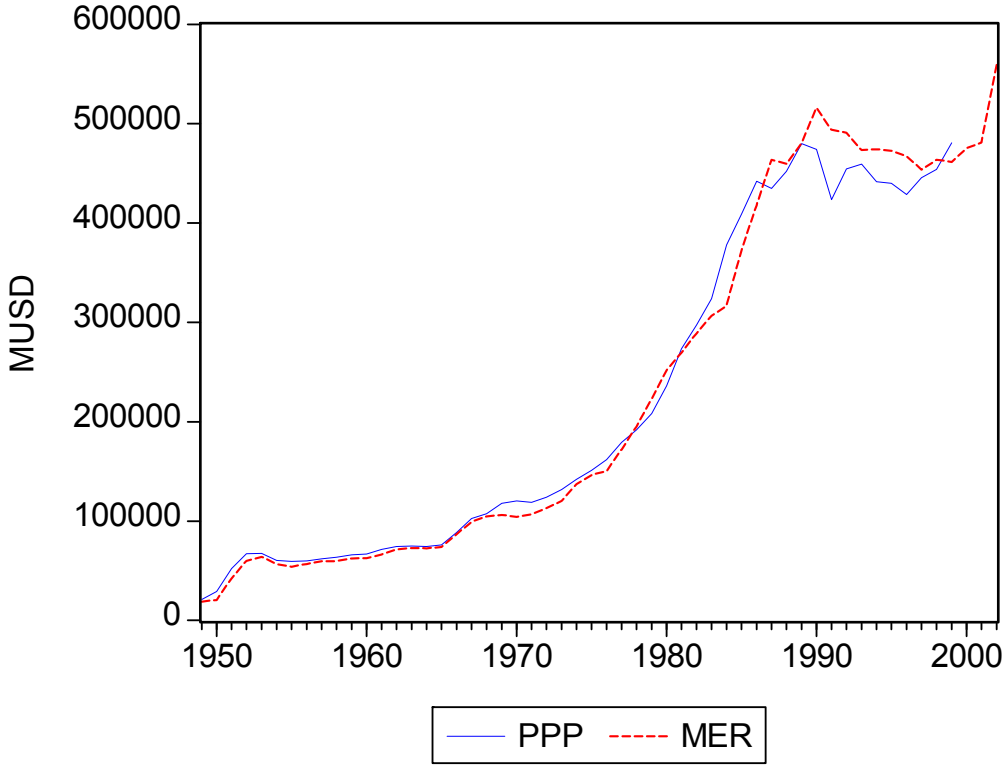

Figure 1a: Total NATO Military Expenditures

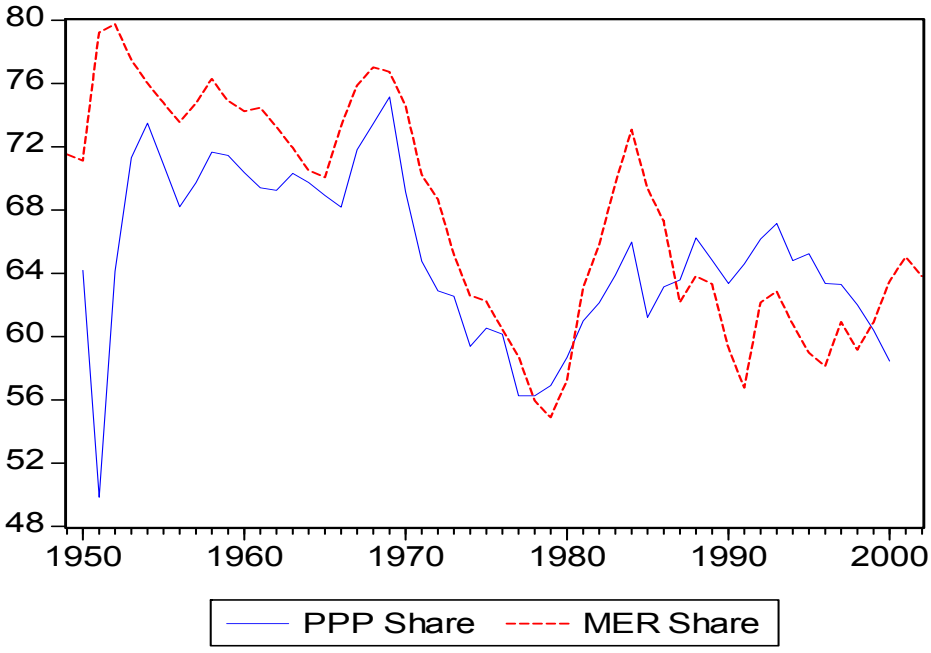

Figure 1b: USA

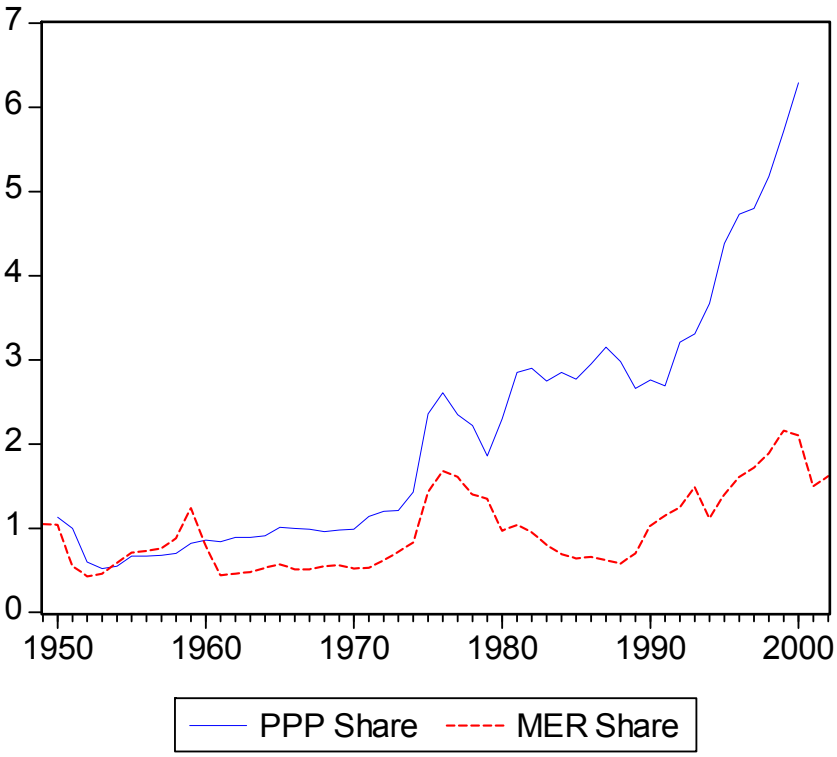

Figure 1c: Turkey

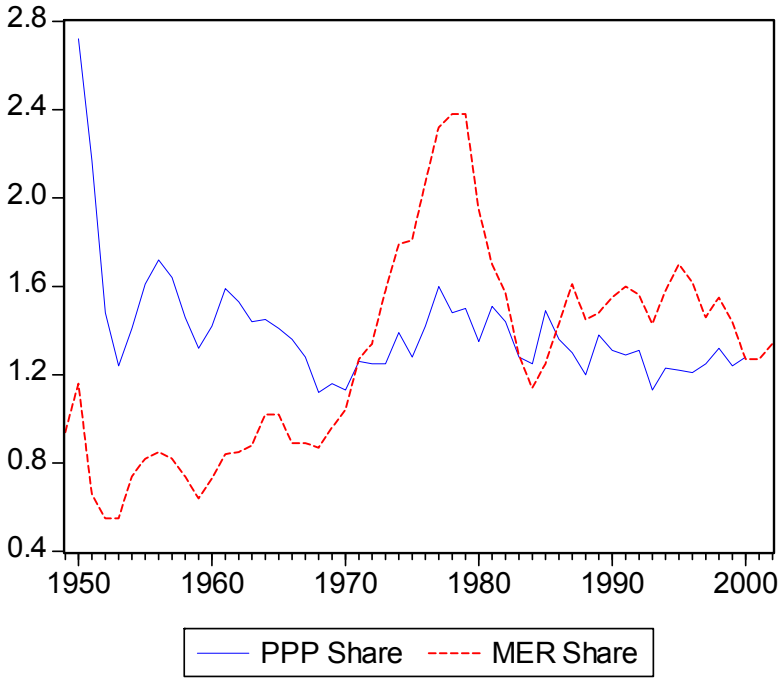

Figure 1d: Netherlands

Table 1: Stationarity of Burden Sharing Measures

	ME	ME/GDP	ME/POP	ME/GOV	ME_PPP	ME_MER
Belgium	-5.08***	0.97 ↓	-0.07 ↑	-1.15 ↓	-1.79*	-1.95**
Canada	-2.07**	-1.16 ↓	-0.16 ↑	-0.20 ↓	-1.93*	-1.09↓
Denmark	-3.91***	-1.13 ↓	1.03 ↑	0.35 ↓	-2.72**	-0.81 ↑
France	-5.2***	-0.61 ↓	1.52 ↑	-0.4 ↓	-1.41↓	-2.31**
Germany	-3.86***	0.16 ↓	0.16 ↑	0.52 ↓	-0.98↓	-1.30 ↑
Greece	-5.10***	-2.02**	0.70 ↑	-0.27 ↓	0.77 ↑	-1.17↑
Italy	-4.00***	-0.63 ↓	0.76 ↑	-0.01 ↓	-1.58↓	-0.57 ↑
Luxemburg	-1.05 ↓	-1.52 ↓	1.12 ↑	-1.08 ↓	-2.29**	-0.07↑
Netherlands	-1.19 ↓	-0.17 ↓	0.58 ↑	0.29 ↓	-0.95↓	-1.59↑
Norway	-4.08***	-1.60 ↓	1.38 ↑	-0.23 ↓	-0.13 ↑	0.01 ↑
Portugal	-6.48***	-0.40 ↓	1.20 ↑	-0.80 ↓	-1.62*	-1.23 ↑
Turkey	-0.90↑	-2.15**	0.64 ↑	-1.26↓	1.36 ↑	-1.46 ↑
UK	-3.68***	0.75 ↓	0.64 ↑	1.40 ↓	-0.62↓	-1.62*
USA	-2.13**	-1.54 ↓	-0.18 ↑	-1.22 ↓	-2.48**	-1.80*

DF-GLS test statistic critical values: -2.61 at 1% significance level, -1.95 at 5% significance level, -1.61 at 10% significance level.

* statistically significant at 10%, ** statistically significant at 5%, *** statistically significant at 1%

↑↓ arrows denote increase/decrease in burden sharing measure

Table 2: Weighted Burden Sharing Measures

	ME	ME/GDP	ME/POP	ME/GOV	ME_PPP	ME_MER	Total	Rank
Belgium	0.5	0	1	0	0.5	0.5	2.5	5
Canada	0.5	0	1	0	0.5	0	2	6
Denmark	0.5	0	1	0	0.5	1	3	4
France	0.5	0	1	0	0	0.5	2	6
Germany	0.5	0	1	0	0	1	2.5	5
Greece	0.5	0.5	1	0	1	1	4	2
Italy	0.5	0	1	0	0	1	2.5	5
Luxemburg	0	0	1	0	0.5	1	2.5	5
Netherlands	0	0	1	0	0	1	2	6
Norway	0.5	0	1	0	1	1	3.5	3
Portugal	0.5	0	1	0	0.5	1	3	4
Turkey	1	0.5	1	0	1	1	4.5	1
UK	0.5	0	1	0	0	0.5	2	6
USA	0.5	0	1	0	0.5	0.5	2.5	5

0 weight denotes decrease in burden sharing measure

.5 denotes stationarity in burden sharing measure

1 denotes increase in burden sharing measure

Ranks are ordered from 1 - largest burden sharing commitment to 6 - lowest

Table 3 MER Share of total NATO military expenditures

year	Bel	Can	Cz	Den	Fra	Ger	Gre	Hun	It	Lux	Neth	Nor	Pol	Por	Sp	Tur	Uk	USA
1949	0.83	1.90		0.27	7.22		1.71		2.54	0.01	0.94	0.27		0.26		1.05	11.49	71.51
1950	0.89	2.22		0.25	7.80		0.64		2.76	0.02	1.16	0.24		0.26		1.04	11.61	71.11
1951	0.63	2.73		0.16	5.97		0.41		1.73	0.01	0.66	0.19		0.13		0.55	7.58	79.23
1952	0.66	3.19		0.16	5.97		0.29		1.39	0.01	0.55	0.19		0.10		0.43	7.31	79.74
1953	0.62	3.11		0.20	6.19	2.30	0.14		1.20	0.02	0.55	0.23		0.11		0.46	7.38	77.50
1954	0.71	3.20		0.23	5.93	2.65	0.20		1.54	0.02	0.74	0.28		0.13		0.59	7.75	76.02
1955	0.63	3.39		0.25	5.81	3.23	0.23		1.63	0.02	0.82	0.25		0.14		0.71	8.11	74.79
1956	0.60	3.36		0.24	7.39	3.02	0.29		1.65	0.01	0.85	0.24		0.14		0.73	7.92	73.56
1957	0.62	3.20		0.25	6.23	3.58	0.25		1.64	0.01	0.82	0.25		0.14		0.76	7.55	74.72
1958	0.61	3.01		0.24	5.63	2.75	0.25		1.74	0.01	0.74	0.24		0.14		0.88	7.48	76.29
1959	0.60	2.75		0.23	5.83	4.27	0.25		1.73	0.01	0.64	0.25		0.16		1.24	7.15	74.89
1960	0.61	2.72		0.26	6.12	4.63	0.27		1.82	0.01	0.73	0.24		0.17		0.79	7.40	74.23
1961	0.59	2.53		0.26	6.08	4.97	0.25		1.82	0.01	0.84	0.25		0.26		0.44	7.23	74.47
1962	0.59	2.37		0.31	6.28	6.03	0.24		1.94	0.01	0.85	0.27		0.28		0.46	7.11	73.26
1963	0.65	2.18		0.33	6.37	6.89	0.25		2.28	0.01	0.88	0.28		0.27		0.48	7.20	71.93
1964	0.73	2.31		0.35	6.77	6.77	0.26		2.46	0.01	1.02	0.30		0.31		0.53	7.69	70.50
1965	0.72	2.08		0.39	6.93	6.72	0.28		2.62	0.01	1.02	0.36		0.31		0.57	7.92	70.06
1966	0.65	1.89		0.35	6.24	5.87	0.28		2.48	0.01	0.89	0.31		0.29		0.51	6.93	73.30
1967	0.62	1.83		0.30	5.89	5.38	0.31		2.19	0.01	0.89	0.29		0.33		0.51	5.56	75.87
1968	0.62	1.70		0.33	5.84	4.61	0.35		2.15	0.01	0.87	0.31		0.35		0.55	5.30	77.02
1969	0.63	1.66		0.33	5.21	5.51	0.40		2.13	0.01	0.96	0.33		0.35		0.56	5.21	76.72
1970	0.72	1.88		0.35	5.64	5.93	0.45		2.40	0.01	1.04	0.37		0.42		0.52	5.61	74.64
1971	0.78	1.98		0.42	6.40	7.30	0.49		2.92	0.01	1.27	0.42		0.50		0.53	6.74	70.23
1972	0.91	2.00		0.44	6.57	7.94	0.50		3.28	0.01	1.34	0.43		0.53		0.62	6.77	68.68
1973	1.08	2.00		0.47	7.47	9.82	0.56		3.27	0.01	1.58	0.51		0.54		0.72	6.79	65.19
1974	1.08	2.13		0.57	7.85	10.78	0.76		3.20	0.01	1.79	0.55		0.74		0.83	7.12	62.59
1975	1.32	2.10		0.58	8.52	9.80	0.88		3.11	0.01	1.81	0.58		0.50		1.43	7.15	62.21
1976	1.40	2.41		0.65	8.55	10.95	1.02		2.74	0.02	2.07	0.68		0.40		1.68	6.94	60.49
1977	1.45	2.27		0.64	9.13	11.11	1.11		3.03	0.02	2.32	0.67		0.32		1.61	7.56	58.76
1978	1.62	2.09		0.73	10.44	12.05	1.11		3.27	0.02	2.38	0.70		0.30		1.40	7.94	55.95
1979	1.63	1.85		0.67	10.77	11.78	1.05		3.61	0.02	2.38	0.67		0.31		1.35	9.01	54.90
1980	1.57	1.82		0.60	9.83	9.84	0.83		3.50	0.02	1.95	0.63		0.33		0.97	10.90	57.21
1981	1.26	1.95		0.52	8.38	8.59	0.92		3.05	0.02	1.70	0.61		0.30		1.04	8.61	63.07
1982	1.00	2.16		0.48	7.62	7.90	0.87		3.11	0.01	1.57	0.54		0.25		0.95	7.74	65.79
1983	0.78	2.14		0.42	6.44	6.76	0.64		2.83	0.01	1.29	0.52		0.19		0.80	7.54	69.63
1984	0.76	2.26		0.37	5.81	5.74	0.67		2.68	0.01	1.14	0.44		0.17		0.69	6.18	73.08
1985	0.65	2.03		0.40	6.64	6.40	0.59		2.98	0.01	1.25	0.55		0.19	1.18	0.64	7.12	69.38
1986	0.81	1.89		0.43	7.31	7.42	0.58		3.54	0.01	1.43	0.52		0.23	1.29	0.66	6.58	67.29
1987	0.90	1.90		0.52	8.46	8.37	0.67		4.39	0.02	1.61	0.64		0.26	1.69	0.62	7.78	62.17
1988	0.89	2.18		0.49	7.73	7.54	0.69		4.43	0.02	1.45	0.63		0.29	1.60	0.58	7.68	63.80
1989	0.76	2.27		0.50	8.09	7.75	0.66		4.66	0.02	1.48	0.64		0.32	1.75	0.70	7.08	63.32
1990	0.90	2.23		0.55	8.76	8.86	0.75		4.80	0.02	1.55	0.70		0.39	1.84	1.03	8.32	59.30
1991	0.94	2.26		0.59	9.42	8.75	0.80		5.31	0.02	1.60	0.72		0.46	1.98	1.15	9.24	56.76
1992	0.84	2.21		0.56	8.84	7.65	0.79		4.27	0.02	1.56	0.70		0.47	1.65	1.25	7.04	62.15
1993	0.79	2.18		0.54	8.64	7.53	0.79		4.01	0.02	1.43	0.64		0.42	1.57	1.49	7.10	62.85
1994	0.73	2.00		0.60	9.73	8.03	0.93		4.25	0.03	1.58	0.75		0.48	1.59	1.12	7.41	60.78
1995	0.83	1.92		0.67	10.29	8.70	1.05		4.21	0.03	1.70	0.74		0.57	1.88	1.40	7.03	58.98
1996	0.91	1.81		0.64	9.71	8.08	1.16		5.06	0.03	1.62	0.76		0.55	1.78	1.61	8.12	58.14
1997	0.81	1.73		0.60	8.92	7.09	1.18		4.85	0.03	1.46	0.69		0.50	1.63	1.72	7.88	60.92
1998	0.79	1.71		0.64	9.06	7.52	1.32		5.32	0.03	1.55	0.71		0.53	1.70	1.89	8.06	59.16
1999	0.73	1.80	0.25	0.57	7.95	6.66	1.22	0.16	4.84	0.03	1.44	0.70	0.66	0.49	1.54	2.16	7.90	60.90
2000	0.73	1.74	0.25	0.51	7.19	5.98	1.16	0.17	4.76	0.03	1.27	0.61	0.68	0.47	1.49	2.10	7.39	63.48
2001	0.71	1.77	0.26	0.52	6.81	5.62	1.10	0.20	4.51	0.03	1.27	0.62	0.75	0.48	1.46	1.50	7.38	65.02
2002	0.64	1.52	0.29	0.54	7.26	5.85	1.14	0.25	4.86	0.04	1.34	0.83	0.68	0.52	1.58	1.62	7.23	63.82
Avg	0.86	2.25	0.26	0.44	7.58	7.13	0.68	0.20	3.18	0.02	1.31	0.49	0.69	0.34	1.72	0.99	7.69	68.82

Table 4: PPP share of total NATO military expenditures

Year	Bel	Can	Cz	Den	Fra	Ger	Gre	Hun	It	Lux	Neth	Nor	Pol	Por	Sp	Tur	Uk	USA
1950	0.97	2.28		0.48					6.06	0.02	2.72	0.34		0.39		1.13	21.44	64.18
1951	1.07	4.03		0.47	12.87		0.85		5.65	0.02	2.17	0.38		0.32		1.00	21.31	49.85
1952	0.85	3.42		0.36	9.30		0.48		3.40	0.02	1.48	0.28		0.20		0.60	15.47	64.13
1953	0.65	2.70		0.37	7.30		0.31		2.40	0.02	1.24	0.28		0.18		0.52	12.74	71.30
1954	0.67	2.37		0.35	5.98		0.38		2.59	0.02	1.41	0.30		0.20		0.55	11.70	73.49
1955	0.66	2.75		0.41	6.23		0.45		2.88	0.02	1.61	0.28		0.24		0.67	12.94	70.86
1956	0.67	2.85		0.41	8.43		0.53		3.05	0.02	1.72	0.27		0.26		0.67	12.90	68.20
1957	0.71	2.74		0.45	7.10		0.52		3.20	0.02	1.64	0.29		0.28		0.68	12.64	69.72
1958	0.72	2.52		0.42	6.17		0.49		3.24	0.02	1.46	0.28		0.29		0.70	12.03	71.66
1959	0.73	2.31		0.41	6.98		0.50		3.32	0.02	1.32	0.29		0.30		0.82	11.54	71.45
1960	0.72	2.21		0.45	8.00		0.51		3.34	0.01	1.42	0.27		0.31		0.86	11.52	70.36
1961	0.75	2.25		0.43	8.30		0.50		3.40	0.01	1.59	0.30		0.52		0.84	11.69	69.41
1962	0.78	2.25		0.50	8.52		0.48		3.39	0.01	1.53	0.30		0.58		0.89	11.51	69.25
1963	0.83	2.02		0.50	8.04		0.47		3.40	0.01	1.44	0.31		0.56		0.89	11.21	70.32
1964	0.91	2.10		0.50	7.90		0.47		3.43	0.01	1.45	0.32		0.63		0.91	11.62	69.74
1965	0.93	1.92		0.52	8.07		0.53		3.60	0.02	1.41	0.39		0.69		1.01	12.01	68.91
1966	0.95	1.95		0.51	8.43		0.59		4.00	0.02	1.36	0.38		0.73		1.00	11.92	68.18
1967	0.88	1.82		0.44	7.88		0.62		3.54	0.01	1.28	0.35		0.79		0.99	9.59	71.80
1968	0.82	1.52		0.45	7.17		0.63		3.23	0.01	1.12	0.33		0.78		0.96	9.51	73.46
1969	0.82	1.40		0.43	6.10		0.71		3.10	0.01	1.16	0.35		0.77		0.98	9.01	75.15
1970	0.85	1.39		0.40	6.09	6.49	0.74		3.20	0.01	1.13	0.35		0.79		0.99	8.44	69.14
1971	0.89	1.43		0.46	7.38	7.20	0.81		3.62	0.01	1.26	0.38		0.96		1.14	9.70	64.76
1972	0.97	1.49		0.45	7.95	7.57	0.89		4.02	0.01	1.25	0.39		1.03		1.20	9.88	62.89
1973	1.02	1.50		0.41	8.25	7.71	0.95		3.86	0.01	1.25	0.40		0.96		1.21	9.94	62.54
1974	1.05	1.62		0.51	7.90	8.66	1.23		4.27	0.01	1.39	0.43		1.44		1.43	10.67	59.38
1975	1.13	1.60		0.46	8.58	7.71	1.42		4.01	0.01	1.28	0.42		0.96		2.36	9.55	60.53
1976	1.16	1.60		0.50	7.02	8.58	1.63		3.94	0.01	1.42	0.46		0.86		2.61	10.05	60.14
1977	1.20	1.73		0.52	8.25	8.84	1.77		4.43	0.01	1.60	0.46		0.84		2.35	11.74	56.26
1978	1.21	1.74		0.55	9.58	8.70	1.65		4.28	0.01	1.48	0.48		0.82		2.22	11.00	56.25
1979	1.24	1.66		0.52	9.07	8.52	1.50		4.43	0.01	1.50	0.49		0.91		1.86	11.39	56.90
1980	1.28	1.71		0.52	7.88	7.67	1.31		4.14	0.01	1.35	0.48		0.92		2.30	11.75	58.69
1981	1.25	1.73		0.52	6.13	8.20	1.59		3.96	0.01	1.51	0.50		0.90		2.85	9.86	60.98
1982	1.12	1.75		0.50	6.41	7.71	1.36		4.10	0.01	1.44	0.45		0.82		2.90	9.29	62.13
1983	0.96	1.67		0.45	6.04	6.86	1.13		3.71	0.01	1.28	0.47		0.73		2.75	10.08	63.88
1984	0.96	1.75		0.42	5.67	6.27	1.19		3.59	0.01	1.25	0.41		0.71		2.85	8.95	65.98
1985	0.88	1.65		0.47	7.17	7.37	1.09		4.09	0.01	1.49	0.52		0.78		2.77	10.49	61.21
1986	0.85	1.61		0.41	8.33	6.53	1.02		3.79	0.01	1.36	0.42		0.76	0.78	2.95	8.04	63.14
1987	0.81	1.54		0.39	7.50	6.21	1.03		3.92	0.01	1.30	0.45		0.77	0.88	3.15	8.46	63.58
1988	0.81	1.65		0.36	6.02	5.60	1.03		3.46	0.01	1.20	0.42		1.86	0.79	2.98	7.56	66.24
1989	0.76	1.65		0.41	6.34	6.32	0.99		3.86	0.01	1.38	0.46		1.99	0.87	2.66	7.49	64.82
1990	0.78	1.64		0.39	7.54	6.48	0.99		3.41	0.01	1.31	0.49		1.98	0.79	2.76	8.06	63.35
1991	0.76	1.49		0.40	7.04	5.89	0.97		3.56	0.01	1.29	0.49		1.91	0.77	2.69	8.14	64.58
1992	0.71	1.72		0.40	6.97	5.31	1.01		3.22	0.02	1.31	0.51		1.90	0.67	3.21	6.87	66.17
1993	0.63	1.64		0.38	6.54	4.87	0.97		3.42	0.01	1.13	0.49		1.79	0.70	3.31	6.97	67.15
1994	0.55	1.60		0.41	7.26	5.12	1.10		3.74	0.02	1.23	0.56		1.96	0.74	3.67	7.23	64.81
1995	0.58	1.64		0.43	7.26	5.10	1.08		3.85	0.01	1.22	0.52		0.92	0.83	4.38	6.96	65.24
1996	0.65	1.51		0.41	6.89	4.88	1.24		4.07	0.01	1.21	0.52		0.96	1.76	4.73	7.79	63.36
1997	0.67	1.46		0.43	7.23	4.95	1.30		4.18	0.02	1.25	0.51		0.93	1.86	4.80	7.12	63.30
1998	0.64	1.52		0.46	7.25	5.26	1.46		4.46	0.02	1.32	0.53		0.89	1.93	5.18	7.11	61.99
1999	0.65	1.60	1.00	0.41	6.58	4.82	1.31	0.48	4.17	0.02	1.24	0.52	1.47	0.80	1.79	5.72	7.03	60.41
2000	0.66	1.58	1.11	0.43	7.10	5.19	1.44	0.57	4.86	0.02	1.28	0.51	1.59	0.87	0.88	6.29	7.18	58.45
Avg	0.88	1.95	1.06	0.45	7.63	6.89	0.94	0.53	3.84	0.01	1.43	0.42	1.53	0.87	1.14	2.18	10.58	66.39

Table 5 Military expenditure share of Gross Domestic Product

year	Bel	Can	Cz	Den	Fra	Ger	Gre	Hun	It	Lux	Neth	Nor	Pol	Por	Sp	Tur	Uk	USA
1949		2.14					5.91					2.71					6.17	5.08
1950		2.59		1.66	5.54		6.01			1.34	4.77	2.37		3.78			6.45	4.96
1951		5.48		2.05	7.13		6.64		4.26	1.56	4.90	3.05		3.87			7.84	9.84
1952		7.45		2.74	8.61		6.43		4.50	2.37	5.52	4.01		4.22			9.83	13.35
1953	4.9	7.46		3.36	9.13	4.20	5.11		3.75	2.89	5.50	5.08		4.01			9.89	13.08
1954	4.7	6.68		3.19	7.29	4.00	5.49		3.98	3.26	5.86	5.00		4.16			8.73	11.28
1955	3.8	6.22		3.18	6.41	4.10	5.12		3.67	3.23	5.61	3.93		4.16			8.13	9.77
1956	3.6	5.74		3.03	7.69	3.60	5.94		3.57	1.90	5.74	3.52		4.00			7.80	9.55
1957	3.6	5.31		3.08	7.33	4.10	5.00		3.48	1.95	5.27	3.59		3.98			7.21	9.66
1958	3.6	4.88		2.88	6.77	3.00	4.76		3.43	1.93	4.65	3.51		3.94			6.99	9.74
1959	3.5	4.34		2.59	6.71	4.40	4.86		3.33	1.76	4.70	3.58		4.19			6.61	9.20
1960	3.4	4.19		2.73	6.39	4.00	4.86		3.06	1.00	4.98	3.20		4.12			6.45	8.84
1961	3.3	4.16		2.59	6.16	4.00	4.24		2.90	1.11	5.74	3.27		6.24			6.29	9.07
1962	3.3	4.05		3.02	6.14	4.80	4.05		2.97	1.29	5.84	3.53		6.85			6.37	8.94
1963	3.4	3.57		3.04	5.64	5.20	3.82		3.10	1.18	5.52	3.51		6.28			6.17	8.47
1964	3.4	3.45		2.84	5.41	4.70	3.57		3.07	1.37	6.02	3.43		6.54			6.04	7.72
1965	3.2	2.86		2.98	5.23	4.40	3.50		3.10	1.35	5.70	3.75		6.08			5.84	7.21
1966	3.1	2.72		2.64	5.11	4.20	3.58		3.37	1.34	5.41	3.57		6.14			5.65	8.07
1967	2.9	1.16		2.59	5.11	4.30	4.35		3.12	1.11	5.27	3.51		7.11			5.72	9.06
1968	3.1	2.53		2.68	4.91	3.60	4.69		2.99	0.76	4.84	3.61		7.30		3.15	5.36	8.87
1969	2.9	2.27		2.39	4.38	3.60	4.79		2.73	0.78	4.99	3.60		6.72		2.95	4.91	8.27
1970	2.7	2.29		2.26	4.12	3.30	4.20		2.32	0.87	4.83	3.05		6.96		3.03	4.74	7.50
1971	3	2.90		2.90	3.95	3.80	5.50		3.20	0.90	4.89	4.00		8.10		4.90	5.80	6.64
1972	2.8	2.80		2.30	3.85	3.90	4.60		3.10	0.90	4.28	3.30		7.00		4.30	5.90	6.27
1973	2.7	2.50		2.10	3.80	3.50	4.10		2.90	0.80	4.18	3.10		6.00		4.10	5.60	5.67
1974	2.7	2.80		2.40	3.70	3.60	4.20		2.80	0.80	3.30	3.10		7.40		3.90	5.90	5.73
1975	3.1	3.00		2.40	3.90	3.60	6.50		2.50	1.00	3.50	3.20		5.40		5.80	5.00	5.55
1976	3.1	1.90		2.20	3.80	3.50	6.90		2.30	1.00	3.30	3.10		4.00		6.10	4.60	4.99
1977	3.1	1.90		2.30	3.90	3.40	7.00		2.40	1.00	3.30	3.10		3.50		5.80	4.70	4.97
1978	3.3	2.00		2.30	4.00	3.40	6.70		2.40	1.00	3.10	3.20		3.50		5.20	4.60	4.76
1979	3.3	1.80		2.30	3.90	3.30	6.30		2.40	1.00	3.20	3.10		3.50		4.30	4.70	4.77
1980	3.4	1.80		2.40	4.00	3.30	5.70		2.40	1.10	3.10	2.90		3.50		4.30	5.00	5.16
1981	3.5	1.90		2.50	4.20	3.40	7.00		2.50	1.20	3.20	2.90		3.50		4.90	4.80	5.43
1982	3.4	2.10		2.50	4.10	3.40	6.90		2.60	1.20	3.20	3.00		3.40		5.10	5.40	5.84
1983	3.3	2.00		2.50	4.10	3.40	6.30		2.70	1.20	3.20	3.10		3.40		4.80	5.30	6.04
1984	3.1	2.30		2.30	4.00	3.30	7.10		2.70	1.20	3.20	2.80		3.30		4.40	5.50	5.88
1985	3.1	2.20		2.20	4.00	3.20	7.00		2.30	1.10	3.10	3.10		3.20	2.4	4.50	5.20	6.12
1986	3.1	2.20		2.00	3.90	3.10	6.20		2.20	1.10	3.00	3.10		3.20	2.2	4.80	4.90	6.30
1987	3	2.10		2.10	3.90	3.10	6.30		2.40	1.20	3.10	3.30		3.10	2.4	4.30	4.60	6.08
1988	2.7	2.10		2.20	3.80	2.90	6.40		2.50	1.30	3.00	3.20		3.20	2.1	4.10	4.20	5.74
1989	2.5	2.00		2.10	3.70	2.80	5.70		2.30	1.10	2.80	3.30		3.20	2.1	3.10	4.10	5.54
1990	2.4	2.00		2.10	3.60	2.80	5.80		2.10	1.10	2.60	3.20		3.10	1.8	3.50	4.10	5.28
1991	2.3	1.90		2.10	3.60	2.30	5.40		2.10	1.20	2.50	3.10		3.10	1.7	3.80	4.30	4.67
1992	1.9	1.90		2.00	3.40	2.20	5.60		2.00	1.20	2.50	3.30		3.00	1.6	3.90	4.00	4.81
1993	1.8	1.90		2.00	3.40	1.90	4.40		2.10	1.10	2.30	2.70		2.70	1.7	3.90	3.60	4.47
1994	1.7	1.80		1.90	3.30	1.80	4.40		2.00	0.90	2.10	2.80		2.60	1.5	4.10	3.40	4.07
1995	1.6	1.60		1.80	3.10	1.70	4.40		1.80	0.80	2.00	2.30		2.70	1.5	3.90	3.10	3.77
1996	1.6	1.50		1.80	3.00	1.70	4.50		1.90	0.80	1.90	2.40		2.50	1.5	4.10	3.00	3.47
1997	1.5	1.30		1.70	2.90	1.60	4.60		1.90	0.80	1.80	2.10		2.20	1.4	4.10	2.70	3.33
1998	1.5	1.30		1.70	2.80	1.50	4.80		2.00	0.80	1.70	2.30		2.10	1.3	4.40	2.60	3.14
1999	1.4	1.30	2.20	1.60	2.70	1.60	4.80	1.60	2.00	0.70	1.80	2.10	2.00	2.10	1.3	5.40	2.50	3.03
2000	1.4	1.20	2.20	1.50	2.60	1.50	4.90	1.70	2.10	0.70	1.60	1.80	1.90	2.10	1.2	5.00	2.50	3.07
2001	1.3	1.20	2.10	1.60	2.50	1.50	4.60	1.80	2.00	0.80	1.60	1.70	1.90	2.10	1.2	5.00	2.50	3.09
2002	1.3	1.20	2.10	1.60	2.50	1.50	4.30	1.90	2.10	0.90	1.60	2.10	1.90	2.10	1.2	4.90	2.40	3.40

Table 6 Country rank based on MER Share of total NATO military expenditures

year	Bel	Can	Cz	Den	Fra	Ger	Gre	Hun	It	Lux	Neth	Nor	Pol	Por	Sp	Tur	Uk	USA
1949	9	5		10	3		6		4	12	8	10		11		7	2	1
1950	8	5		11	3		9		4	13	6	12		10		7	2	1
1951	7	4		11	3		9		5	13	6	10		12		8	2	1
1952	6	4		11	3		9		5	13	7	10		12		8	2	1
1953	7	4		11	3	5	12		6	14	8	10		13		9	2	1
1954	8	4		11	3	5	12		6	14	7	10		13		9	2	1
1955	9	4		10	3	5	11		6	13	7	10		12		8	2	1
1956	9	4		11	3	5	10		6	13	8	11		12		7	2	1
1957	9	5		10	3	4	10		6	12	7	10		11		8	2	1
1958	9	4		11	3	5	10		6	13	8	11		12		7	2	1
1959	9	5		11	3	4	10		6	13	8	10		12		7	2	1
1960	9	5		11	3	4	10		6	14	8	12		13		7	2	1
1961	8	5		10	3	4	11		6	12	7	11		10		9	2	1
1962	8	5		10	3	4	13		6	14	7	12		11		9	2	1
1963	8	6		10	4	3	13		5	14	7	11		12		9	2	1
1964	7	5		9	3	3	12		4	13	6	11		10		8	2	1
1965	8	6		10	3	4	13		5	14	7	11		12		9	2	1
1966	8	6		10	3	4	13		5	14	7	11		12		9	2	1
1967	8	6		12	2	4	11		5	14	7	0		13		9	3	1
1968	8	6		11	2	4	10		5	13	7	12		10		9	3	1
1969	8	6		12	3	2	10		5	13	7	12		11		9	3	1
1970	8	6		13	3	2	10		5	14	7	12		11		9	4	1
1971	8	5		12	4	2	11		5	13	7	12		10		9	3	1
1972	8	6		12	4	2	11		5	14	7	13		10		9	3	1
1973	8	6		13	3	2	10		5	14	7	12		11		9	4	1
1974	8	6		12	3	2	11		5	14	7	13		10		9	4	1
1975	9	6		11	3	2	10		5	13	7	11		12		8	4	1
1976	9	6		12	3	2	10		5	14	7	11		13		8	4	1
1977	9	7		12	3	2	10		5	14	6	11		13		8	4	1
1978	8	7		11	3	2	10		5	14	6	12		13		9	4	1
1979	8	7		11	3	2	10		5	13	6	11		12		9	4	1
1980	8	7		12	3	2	10		5	14	6	11		13		9	4	1
1981	8	6		12	4	3	10		5	14	7	11		13		9	2	1
1982	8	6		12	4	2	10		5	14	7	11		13		9	3	1
1983	9	6		12	4	3	10		5	14	7	11		13		8	2	1
1984	8	6		12	3	4	10		5	14	7	11		13		9	2	1
1985	9	6		13	3	4	11		5	15	7	12		14	8	10	2	1
1986	9	6		13	3	2	11		5	15	7	12		14	8	10	4	1
1987	9	6		13	2	3	10		5	15	8	12		14	7	11	4	1
1988	9	6		13	2	4	10		5	15	8	11		14	7	12	3	1
1989	9	6		13	2	3	11		5	15	8	12		14	7	10	4	1
1990	10	6		13	3	2	11		5	15	8	12		14	7	9	4	1
1991	10	6		13	2	4	11		5	15	8	12		14	7	9	3	1
1992	10	6		13	2	3	12		5	15	8	11		14	7	9	4	1
1993	10	6		12	2	3	10		5	14	9	11		13	7	8	4	1
1994	12	6		13	2	3	10		5	15	8	11		14	7	9	4	1
1995	11	6		13	2	3	10		5	14	8	12		14	7	9	4	1
1996	11	6		13	2	4	10		5	15	8	12		14	7	9	3	1
1997	11	7		13	2	4	10		5	14	9	12		14	8	6	3	1
1998	11	7		13	2	4	10		5	14	9	12		14	8	6	3	1
1999	11	7	16	14	2	4	10	17	5	18	9	12	13	15	8	6	3	1
2000	11	7	16	14	3	4	10	17	5	18	9	13	12	15	8	6	2	1
2001	12	7	16	14	3	4	10	17	5	18	9	13	11	15	8	6	2	1
2002	13	8	16	14	2	4	10	17	5	18	9	11	12	15	7	6	3	1

Table 7: Country rank using PPP share of total NATO military expenditures

Year	Bel	Can	Cz	Den	Fra	Ger	Gre	Hun	It	Lux	Neth	Nor	Pol	Por	Sp	Tur	Uk	USA
1950	7	4		8					3	11	5	10		9		6	2	1
1951	7	5		10	3		9		4	13	6	11		12		8	2	1
1952	7	4		10	3		9		5	13	6	11		12		8	2	1
1953	7	4		9	3		10		5	13	6	11		12		8	2	1
1954	7	5		10	3		9		4	13	6	11		12		8	2	1
1955	8	5		10	3		9		4	13	6	11		12		7	2	1
1956	7	5		9	3		8		4	12	6	10		11		7	2	1
1957	7	5		10	3		9		4	13	6	11		12		8	2	1
1958	7	5		10	3		9		4	13	6	12		11		8	2	1
1959	8	5		10	3		9		4	13	6	12		11		7	2	1
1960	8	5		10	3		9		4	13	6	12		11		7	2	1
1961	8	5		11	3		10		4	13	6	12		9		7	2	1
1962	8	5		10	3		11		4	13	6	12		9		7	2	1
1963	8	5		10	3		11		4	13	6	12		9		7	2	1
1964	7	5		9	3		10		4	12	6	11		8		7	2	1
1965	8	5		11	3		10		4	13	6	12		9		7	2	1
1966	8	5		11	3		10		4	13	6	12		9		7	2	1
1967	8	5		11	3		10		4	13	6	12		9		7	2	1
1968	8	5		11	3		10		4	13	6	12		9		7	2	1
1969	8	5		11	3		10		4	13	6	12		9		7	2	1
1970	8	5		11	4	3	10		5	13	6	12		9		7	2	1
1971	9	5		11	3	4	10		5	13	6	12		8		7	2	1
1972	10	6		12	3	4	11		5	14	7	13		9		8	2	1
1973	9	6		12	3	4	11		5	14	7	13		10		8	2	1
1974	11	6		12	4	3	10		5	14	7	13		8		9	2	1
1975	10	7		12	3	4	8		5	14	9	13		11		6	2	1
1976	10	8		12	4	3	7		5	14	9	13		11		6	2	1
1977	10	8		12	4	3	7		5	14	9	13		11		6	2	1
1978	10	7		12	3	4	8		5	14	9	13		11		6	2	1
1979	9	7		11	3	4	8		5	13	8	12		10		6	2	1
1980	10	7		12	3	4	9		5	14	8	13		11		6	2	1
1981	10	7		12	4	3	8		5	14	9	13		11		6	2	1
1982	10	7		12	4	3	9		5	14	8	13		11		6	2	1
1983	10	7		13	4	3	9		5	14	8	12		11		6	2	1
1984	10	7		12	4	3	9		5	14	8	13		11		6	2	1
1985	10	7		13	4	3	9		5	14	8	12		11		6	2	1
1986	10	7		14	2	4	9		5	15	8	12		12	11	6	3	1
1987	11	7		14	3	4	9		5	15	8	13		12	10	6	2	1
1988	11	8		14	3	4	10		5	15	9	13		7	12	6	2	1
1989	12	8		14	3	4	10		5	15	9	13		7	11	6	2	1
1990	12	8		14	3	4	10		5	15	9	13		7	11	6	2	1
1991	12	8		14	3	4	10		5	15	9	13		7	11	6	2	1
1992	11	8		14	2	4	10		5	15	9	13		7	12	6	3	1
1993	12	8		14	3	4	10		5	15	9	13		7	11	6	2	1
1994	13	8		14	2	4	10		5	15	9	12		7	11	6	3	1
1995	12	7		14	2	4	9		6	15	8	13		10	11	5	3	1
1996	12	8		14	3	4	9		6	15	10	13		11	7	5	2	1
1997	12	8		14	2	4	9		6	15	10	13		11	7	5	3	1
1998	12	8		14	2	4	9		6	15	10	13		11	7	5	3	1
1999	14	8	12	17	3	5	10	16	6	18	11	15	9	13	7	4	2	1
2000	14	8	11	17	3	5	9	15	6	18	10	16	7	13	12	4	2	1

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