

The Poverty of Statistics

Military Power and Strategic Balance

Jan Ludvík

Military expenditures and the number of service personnel are the two most common features used to compare national military power. However, to what extent they reflect the real world remains a question. This article aims to provide the answer by using data on the great power conflicts in the last 160 years. The Correlates of War data are utilized to highlight that the relation between pre-war military expenditures and the numerical strength of armies on one hand and the outcome of the war on the other is blurred to say the least. States with higher military expenditures prevailed only in six great power conflicts out of nine. Only four of them were won by the state with a numerically stronger peacetime army. The case of the Franco-Prussian war is then used to illustrate that not even superiority in both categories can safely prevent a crushing defeat, still less ensure victory. A nation's military power stems from its ability to adapt effectively to the realities of modern warfare. That is what neither the sheer number of soldiers, nor high military expenditures can guarantee.

Keywords: strategic balance; military power; military expenditures; Franco-Prussian war.



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Introduction

The significance of studying shifts in the balance of military power hardly needs explaining.¹ The concept of balance lies at the very heart of the realist tradition of international relations theory and changes in the distribution of power are often seen as causes of systemic wars between great powers.² The balance of military power is one of the most

important components of the overall balance of power, if not *the* most important. Nonetheless, the critical issue how the balance should be estimated remains to be solved. When powers are at war the balance is visible on the battlefield. But peacetime estimates pose more challenging issue. Elaborated models can be produced, and are occasionally utilized by scholars and specialist.³ But most practitioners use much easier estimates that are drawn from readily available data.

Arguably the most influential estimates are drawn from data on military expenditures and the numerical strengths of armed forces, often establishing guidelines for the policy. NATO's discourse that sets the defence expenditures at two percent of nation's GDP as the threshold of nation's responsible behaviour in the realm of defence and alliance commitments stands as a prime example. The question is to what extent we simplify reality by assuming (purely intuitively) that a state with a larger army and military budget must be stronger than another with a smaller military budget and a smaller army. The relation between strategic balance on one hand and military expenditure and troop numbers on the other remains largely operationally undefined. This text aims to fill this gap and offer a simple, rigorous operational definition of the relation between strategic balance and military power as measured by arms spending and number of military personnel.

The text proceeds as follows: the research strategy and data are first introduced. Thereafter follows the results, which show that the relation between military expenditures and number of military personnel on one side and the outcome of a war on the other is far less intuitive than it might seem. In its next section, the text therefore presents a brief case study of the Franco-Prussian war of 1870-1871, whose analysis serves to illustrate the critical flaws of the reductionist comparisons of military balance.

Method and data

War is a highly visible and unequivocal comparison of military strength, hard to contest. If we wish to stay within the Clausewitzian paradigm of war as a utilitarian act that serves to achieve a political goal, we can assume that the outcome of a war is the best dependent variable for testing the measures of military power in the real world. The state with

higher military expenditures and numerically preponderant army should overpower its opponent, thus it must prove capable of achieving their political aims also when it comes to a real war conflict.

The analysis presented here is based on the outcomes of great power conflicts since 1850. For each of these conflicts, the author examines the data on military expenditures and number of military personnel of the great powers involved. The data are taken from the *Correlates of War* database⁴. The choice of 1850 as the starting point in time is largely arbitrary. The general aim was to use data from as many conflicts as possible: however, the different nature of wars in the period before the industrial revolution and the rise of nationalism could have affected the validity of results. On the other hand, skewing the data set markedly toward the present would radically reduce the number of cases that could be studied and ultimately prevent the use of quantitative analysis to illustrate the relation between the variables.

The key criterion a conflict must satisfy to be included in this analysis concerns the parties involved: it must be a conflict between great powers. This criterion is based primarily on the concept of strategic balance, which is concerned with the strongest countries of the world. This is justifiable, since great powers have traditionally been the agents of international relations, while small states often end up as mere objects of these relations. In reality, small states often have negligible impact on strategic balance. The analysis therefore includes only those conflicts in which at least one contemporary great power was fighting on either side. Conversely, conflicts in which a great power was involved only on one side have been excluded, as these are often asymmetrical conflicts that follow a different logic than great power conflicts.⁵ In line with the *Correlates of War* methodology, war is defined as a conflict with more than 1,000 battle-related deaths a year. The term “great power” is used to denote the following countries: Russia (including the Soviet Union), France and the United Kingdom for the entire period taken into account, Germany (and Prussia) until 1945, Austria until 1918, Italy from 1859 till 1945, Japan from 1900 till 1945, the United States since the turn of the century, the People’s Republic of China since 1949, India and Pakistan since 1998. Another condition for including a great power in the data set analysed is a significant participation of its forces in combat operations.

The period studied includes nine wars between great powers. The first of these is the Crimean War of 1856 between Russia on one side and a

coalition led by the United Kingdom and France on the other. Three years later, France and Austria clashed in northern Italy. The struggle for national unification of Germany and Italy produced two more conflicts: in 1866, Austria found itself at war with Prussia and Italy, and in 1870-1871 Prussia, aided by smaller German states, waged war against France. The twentieth century ushered in the first Asian great power and with it the Russo-Japanese War. This conflict is followed by the two systemic world wars. The analysis further includes the Korean War as a conflict between the US and the People's Republic of China. The last war between great powers as defined above is the 1999 conflict between India and Pakistan in the Kargil area.

For each of these conflicts, two indexes are provided, indicating the ratio of military expenditure of the victorious party to the expenditure of the defeated party and a corresponding ratio between numbers of military personnel on the two sides. The indexes are evaluated as follows: values between 0.9 and 1.1 are considered as parity; values between 1.1 and 1.5 are classified as moderate preponderance of the victorious party/coalition; the range between 1.5 and 2.0 denotes significant preponderance; a value exceeding 2.0 is considered an overwhelming preponderance. On the other hand, values between 0.75-0.9 denote moderate disadvantage; 0.5-0.75 significant disadvantage, and a value below 0.5 an overwhelming disadvantage. Assumption that the preponderant state should win the war is then tested against empirical reality and the correlation between this hypothesis and reality is examined to determine whether it is strong enough to indicate a causal relationship.

Two crucial steps that impact the selected data should be highlighted. Firstly, the indexes only represent the troop or expenditure ratios between the great powers involved. The role of small states is thus disregarded, although it is taken into account in the (qualitative) explanation of deviant cases. The second step was the decision to use data from the year immediately preceding the conflict. In this case, the aim was to establish to what extent the comparison of "peacetime data" is useful in determining the balance of power.

Alliance changes make it rather difficult to analyse either of the world wars. However, in both of them, the determining factor for assessing the role of a state was whether – and on which side – the forces of that state significantly participated in combat operations. For this reason, the First World War is regarded as a conflict between Germany and

Austria on one side and the United Kingdom, France, Russia, Italy and the us on the other. Though Italy supported the Central Powers before the war, it entered the war on the side of the Entente Powers. Russia quit the war in 1917, but until then had borne a significant part of the war fighting burden. Similarly, the us only entered the war in 1917, but its share was also significant. In contrast, Japan is not included in the aggregate data for the Entente, since its participation in the war effort was negligible after its early occupation of the German Pacific colonies. In the case of the Second World War, data for Germany, Italy and Japan on one side are compared with the United Kingdom, France, Russia and the us on the other. A late entry into war (Japan, the us, the Soviet Union, to some extent also Italy) or an early exit due to defeat (France, Italy) are neglected. It should be acknowledged that the choices made by the author in the case of both world wars can definitely be questioned. However, other imaginable choices should not alter the final outcomes very strongly, since the research does not only focus on the correlation between military expenditure/number of military personnel and the outcome of the war, but also seeks to determine whether the relationship is causal. This implies that even a single case that cannot be satisfactorily explained within the framework of the model may suffice to prove that the above-mentioned variables are not linked by a causal relationship.

Results

A difference in pre-war military spending of the future warring states (Table 1) can explain the outcome of six of the nine great power conflicts in the last 160 years. In two cases (First World War and Kargil War) the victorious party/coalition had an overwhelming advantage in terms of pre-war military expenditure. A significant advantage in this field was converted into victory in three cases (Crimean War, Second Italian War of Independence, Austro-Prussian War). In one case (Russo-Japanese War), the victorious state had moderate advantage in military expenditure. On the other hand, in three cases the model fails to explain the outcome. The most marked counterexample demonstrating the inadequacy of an approach that identifies the ratio between military expenditures with the balance of military power is provided by the Franco-Prussian War of 1870-1871 in which a Prussia-led coalition of German states defeated France. Prussia wins even though the model places it at an overwhelming disadvantage. The model also fails to explain the outcome of the Second

World War and the Korean War. In the first case, however, its failure may be due to the fact that the US enters the war later and the data reflecting its contribution to the coalition potential are not from the year before the war. As for the Korean War, which ends in a stalemate, the failure of the model can be attributed to the fact that the overwhelming superiority in military expenditure on one side is offset by significantly lower troop numbers.⁶

Table 1

Conflict	Year(s)	Victor (coalition)	Military expenditure	Defeated (coalition)	Military expenditure	Preponderance index
Crimean War	1853-1856	France	17,257	Russia	15,692	1.75
		United Kingdom	10,132			
Second Italian War of Independence	1859-1860	France	19,967	Austria	12,835	1.56
Austro-Prussian War	1866	Prussia	5,950	Austria	9,121	1.65
		Italy	9,102			
Franco-Prussian War	1870-1871	Prussia	10,196	France	23,912	0.43
Russo-Japanese War	1905	Japan	67,273	Russia	50,305	1.34
First World War	1914-1918	Russia	73,512	Germany	63,926	3.34
		United Kingdom	67,957	Austria	27,376	
		USA	62,825			
		France	61,367			
		Italy	38,849			
Second World War	1939-1945	Russia	5,429,984	Germany	7,415,163	0.95
		United Kingdom	1,863,997	Japan	1,699,210	
		USA	1,131,499	Italy	746,050	
		France	919,284			
Korean War	1950-1953	USA	13503000	China	2,030,000	6.65
Kargil War	1999	India	13594000	Pakistan	4,078,000	3.33

Before 1913, the data are in thousands of GBP in the prices of the given year; since 1914 similarly in thousands of USD

If comparing military expenditure produces at least a limited correlation between superiority in this area and the outcome of the war, the numerical strength of armies seems to lack explanatory potential almost entirely (see Table 2). This model can only explain four of the nine cases. An overwhelming numerical preponderance may have been the reason for the victories of Indian forces in the Kargil conflict and of the Entente Powers in the First World War. The victorious countries of the Second World War had a significant advantage in this respect. In one case (Austro-Prussian War), the victorious coalition of Prussia and Italy had a moderate numerical preponderance. In the Second Italian War of Independence, France defeats Austria in a situation of parity. What is far more significant, however, is the fact that in the Crimean, Franco-Prussian, Russo-Japanese and Korean wars, the numerically stronger army fails to win, thus indicating a failure of the statistical model. In the case of the Crimean war the failure can be partly explained by the involvement of Turkey, which, if taken into account, would bring the two sides to a parity of forces, although, for the purposes of the model, Turkey in 1856 is no longer a great power. A critical failure of the model can be demonstrated on the example of the Russo-Japanese War and the Franco-Prussian War.

To better explain the cases where one of the parties is preponderant in the number of personnel, while the other in military expenditure, I have compiled a composite index of preponderance (Table 3). This index should help explain such cases as the Korean War. The index is an average value, calculated from the victorious party's preponderance indexes in the two areas taken into account. Since preponderance in military expenditure need not be equally significant as preponderance in troop numbers, I have calculated three versions of the index. The first (v. 1) is the actual arithmetical mean of the preponderance indexes in the two areas. The second index (v. 2) assumes that preponderance in military expenditure is twice as significant as numerical advantage in military personnel. Conversely, the third index (v. 3) works with the assumption that a numerically preponderant army is twice as significant for the outcome as preponderance in military expenditure.

However, even after compiling the composite index of preponderance, based on both military expenditure and the numerical strength of armies, the predictive value of the model has not improved significantly.

Conflict	Year(s)	Victor (coalition)	Troop numbers	Defeated (coalition)	Troop numbers	Preponderance index
Crimean War	1853-1856	France	397	Russia	756	0.79
		United Kingdom	201			
Second Italian War of Independence	1859-1860	France	427	Austria	403	1.06
Austro-Prussian War	1866	Prussia	216	Austria	292	1.46
		Italy	209			
Franco-Prussian War	1870-1871	Prussia	318	France	474	0.67
Russo-Japanese War	1905	Japan	218	Russia	1160	0.19
First World War	1914-1918	Russia	1,434	Germany	716	3.04
		United Kingdom	523	Austria	322	
		USA	155			
		France	642			
		Italy	398			
Second World War	1939-1945	Russia	1,566	Germany	782	1.74
		United Kingdom	376	Japan	370	
		USA	330	Italy	486	
		France	581			
Korean War	1950-1953	USA	1,615	China	2,570	0.63
Kargil War	1999	India	1,300	Pakistan	590	2.20

In thousands of soldiers

Table 2

The version which represents the actual arithmetic mean of the two preponderance indexes can explain six of the nine cases. However, it once again fails in the case of the Franco-Prussian War, the Russo-Japanese War and the Korean War. The assumption that an advantage in troop numbers is less significant than higher military expenditure fares slightly better.

Conflict	Year(s)	Victor (coalition)	Defeated (coalition)	Composite index		
				v. 1	v. 2	v. 3
Crimean War	1853-1856	France	Russia	1.27	1.43	0.95
		United Kingdom				
Second Italian War of Independence	1859-1860	France	Austria	1.31	1.39	1.23
Austro-Prussian War	1866	Prussia	Austria	1.56	1.59	1.52
		Italy				
Franco-Prussian War	1870-1871	Prussia	France	0.55	0.51	0.59
Russo-Japanese War	1905	Japan	Russia	0.77	0.96	0.57
First World War	1914-1918	Russia	Germany	3.19	3.24	3.14
		United Kingdom	Austria			
		USA				
		France				
		Italy				
Second World War	1939-1945	Russia	Germany	1.34	1.21	1.48
		United Kingdom	Japan			
		USA	Italy			
		France				
Korean War	1950-1953	USA	China	3.65	4.64	2.64
Kargil War	1999	India	Pakistan	2.77	2.95	2.58

Table 3

With the calculation method thus altered, the Russo-Japanese War becomes a parity situation, which cannot be regarded as a complete failure of the model. On the other hand, attributing greater significance to troop numbers than to military expenditure would lead us back to firm expectations of Russian victory. The Crimean War would then seem a parity situation.

All the failures pointed out above demonstrate how problematic it is to assume a causal relationship between preponderance in both areas and the outcome of the war. At the same time, they confirm the limited predictive power of quantitative models. Without including a qualitative analysis, it is impossible to rule out the role of other factors that may have determined the outcome. Since a theory, under prede-

financed conditions, must hold true for all cases, the hypothesized causal relationship need only be disproved once. For this purpose, then, the text analyses the case of the Franco-Prussian War, which exemplifies the model's critical failure.

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Explanation of the critical failure

In the summer of 1870, Prussia stunned Europe by its *Blitzkrieg* victory over France. Its army seemed to emerge almost out of nowhere. Since the defeat of Napoleon till the victory in the Battle of Königgrätz it had not fought a single major battle. In contrast, French armies had been victorious on the Crimean Peninsula and in Italy. French military professionals had also been hardened by the fierce fighting in Algeria and Mexico. The French government could (and should) have been warned by the outcome of the Austro-Prussian War four years earlier. However, most observers quickly attributed the Prussian victory simply to technological advantage represented by the breech-loading needle guns of the Prussian infantry. By that time, Europe had grown so used to Hapsburg defeats that it didn't pay much attention.

The case of the Franco-Prussian war is crucial for determining to what extent peacetime statistics are helpful for assessing strategic balance. In this war, Prussia defeats France despite the fact that, according to our model, the country is at an overwhelming disadvantage in military expenditure and also significantly outnumbered in military personnel. An adequate strategic balance model should be able to provide viable explanations (with the exception of the role of chance, which cannot be adequately evaluated in any model). An analysis of the conflict can uncover a number of aspects which assumption about the relation between strategic balance and military expenditure/number of military personnel simply does not take into account.

The two great powers clashed on a scale probably unsurpassed by any of the other conflicts under analysis, with the exception of the two world wars. The outcome cannot be explained by a merely partial deployment of forces by one of the great powers. Also, the French collapse can be satisfactorily explained neither by a difference in tactics between the opposing parties, nor by the involvement of Prussia's allies.

On Prussia's side we find three relatively important South German states: Bavaria, Baden and Württemberg. However, even after adding their forces and defence expenditure, France still significantly outspends

and moderately outnumbers the Prussian side.⁷ The failure of the model thus cannot be ascribed to the fact that Prussia was aided by allies. Even after factoring in their contribution, the model still predicts French victory, the only anticipated difference being that the French would prevail less overwhelmingly.

On the level of tactics, difficult to capture in a strategic balance model, the French and the Germans are almost on a par. On the whole, Prussian commanders do not differ greatly in quality from their French counterparts, von Moltke being perhaps the only exception. On the contrary: as has been aptly noted by Conrad Prince, the commander of the First Prussian Army, General Karl von Steinmetz almost rivals his opponents in incompetence.⁸ A combination of infantry, cavalry and artillery forms the core of the combat forces on both sides. Both armies are divided into corps, about 30,000 men strong, made up by two to four divisions. The importance of cavalry is slowly but steadily diminishing and, on an industrial-warfare battlefield, will not be crucial for either of the parties. Prussia has the advantage of superior artillery, equipped with Krupp's steel cannons. France, however, has learned one lesson from the Austrian defeat in 1866, introducing state-of-the-art *chassepot* infantry rifles; with an effective range double that of the Prussian firearms.

The main reason for Prussia's victory was the country's ability to adapt to the changing times. Nationalism, the industrial revolution and the new opportunities it brought had been changing the world's battlefields. The crushing defeat of France was caused by three key factors: a) the existence of a truly effective Prussian General Staff, b) a different organization of the army, c) Prussia's better management of logistics and mobilization at the beginning of the war.

The Prussian General Staff, headed by Helmuth von Moltke, was the key to the other two advantages mentioned. Von Moltke filled the General Staff with the *crème de la crème* of *Kriegsakademie* graduates, and supervised a further honing of their skills and capabilities. Many commanders of Prussian divisions and brigades had gone through this training and the commander of each Prussian corps could consult his Chief of Staff, well acquainted with von Moltke's intentions and his style of warfare. In peacetime, the General Staff prepared the Prussian army for war. In contrast, France had no real plan for the war with Prussia. Its system of command perpetuated the Napoleonic tradition. While Prussia established its General Staff as a substitute for "individual genius", the

French relied excessively on their supreme command. Unfortunately, Napoleon III with his marshals was far less capable than his uncle.

Of the two remaining causes, the different organization of the army in particular is crucial for demonstrating the deficiencies of the model. Prussia reformed its army in the 1860s under the leadership of the Minister of War, Albrecht von Roon. With the exception of commissioned and non-commissioned officers, its ranks were filled by universal conscription that almost no one could avoid. After three years of service, Prussian conscripts had to serve another four years in the army reserve and thereafter were transferred to *Landwehr*. In contrast, the French army was, in June 1870, composed of some 277,000 long-serving professionals and 173,000 poorly trained reserves.⁹ The French system was based on a specific concept of the defence duty: a lottery was held to determine which of the men subject to military service would actually be drafted. However, the person selected merely had the obligation to provide the state with a soldier. Whoever was sufficiently rich could afford to send a substitute. The soldiers who had already completed their compulsory years of service were encouraged to stay on – and most of them did, for want of better prospects outside the army. While Paris did realize that the system needed reform, the reform itself was extremely unpopular and could hardly be carried out by the unstable regime. In 1868, Minister of War Adolphe Niel implemented a compromise. The lottery continued to select part of the men born in a given year for five-year service, after which they spent four years in the army reserve. The rest, including those who sent a substitute, were to go through five-month training, after which they would serve for five years in what was called *Garde Mobile*. The *Garde Mobile* would have a three-week intensive training every year. However, the parliament made alterations to Niel's original plan: not only was the annual training of the *Garde Mobile* shortened to two weeks, but the soldiers even returned home every night. In 1870, the French drafting system was thus in the middle of a half-hearted transformation attempt. The *Garde Mobile* was still largely untrained, unequipped and unorganized.¹⁰

In theory, France could have used the advantage it had in its longer-serving professional soldiers to launch a quick attack against the Prussian initial positions and thus disrupt the enemy's mobilization effort. Von Moltke was not only aware of this threat, but also took precautions, drawing on the experience of the last war. The Prussian General Staff drew up

plans of the mobilization, focusing, amongst other things, on the most effective use of railroads. In the course of just eighteen days, 1,183,000 soldiers passed through Germany's military barracks and 462,000 were sent to the French border. With a quick enough mobilization of forces, France had a good chance of victory. Realizing this, the French decided to send their troops directly to the front, without waiting for reserves and materiel, both of which were to be delivered directly to the Franco-German border. However, this led to enormous logistics problems on the railroads, which could perhaps have been solved if France's general staff had been as competent and efficient as the Prussian one and had dealt with the logistics in advance. Instead, French railroads plunged into chaos. The trains waited at the stations with no one to unload them, while the troops at the front lacked materiel, and the still unemptied wagons were already sorely needed elsewhere. Materiel was abundant, but the distribution system broke down completely.

In the 1860s, Prussia built an army that fully reflected the needs and conditions of the time – and the outcome of the war was a confirmation of this. On the surface, the French army looked no worse than the Prussian one. But Roon and Moltke managed to transform the Prussian army into an effective training institution, which made capable soldiers of most Prussian men. The chosen manner of organization was well suited to contemporary technology and tactics. The Prussian soldier was sufficiently trained for serving in the field. A large army made up of conscripts was at an advantage against a smaller, *de facto* professional force. Without taking into account the mobilization potential, logistics plans and the qualitative advantage represented by Prussia's General Staff, it would be impossible to comprehend how Prussia could defeat France so crushingly.

Conclusion

Distribution of military power has a clear impact on the functioning of the international system. It is a fairly customary procedure to determine this distribution by comparing national military expenditures and the numerical strength of national military forces. However, war as a real-world confrontation of military power takes little heed of peacetime spending or personnel statistics and often grants victory to the party which, based on the statistician's records of pre-war expenditure and troop numbers, should be destined for defeat. This text convincingly

demonstrates that there is no causal relationship between peacetime preponderance in terms of expenditure and personnel numbers, and the outcome of a war. Although a certain level of positive correlation can be shown to exist, i.e., in very general terms, it is true that the state with higher defence expenditure and a larger army has a statistically greater chance of winning the war, these characteristics are nothing more than imprecise indicators. Out of the nine great power wars examined, no more than six have been won by the state with larger pre-war military spending. Only four of these wars have been won by the state which, in peacetime, kept a larger army. The example of the Franco-Prussian War shows that not even preponderance in both areas provides sufficient safeguard against crushing defeat, let alone guarantees victory. The military power of a state consists solely in its ability to adapt effectively to the demands of modern warfare. Neither a large army, nor high defence expenditures can in themselves guarantee that.

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Notes

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- 2 Cf. e.g., Hans J. Morgenthau and Kenneth W. Thompson, *Politics among nations: the struggle for power and peace* (New York: McGraw-Hill, 1993); Kenneth N. Waltz, *Theory of international politics* (Boston, Mass.: McGraw-Hill, 1979); Kenneth N. Waltz, “Structural Realism after the Cold War,” *International Security* 26:1 (2001): 5-41; John J. Mearsheimer, *The tragedy of great power politics* (New York: W. W. Norton, 2002).
- 3 Good overview of the literature is given by Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton: Princeton University Press, 2004):14-27.
- 4 The databases of the Correlates of War project are available at www.correlatesofwar.org. Authors working with databases of interstate wars can

- consult Meredith Reid Sarkees and Frank Whelon Wayman, *Resort to war: a data guide to inter-state, extra-state, intra-state, and non-state wars, 1816-2007* (Washington, D.C.: CQ Press, 2010). When working with a database of national material capabilities it is possible to consult J. David Singer, Stuart Bremer and John Stuckey, "Capability Distribution, Uncertainty, and Major Power War, 1820-1965", in *Peace, war, and numbers*, ed. Bruce M. Russett (Beverly Hills: Sage Publications, 1972): 19-48; J. David Singer, "Reconstructing the Correlates of War dataset on material capabilities of states, 1816-1985," *International Interactions* 14:2 (1988): 115-132.
- 5 Cf. Ivan Arreguín-Toft, "How the Weak Win Wars: A Theory of Asymmetric Conflict," *International Security* 26:1 (2001): 93-128.
 - 6 For the sake of simplicity, the us features in the table as the victorious party. This, however, is not an attempt to evaluate the outcome of the war, but simply the wish to maintain a unified approach to the calculation of the index. The designation of the us as the victorious party does not affect the validity of the conclusions.
 - 7 Bavaria contributes a 50,000-strong army and GBP 1,363,000 in defence spending to the coalition. The two less important states, Baden and Württemberg, have, in the year before the war, 15,000 and 14,000 men in arms respectively and the defence expenditure of each slightly exceeds GBP 400,000 in contemporary prices. If taken into account, their contributions would raise the preponderance index of the victorious side to 0.52 in military spending and 0.84 in the number of military personnel.
 - 8 Conrad Prince, "Metz 1870 - Marshal Francois Achille Bazaine: A Classic Example of an Over-promoted Man," *Defence Studies* 5:1 (2005): 101.
 - 9 John G. Lorimer, "Why Would Modern Military Commanders Study the Franco-Prussian War?," *Defence Studies* 5:1 (2005): 111.
 - 10 Michael Howard, *The Franco-Prussian War: the German invasion of France, 1870-1871* (New York: Routledge, 2001): 22-31.