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Global Militarisation Index: Presentation, Codebook and reflexion

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SUMMARY

Measuring militarisation is complex. Since 2003 and retrospectively up to 1990, BICC has been measuring militarisation worldwide with the Global Militarisation Index (GMI). The GMI's approach is resource-based and measures the level of militarisation of a society by its allocation of resources by the state to the military in relation with other areas of society. By measuring the level of militarisation and the resulting time series annually, processes of militarisation or demilitarisation of societies and regions can be mapped.
In this *Working Paper,* for the first time, the authors present the Codebook which underpins the GMI. They also discuss the current methodology and possible additions in view of the changing framework conditions and new data sources. In particular, they discuss the inclusion of novel weapons systems but also the vision of a multi-dimensional concept of militarisation.

CONTENTS

Central findings

The GMI's unique feature is its resource-based approach

To measure and compare militarisation worldwide, BICC has been publishing the *Global Militarisation Index* (*GMI*) since 2003. Following a state-centred, relational resource-based approach, the GMI understands militarisation as a description of the relative weight and importance of a state's military apparatus in relation to its society as a whole as well as a process that records the increase or decrease in the level of militarisation. This differentiates the GMI from other indices, such as the *SIPRI Military Expenditure Database*. Its sub-indices, the Expenditure-, the Personnel- and the Heavy Weapons Index put the financial, human and material resources allocated to the military in relation to other areas of society and the resources allocated to them. This gives us an unbiased, comprehensive and differentiated view of the concept of militarisation.

The GMI methodology is based on the weighting of indicators

The overall GMI represents a sum of its six weighted indicators. These are divided into three sub-indices: The Expenditure-, Personnel-, and Heavy Weapons index. We consider expenditures and personnel as the two most important determinants of militarisation. Therefore, the indices on expenditures and personnel are weighted by a factor of two against the third index, which represents the heavy weapons in the arsenals of a country. This weighting is indirectly derived from the scores of the indicators belonging to the respective sub-index.

The GMI has room for development

New developments in warfare (such as drones, cyberwar) suggest that the sub-indices of the GMI should be revisited. Moreover, new data sources offer the opportunity to further develop the Index and its sub-indices respectively.

The following aspects will be discussed:

Focus the attention not only on state-centred but also private militarisation

The field of militarisation research has expanded beyond that of the armed forces as the central actor (for instance privatisation of security firms, militarisation of the police). Still, state militaries remain the most significant actors for militarisation processes. Even though the GMI is seeking to further differentiate its concept and measure various militarisation processes, this should be implemented separately for analytical reasons. This is why the GMI will continue to measure militarisation with its state- and military-centred approach.

Include small arms and light weapons if reliable data is available

Despite their far-reaching relevance as a means of organised violence, small arms and light weapons have not yet been included in the GMI. In contrast to major conventional weapons systems, small arms and light weapons are more often traded illegally. At the same time, they are often manufactured locally, which makes further transfers unnecessary. There is not sufficient reliable data on how many weapons can be found in arsenals of the armies around the world. By using a methodology based on estimates, the Small Arms Survey is currently arriving at fairly reliable data. But before small arms and light weapons can be included in the GMI, the extent to which they could become part of it retrospectively would have to be verified.

Include novel weapons systems

Hybrid, network-centric or liquid warfare and the revolution in military affairs have fundamentally changed both military technology and warfare. Novel weapons systems and military technologies, such as military satellites, unmanned drones, as well as cyberspace as a new battlefield, play an increasingly important role. In all the areas addressed, the problem is

to identify reliable and annual data. Only the USC Satellite Database is an exception that will, in all likelihood, allow us to include military satellites in the GMI in the next update.

If we succeed in complementing data from the Drone Databook and the annual SIPRI data on drone exports with our own research on drone production, we intend to include a state's ability to deploy weaponised drones as of 2022.

Develop a multi-dimensional approach to militarisation and organised violence

To be able to fully comprehend militarisation in its entirety and its complex implications on civil-military relations and organised violence, a three-dimensional concept of militarisation, which could be covered by three independent indices is necessary. While the GMI continues to record the material/military dimension, the Political Roles of the Military (PRM) dataset covers the political dimension and collects data on the influence of the military or rather the political control of the military. The creation of a new Military-Social Relations (MSR) Index would complete the concept. A triad of GMI, PRM and MSR would not only allow us to identify different types of militarisation but to also study the complex interactions between the dimensions and their implications on violence and regime stability in more detail.

Introduction

The 20th century is sometimes referred to as the 'age of militarisation' not only in view of the two World Wars but also the decades-long Cold War, characterised by a global arms race and very high levels of militarisation on both sides of the Iron Curtain (Wallensteen et al., 2019, XI). Since the end of the East-West antagonism, the concept of militarisation seems to have become less significant. Today, however, against the backdrop of increasing geopolitical tensions and rising military expenditures, this term is experiencing a renaissance and a conceptual reinterpretation, or rather expansion. Militarisation, on the one hand, is increasingly used in a spatial sense to describe a military build-up at borders and border areas (Gohain, 2018; Slack et al., 2016), in the Arctic (Kickert & Lackenbauer, 2020; Exner-Pirot, 2020) or in outer space (Wowthorpe, 2004). On the other hand, the term is increasingly used in the context of police and state security forces to refer to the increasing adoption of military thinking as well as military tactics and equipment by these forces (see Flores-Macia & Zarkin, 2019; Bieler, 2016).

To measure and compare militarisation worldwide, BICC has published the Global Militarisation Index (GMI) since 2003. With this *BICC Working Paper*, we explain the GMI in more detail, using a *Codebook* (V. 1.0). In a way, the *Codebook* is the academic operating manual for the GMI. In its most up-to-date version, it is a reflection of the currently adopted concept of the GMI and the methodology and data sources underpinning the Index. In this sense, the *Codebook* is a 'living document'. Regular updates of the *Codebook* will reflect changes to the Index. With debates around the conceptualisation of militarisation evolving since the first publication of the Index, and with other, additional data sources being available today, the authors also want to use this *Working Paper* to critically reflect on the status of the Index and identify possible improvements/ new developments.

Introduction to the Global Militarisation Index and why it differs from other indices

In most countries in the world, the military is the central state-run institution of organised violence.[1] Its main task is to defend the country and its population against aggression and enemies, thus ensuring security. Accordingly, a strong military can be an indicator of a strained security situation in a country or a region. In such a situation, however, high militarisation tends to exacerbate the existing security dilemma and can drive regional arms dynamics. Yet in some cases, the main task of the military is to secure the power of the ruling elite and to subdue opposition. In these cases, a strong military is clearly problematic. A weak or dysfunctional military, by contrast, is often not in a position to prevent violence or the escalation of conflict as it cannot enforce or maintain its monopoly on the use of force. This, in turn, can have negative implications on the population and the economic and social development of the country. To carry out its mission effectively, a military needs to be provided with adequate resources in terms of personnel, finances and weapons.[2] Such investment in the armed forces may pay off as a development dividend, but they also invariably represent a greater or lesser burden, as these resources are lacking in other sectors, such as the health service. A military that absorbs a large part of a society's resources could hamper necessary structural economic and social change and cause development deficits in industry and agriculture.

The GMI aims to provide data for a more nuanced debate about the role of militarisation that goes beyond the usual normative debates. Following a resource-based approach, the GMI understands militarisation as the relative weight and importance of the state's military apparatus in relation to its society as a whole. For this, the GMI compares spending on the military and military equipment with spending on other areas of society and thus allows statements about the social weighting of the military. It also complements expenditure on the military and armament of a society with information on the allocation of human and material resources to the military. These are also compared to resource expenditures in other areas of society, such as the health sector. Via its sub-indices, it thus allows a more detailed and more nuanced view of the concept of militarisation.

In doing so, it differs from other existing indices, such as the Military Expenditure Database published by the Stockholm International Peace Research Institute SIPRI. This database covers military expenditures from 1949 to 2020 and is updated annually. The GMI also uses this data for its calculations.

As described above, the GMI's concept is neither limited to military expenditures nor does it measure military power (such as the Global Firepower Index) or geopolitical influence or rather the capacity to intervene (such as the Elcano Global Presence Index).

In contrast to the World Military Expenditures and Arms Transfers (WMEAT) dataset of the US State Department, the GMI collects data yearly and does not cover longer periods at irregular intervals. This results in consistent timelines that allow us to look at and analyse the current development of militarisation globally or in certain regions. This is an important advantage, especially for mapping arms and escalation dynamics.

1 \ We understand organised violence as all measures that a societal collective uses to counter the problem of internal/ intra-societal violence. Yet, as social orders always need a modicum of violence to uphold the status quo, organised violence always encompasses both, measures to contain it and measures to use it. This is why every social order creates norms that sanction internal/ intra-societal violence ('murder is taboo') and others that legitimise certain forms of violence under certain conditions. At the institutional level, organised violence means the establishment of institutions of violence (such as police, army) that may use violence under certain circumstances to prevent or limit illegitimate private violence (see Schetter & Müller-Koné, 2021

2 \ We assume that other aspects, such as an effective control by a legitimate government and military-societal relations which prevent the use of (miilitary) violence against one's own people, also play an important role in the functionality of the military.

However, it should be emphasised that the GMI, especially in tandem with other indices, offers the chance to explore domestic or regional effects of militarisation, such as on security, prosperity or human development. The GMI thus addresses researchers, advisors or policymakers who are interested in regional and domestic effects of militarisation and who are working on arms exports and global or regional dynamics of armament and conflict.

Unit of analysis and inclusion/ exclusion criteria

The GMI is a global index, which means that it has the ambition to record the annual status of militarisation of every country in the world. Criteria, such as size or number of citizens, are irrelevant for this. This is why the current GMI ranking contains the Fiji Islands or Iceland; both countries with less than one million inhabitants. The only factor that restricts inclusion in the Index is the insufficient availability of (up-to-date) data—and this solely serves to secure the quality of the Index (see Note on missing data on page 13).

Coverage

The GMI covers the period from 1990 to 2019 and currently comprises 151 countries. It is updated annually. Depending on the availability of data, coverage of the number of countries included in the Index may vary slightly from year to year.

Publication

As the GMI is based on data made available externally, it is published retrospectively at the end of each year. The GMI 2020, for instance, was published in December 2020 and is based on data from 2019.

How to measure militarisation?

The concept of militarisation

Militarisation is both tied to the concepts of the military on the one hand and militarism on the other. In a narrower interpretation, militarisation is understood as an increase in military capacity (Lind, 2004). Eide and Thee (1980, p. 9), for instance, proposed to understand militarisation as an "increase in armaments, advance in the destructive capacity of weapons, growing numbers of people under arms, and dramatic increases in military expenditure". A broader interpretation looks at militarisation as a steady development towards the state of militarism (see Levy, 2015; Shaw, 1991). This is in line with Stearn's definition of demilitarisation as a process of "reducing the role of the military in the political and social life—with or without slimming the size of the military sector" (2013, pp. 23). By a combination of both interpretations, militarisation can be considered as a multidimensional phenomenon, which consists of a material, a political and a social dimension (Bowman, 2002). Such an interpretation also includes a discursive dimension that changes convictions and values of a society to such a degree that they legitimise the use of violence, the organisation and the financing of large, standing armies as well as the associated higher tax burden (Lutz, 2002, p. 723).

The GMI's approach is resource-based and measures the level of militarisation by the allocation of resources by the state to the military in relation with other areas of society. By measuring the level of militarisation and the resulting time series annually, processes of militarisation or demilitarisation (see Wolpin, 1983, 130) of societies and regions can be mapped. This means, inter alia, that the GMI is not (or only an indirect) an indicator of military power. In other words: The most heavily militarised country is not automatically the most powerful in military terms. Besides material (heavy weapons) resources, the GMI also takes account of human resources and thus records the aspect of social militarisation. Material militarisation measures the power resources in the hands of the military (Kühn & Levy, 2020) manifested in heavy weapons. Social militarisation is understood as the size of the military compared to the total population (Bullock & Firebaugh, 1990). In our approach, we relate the resources allocated to the military to those allocated to the whole of society (see below). For instance, we consider resources allocated to the health sector as an indicator of human development.

In the past, we have witnessed frequent expansions of the concept of militarisation. At times, this concept is used to examine how military equipment is enhanced or how institutions, such as the police, adopt military tactics and attitudes (see Flores-Macias & Zarkin, 2019; Bieler, 2016). It can also serve to analyse private militarisation (Hutchful & Aning, 2001) as manifested by private military providers (Kinsey, 2006). In contrast to that, when looking at militarisation, we focus on the state and the military as its core institution of organised violence. In doing so, we include paramilitary units in our definition of the military, as the regular military alone does not adequately reflect the total size of the armed forces in many countries (see Personnel Index).

Operationalisation

The GMI provides information on the level of militarisation. By analysing the level of militarisation, we can observe tendencies of an increase in or a scaling down of the military. This can be used to ask specific development policy and socio-political questions. Our Index ranks the countries according to their level of militarisation on a scale from 0 to 1,000 (whereby 1,000 represents the highest level of militarisation). The GMI consists of three sub-indices that assess different aspects of militarisation, namely **expenditures**, **personnel** and heavy **weapons**. These three sub-indices are made up of six indicators in total.

Expenditure Index (EI)

For a long time, military expenditures have been considered the standard measure of militarisation (Gifford, 2006, p. 473). Financial resources made available by a government are a major factor that determines the ordnance, capabilities and size of a country's armed forces. According to our relational approach, the EI relates the budget of the armed forces to two important indicators: For one, the economic performance of a country and its society (measured as the gross domestic product, GDP), for another its government's spending on health. Data on military spending are sourced from the Military Expenditure Database of the Stockholm Peace Research Institute SIPRI. It is important to note that SIPRI uses a broad definition of military spending that goes beyond the defence budget of a country. It also includes other expenditures, such as pensions for military personnel or spending on military research and development. Even though SIPRI can be considered to be the most reliable source to date, data on military spending must be treated with the utmost caution. For many countries, in particular developing countries and autocratic states, the figures are only rough estimates. In those cases where SIPRI does not provide up-to-date data, we use the latest available figures, provided they are not older than three years. Data on health expenditures is obtained from the Global Health Observatory Data Repository of the World Health Organization (WHO).

Both EI-indicators are calculated as follows:

With milex_gdp being the "military expenditure as percentage of the GDP", and health_gdp being the "health expenditure as percentage of the GDP":
milex_health_norm := norm(log((milex_gdp / health_gdp) + 1))
and
norm(x) := (x – min(x)) / (max(x) - min(x))

Personnel Index (PI)

Besides military expenditures, we also use the Personnel Index (PI) to measure militarisation. The PI measures the level of "social militarisation" by the size of the military. It consists of three indicators:

The first and most important indicator in this category is active (para-)military personnel set in relation to the total population. As mentioned above (see The concept of militarisation), we include paramilitary personnel to adequately reflect the total size of the armed forces. The main criterion for coding an organisational unit as military or paramilitary is that the armed forces concerned are not only armed, wear uniforms and live in barracks but that they are also under the direct control of the government. Based on data of the International Institute for Strategic Studies (IISS), we count personnel in the army, the navy and the air force as well as additional (if applicable, such as from the coastguard, national guard or training commands) and paramilitary personnel.

For a comprehensive presentation of the available personnel and an appropriate presentation of the relative level of militarisation in society, a second indicator takes the percentage of reserve forces measured against the total population into account. This factor is particularly relevant for some countries, such as Switzerland, which have a comparatively small standing army but a larger amount of available reserves within society. We again rely on IISS data on military and paramilitary reserve forces.

The third indicator compares the total number of military and paramilitary forces with the number of physicians in a country to express the ratio of military to non-military expertise in a society.

All data on military personnel is taken from the *Military Balance* of the International Institute for Strategic Studies (IISS). Population figures are taken from World Bank sources. The number of physicians of a country is taken from World Health Organization (WHO) data.

The three indicators of the PI are calculated according to the following formulas:

1. milpara_pop_norm := norm(log(milpara_pop + 1))
2. reserve_pop_norm := norm(log(reserve_pop + 1))
3. milpara_phy_norm := norm(log(milpara_phy + 1))
with
1. milpara_pop := milpara / population
2. milpara_phy := milpara / physicians
3. reserve_pop := reserve / population
and:
milpara := military + paramilitary

Heavy Weapons Index (HWI)

To determine the degree of "material militarisation" of a country, the GMI takes into account certain types of heavy weapons. The Heavy Weapons Index (HWI) indicates the number of heavy weapons in the arsenals of the armed forces in relation to the overall population.

We define heavy weapons as any military equipment that fits into one of four categories: Armoured vehicles (armoured personnel carriers[3] , light tanks, main battle tanks), artillery (multiple rocket launchers, self-propelled artillery systems, pulled artillery systems) of 100mm calibre and above, combat aircraft (combat helicopters, fixed-wing aircraft) and large vessels of war (submarines, principal surface combatants larger than corvettes). We also count stockpiled weapons as they are part of the military potential of a country. Data on weapons holdings are compiled from the ISS Military Balance. Data on small arms and light weapons (SALW) is not only extremely difficult to come by but is also unreliable. This is why they are not included in the GMI.

3 \ Including autonomous underwater vehicles, infantry combat vehicles, airborne combat vehicles and protected patrol vehicles.

The HWI is calculated with the following formula:

weapons_pop_norm := norm(log(weapons_pop +1))
*weapons_pop := weapons * 100,000 / population (Number of heavy weapons per 100,000 inhabitants)*

Note on missing data

To ensure the overall quality of the Index, we only use original data from the sources indicated in the section on Operationalisation. This is why the Index does not contain any data based on expert assessments, extrapolation or other data projection methods. Beyond that, we strive to use data that are as up to date as possible. This is not always possible for various reasons: For one, such data is not always available or reliable (especially for fragile states). For example, the practice of using shadow armies that exist only on paper to divert their pay is common. For another, military expenditures and troop numbers are sensitive topics that governments sometimes keep secret. To fill such data gaps, the GMI also uses data from previous years. Otherwise, the coverage of the Index would be extremely limited. To ensure that it nonetheless reflects actual developments in militarisation, we limit the use of data that are not up to date. For this, we use two thresholds: As military expenditure and personnel data, as well as the number of heavy weapons, lie at the heart of the Index, this data must not be older than three years. Other data (such as on expenditures on health and number of physicians) must not be older than five years.

This means that military expenditure and data on personnel as well as data on heavy weapons contained in the GMI 2020 may refer to 2016, and the data on health expenditures and the number of physicians may date back as far as 2014. If no data is available, we will code this as missing data. Such missing data results in a '0' score for the respective indicator in the GMI ranking.

Beyond this, we apply a general quality policy to the data for each country. As explained in more detail in the next section on the Methodology, the GMI score is the result of three sub-indices and six indicators. Each indicator (like military spending as percentage of GDP) is weighted differently and then included in the overall GMI score. The already mentioned indicator "Military spending as percentage of GDP", for instance, is one of the most important and is, therefore, weighted with a factor of five. As Table 1 in the section on the methodology shows, the sum of all weighting factors for all six indicators is 20. If missing data results in a '0' score of indicators with a total weighting factor of 10 or less, the corresponding country is excluded from the GMI ranking. However, if data coverage is sufficient, we will list these countries in the ranking of the sub-indices.

The Democratic People's Republic of Korea is an example of an excluded country. It is most likely the most heavily militarised country in the world. But it is an autocratic state that keeps its data, especially that on military spending, personnel and heavy weapons, strictly confidential. There is also no reliable data on Yemen, Syria, Qatar or Myanmar, which is why we do not include these countries in the GMI.

Methodology

The overall GMI represents a weighted sum of its six indicators. These are divided into three sub-indices: The Expenditure-, Personnel-, and Heavy Weapons Index. We consider expenditures and personnel as the two most important determinants of militarisation. Therefore, the indices on expenditure and personnel are weighted by a factor of two against the third index, which represents the heavy weapons in the arsenals of a country. This weighting is indirectly derived from the scores of the indicators belonging to the respective sub-index. As Table 1 below shows, the Expenditure Index is made up of two indicators ("military expenditures as percentage of GDP" and "military expenditures in relation to health spending"), which are given factors of five and three. This results in a total weighting factor of eight. Similarly, the total weighting factor of the Personnel Index is eight, and that of the Heavy Weapons Index is four.

To increase compatibility between different indicators and to prevent extreme values from creating distortions when normalising data, in a first step, each indicator is represented in a logarithm with a factor of 10. In a second step, all data are normalised using the formula x = (y-min) / (max-min), where min and max represent the lowest and the highest value of the logarithm respectively. In a third step,

Table 1
Indicators and weighting factors

Kategory	Indicator	GMI weighting factor
Expenditures	*Military expenditures as percentages of GDP*	5
	Military expenditures in relation to health spending	3
Personnel	*Military and paramilitary personnel in relation to population*	4
	Military reservists in relation to population	2
	Military and paramilitary personnel in relation to physicians	2
Weapons	*Heavy weapons in relation to population*	4

each indicator is weighted in accordance with a subjective factor, reflecting the relative importance attributed to it by BICC researchers. To calculate the final score, the weighted indicators are added up and then normalised one last time on a scale ranging from 0 to 1,000.

In the GMI ranking, the countries are ranked according to their overall GMI score. The Expenditure, Personnel and Heavy Weapons Indices can also be ranked independently. These rankings allow us to also include countries that are not listed in the overall GMI score as such as a result of insufficient data.

Table 2
GMI ranking 2020

Country	*EI score*	*PI score*	*HWI score*	*GMI score*	*Rank*
Israel	*2.4*	*1.7*	*3.1*	*363.2*	*1*
Armenia	*2.2*	*1.7*	*2.3*	*310.1*	*2*
Oman	*3.4*	*0.9*	*1.8*	*305.6*	*3*
Bahrain	*2.1*	*1.3*	*2.6*	*300.8*	*4*
Singapore	*2.0*	*1.3*	*2.7*	*297.2*	*5*
Saudia-Arabia	*3.1*	*0.7*	*2.1*	*293.6*	*6*
Brunei	*2.3*	*1.5*	*1.9*	*286.7*	*7*
Russia	*2.1*	*0.9*	*2.7*	*285.1*	*8*
Kuwait	*2.6*	*0.6*	*2.4*	*284.2*	*9*
Jordan	*2.2*	*1.1*	*2.3*	*279.3*	*10*

EI=Expenditure Index; PI=Personnel Index; HWI=Heavy Weapons Index

Model calculation

To make this Codebook a little easier to understand, we will recapitulate in detail Germany's GMI ranking for 2019, including its sub-indices. With an overall score of 114, Germany was ranked 106th in the GMI 2020, that is for the year 2019. On the valuation of the respective sub-indices, Germany's ranking was as follows in 2019:

1\ Expenditure Index: 0.96
2\ Personnel Index : 0.22
3\ Heavy Weapons Index: 1.12

To calculate the GMI for Germany for 2019, we calculate the sub-indices separately and then aggregate the interim results.

Expenditure Index (EI)

The information from the respective data sources results in the following values:
milex_gdp = 1.2795 (**Military spending as percentage of GDP - SIPRI**)
health_gdp = 11.2 (**Health expenditures as percentage of GDP - WHO**)

We will first calculate their ratio:
milex_health = milex_gdp / health_gdp = 0.114241071

In a second step, we will calculate the shifted logarithm (to the base 10):
log(milex_gdp + 1) = 0.3578
log(milex_health + 1) = 0.0470

Now, we will do the same for all countries and years and determine the max and min values:

	min	max
log(milex_gdp + 1)	0	117.349
log(milex_health + 1	0	1.5263

In a last step, we apply the normalisation function (norm(x) = (x-min) / (max-min)):
EI1 = milex_gdp_norm = 0.1726053
EI2 = milex_health_norm = 0.03077972

Personnel Index (PI)

We use the following data sources for the Personnel Index:
mil = 181,400 (number of military personnel - IISS)
para = 0 (number of paramilitary personnel - IISS)
Reserve = 29,200 (number of reservists - IISS)
pop = 83,132,799 (total population – World Bank)
phy = 351,195 (number of physicians – WHO)
milpara_pop = (mil + para) / pop = 0.002182051
milpara_phy = (mil + para) / phy = 0.5165222
reserve_pop = reserve / pop = 0.0003512452

Now, we will calculate the shifted logarithm (to the base 10):
log(milpara_pop + 1) = 0.0009466203
log(milpara_phy + 1) = 0.1808488
log(reserve_pop + 1) = 0.001525171

Then, we will do the same for all countries and years and calculate the max and min values:

	min	max
log(milpara_pop + 1)	0	0.03632710
log(milpara_phy + 1)	0	3.310017
log(reserve_pop + 1)	0	0.11805287

As a last step, we apply the normalisation function (norm(x) = (x-min) / (max-min)):
PI1 = milpara_pop_norm = 0.02605824
PI2 = milpara_phy_norm = 0.05463681
PI3 = reserve_pop_norm = 0,.01291939

Heavy Weapons Index (HWI)

For the Heavy Weapons Index, we use the following data sources:
weapons = 3,485 (number of heavy weapons - IISS)
pop = 83,132,799 (total populatition - World Bank)
weapons_pop = 100,000 * weapons / pop = 4.192088

First, we will calculate the shifted logarithm (to the base 10):
log(weapons_pop + 1) = 0.7153420

Now, we repeat this step for all countries and years and calculate the max and min values:

	min	max
log(weapons_pop + 1	0	2.560594

As a final step, we apply the normalisation function (norm(x) = (x-min) / (max-min)):
HWI1 = weapons_pop_norm = 0.2793656

Aggregation

To complete the calculation, we multiply the interim results by the respective weighting factors, sum up the results and divide the result by the total weighting factor 20:
ALL = (5***EI1** + 3***EI2** + 4***PI1** + 2***PI2** + 2***PI3** + 4***HWI1**) / 20 = 0.1144459

Finally, we multiply the result by the factor 1,000:
GMI = ALL * 1000 = **114.4459**

Data set

BICC makes the GMI publicly available in a reduced version (the GMI score including the sub-indices). You can access it here as a data set in csv-format for download. The Codebook in its current version can be found at
https://gmi.bicc.de/#rank@2019de/#rank@2019

Discussion and development going forward

With the current Codebook of the GMI, we have presented our state-centred, relational resource approach to measuring militarisation. The Codebook describes not only the current concept of militarisation but also its operationalisation by the GMI. Both, conceptionalisation and operationalisation are challenged by new developments in warfare. For example, the use of weaponised drones equipped with the latest reconnaissance and surveillance technology allows for targeted killings of individuals who are considered a threat to the security of a country or its population. Similar to cyberattacks on vital infrastructure such as nuclear facilities, energy plants or communication infrastructure, such tactics are situated in the realm of so-called hybrid warfare and in the grey areas between classic definitions of war and peace.

Moreover, new data sources offer the opportunity to further develop the Index. In this section, we would like to reflect on our approach and discuss possible options for its adaptation. We will elaborate in particular on the following three points:

1\ the option to expand the Index to include private militarisation;
2\ the expansion of the Heavy Weapons Index and the possible inclusion of small arms and light weapons as well as new weapons systems, such as drones and military satellites;
3\ some thoughts on how to understand the nexus between organized violence and militarisation and on how to measure the later in a multidimensional way.

State centredness

With the Peace of Westphalia, which put an end to the 30 Years War in 1648, the state with its standing armies became the main actor in warfare and thus the central factor in militarisation. Despite this prominent position, however, even in the heyday of state militarism and imperialism, it was never the only actor that led military troops into the battle. In other words: The state was never the undisputed monopolist of military violence. For example, private actors, such as the East India Trading Company (Clegg, 2017) supported and substituted national or state-run armed forces in conquering and securing colonial territories with their own military troops. Similarly, after the end of the East–West antagonism, a wave of liberalisation set in, which also affected the military sector and led to a proliferation of so-called private security (PSC) and private military companies (PMC) (Singer, 2007). This once again called into question the central role of the state in the use of military violence and for processes of militarisation. For some years now, there has also been a discussion about the growing militarisation of police forces, which are increasingly adopting military tactics and equipment and are, thus, becoming more and more like the military (Flores-Macias & Zarkin, 2019; Bieler, 2016). While this does not challenge state centricity, it does broaden the field of militarisation research beyond the armed forces as the central actor. Although we consider this broadening of the field to be appropriate, we still believe that the conceptual, narrow focus of the GMI on the state and its military is sensible for analytical reasons:

First, countries and their armies continue to be by far the most important institutions of military violence with some 19.8 million people under arms, some 23.8 million reservists (IISS, 2021) and military expenditures of US $1,981 billion a year (SIPRI, 2020) and are likely to remain so.

Second, state armies differ significantly from other armed actors, such as private militias, armed parties or movements or even the state police in their mission, methods of recruitment and embeddedness in society.

The GMI will, therefore, continue to focus on the state military as the starting point of militarisation dynamics. In doing so, we assume that the military is embedded in a political regime or a society via its civil-military relations.[4] Militarisation in the narrower sense of the GMI—understood as the allocation of resources to the military in relation to other parts of society—always has an influence on other parts or institutions of society (such as the police) and their relations with each other. Thus, a change in resource allocation, by, for instance, introducing or suspending conscription and the accompanying downsizing of or increase in personnel, inevitably affects the regime and society (militarisation in the broader sense). We consider the conceptual differentiation and measurement of these different dimensions of militarisation to be very important and strive towards this (see Militarisation and organised violence: Towards a multi-dimensional approach). For analytical reasons, we intend, however, to approach these separately while the GMI will continue to measure militarisation by way of a state- and military-centred approach.

Small arms and light weapons as well as novel weapons systems

In its current design, the GMI records the material dimension of militarisation via the ratio of heavy weapons to the total population. With regard to arms dynamics and conventional interstate wars, this approach has proven to be effective. However, we would like to point out two problems of this limitation and offer possible solutions to these.

Small arms and light weapons

First, many wars—particularly domestic wars—are waged primarily with small arms and light weapons (SALW)[5] . SALW are also the most common means of repression against a state's own population and, against this background, are probably the military's most important resource in terms of organised violence. (On BICC's concept of organised violence, cf. Militarisation and organised violence: Towards a multi-dimensional approach.) Despite their far-reaching relevance as a means of organised violence, the GMI has not recorded small arms and light weapons so far. The reason for this is a lack of reliable data. In contrast to major conventional weapons systems, small arms and light weapons are more often traded illegally. At the same time, they are often manufactured locally, which makes further transfers unnecessary. These are the reasons why the GMI's main source of information, the Military Balance, for instance, does not keep any data on small arms and light weapons. One of the few global data sources on small arms in possession of the military is the Small Arms Survey (SAS) of the Graduate Institute of International and Development Studies in Geneva. The Institute collects information on small arms holdings in the arsenals of the military for currently 177 countries. Its data sources used are information provided by states themselves to the Small Arms Survey, reports of states to the UN Register of Conventional Arms (UNROCA) as well as estimates.[6] The latter make up by far the largest part of the SAS data. Even though this methodology based on

4 \ Civi-military relations (CMR) in the broadest sense are understood as the relations between the military on the one hand and the civilian parts of society on the other. Understood like this, CMR cover both political elites and the wider population (Shields, 2015) on the civilian side.

5 \ The United Nations define small arms and light weapons as follows: "Small arms" are, broadly speaking, weapons designed for individual use. They include, inter alia, revolvers and self-loading pistols, rifles and carbines, sub-machine guns, assault rifles and light machine guns "Light weapons" are, broadly speaking, weapons designed for use by two or three persons serving as a crew, although some may be carried and used by a single person. They include, inter alia, heavy machine guns, hand-held under-barrel and mounted grenade launchers, portable anti-aircraft guns, portable anti-tank guns, recoilless rifles, portable launchers of anti-tank missile and rocket systems, portable launchers of anti-aircraft missile systems, and mortars of a calibre of less than 100 millimetres (United Nations, 2006). With the exception of grenades that are weapons and ammunition in one, all small arms need ammunition.

6 \ It multiplies troop numbers with a modificator for different types of armies (people's war militaries, trinitarian militaries, constabulary, militaries, reserve militaries) and thus calculates the estimated number of small arms and light weapons (see Karp, 2018).

estimates has been tested using some examples and has proven to be relatively reliable, before adopting this methodology, it remains to be examined to what extent it can also be applied retrospectively to the GMI.

Novel weapons systems

Second, in the wake of hybrid (McCulloh & Johnson, 2013), network centric (von Boemcken, 2008) or liquid (Mutschler, 2016) warfare and the revolution in military affairs, both military technology and warfare has changed fundamentally. In view of this, novel weapons systems or military technology, for instance, play an increasingly important role. Military satellites have become indispensable for global navigation, reconnaissance, communication and networking with different parts of the army as well as for the control of precision weapons. Unmanned drones, so-called UAVs (unmanned aerial vehicle) play an important role not only for reconnaissance but are increasingly used for air strikes and surveillance of large (maritime) spaces. Furthermore, cyberspace has become a new battlefield. Militarisation, hence, also extends into digital space and includes a corresponding infrastructure.

In all addressed areas, the problem is identifying reliable and annual data so that the respective weapons systems can be included in the GMI. The situation is easiest with regard to satellites. Here, the USC Satellite Database provides an overview of currently 2,787 satellites (status August 2020) of all kinds and differentiates between civilian and military satellites and the respective operators. This data is updated several times a year and represents both the most comprehensive and most reliable source with respect to satellites. **Based on this data situation, we will likely be able to include military satellites with the next update into the GMI.**

For military drones, the situation is more complicated. The Drone Databook published by Dan Gettinger and the Center for the Study of the Drone at Bard College, New York is a well-researched and rather comprehensive data repository, which currently contains 170 types of drones in 101 countries. However, the work of the Center ceased in 2021. Compared to the information in the Drone Databook, the data in the IISS Military Balance is much less comprehensive. The British NGO Drone Wars also collects data on countries operating armed drones, but their list only contains 20 counties at present and thus deviates significantly from the data of the Drone Databook. Moreover, Drone Wars publishes on individual types of drones but not the number used by each country. The data from the SIPRI Arms Transfers Database, in turn, only covers exports and not domestic manufacture. Against this background, including unmanned drones in the GMI requires a great deal of research. The Drone Databook could serve as a starting point, but it would have to be complemented by SIPRI's data on drone exports and own research on manufacture. **Still, we intend to include the ability to use armed drones in the GMI as of 2022.** Given the data situation, this ability will be evaluated in four categories: no ability, little, medium and high ability. Unlike with the other heavy weapons, only a weighted estimate of capacities rather than an exact number of weapons systems will be included in the Index.

The addition of cyberwar capacities to the GMI is also not without its challenges. These capacities are particularly relevant against the backdrop of so-called hybrid warfare. In principle, there are two approaches to estimating/measuring the cyberwar capabilities of a country: For one, via existing structures or infrastructures for electronic warfare, for the other via concrete events that are ascribed to a certain actor.

IISS resorts to the first approach in its Military Balance+, where it has been providing information on military cyber capabilities since 2021. These are collected / estimated through four indicators: Strategy and doctrine, principal military cyber units, defence satellite capability and national military cyber exercises. This data, however, is still being gathered and is currently only available via the Military Balance+. Furthermore, this approach has the shortcoming that, most likely, only a fraction of the actual capabilities can be ascertained via the survey of official units, doctrines and drills and that in all likelihood the approach is subject to systematic distortions.

The Cyber Operations Tracker of the Council on Foreign Relations has been recording state cyber attacks since 2005 and thus follows the second approach. The Tracker differentiates between attacks on the private sector, civil society, the government, or a country's military. This incidence data could be used to infer cyberwar capabilities. However, this is problematic in many respects: First, identifying the so-called threat actor—that is, the aggressor—is by no means easy, as the origins of the attacks are often obscured, and wrong leads are given. Second, language barriers during research lead to over-reporting of attacks on the English-speaking West. Third, and most seriously, only such cyberwar capabilities can be identified via incidences of cyber attacks that are actually deployed. **All in all, the data situation is so inadequate that cyberwar capabilities will not be included in the GMI in the foreseeable future.**

Militarisation and organised violence: Towards a multi-dimensional approach

As mentioned at the beginning, research at BICC on militarisation is based on the concept of organised violence. Here, we assume that each social order is inscribed a modicum of violence that maintains it and is intended to counter the problem of internal violence. Modern states have created institutions of violence for this purpose, which monopolise the legitimate (use of) violence by the state to prevent or limit illegitimate, private violence (see Schetter & Müller-Koné, 2021). These institutions are accompanied by norms that sanction certain manifestations of violence and legitimise others.

Within modern national states, even though the state military is usually tasked with defending against external enemies, it also has the greatest potential for violence within society, closely followed by security forces such as the police or paramilitary units. To assess its role with respect to the organised violence inherent in a society, the military cannot be viewed in isolation from a) the ruling political regime and b) its relation to its own population. In other words: The relational resource-based approach used in the GMI only shows a part of civil-military relations and the dynamics of militarisation that influence them.

Bowman (2002), for instance, argues that militarisation has three dimensions: A military, a political and a social one. The latter two dimensions are explored in civil-military relations. While most empirical work focuses on the relation between the military and political elites or the question of civilian or political control of the military (Bruneau & Matei, 2008), so-called military-society relations (Rukavishnikov & Pugh, 2018, p. 128) are usually ignored. While civil-military relations and civilian oversight are particularly important in avoiding military coups or political interference by the military, the broader military-society relations play an important role in the context of an evaluation of the role of the military as an institution of organised violence. For example, may the military be deployed within a country? Does it act as an organ of repression, or does it maintain a professional distance from the ruling regime? (How) is the military embedded in wider society? Is there a regular exchange (for instance by conscription), or are the civilian and military spheres strictly separated from each other?

To be able to fully comprehend militarisation in its entirety and its complex implications on civil-military relations and organised violence, we aim for a three-dimensional concept of militarisation, which could be covered by three indicators. While the GMI continues to record the material/military dimension, the Political Roles of the Military (PRM) dataset developed by Croissant et al. (2017) could cover the political dimension and collect data on the influence of the military or rather the political control of the military. Both could be complemented by a new Military-Social Relations (MSR) Index, which addresses the questions mentioned above. Such a triad from GMI, PRM and MSR would not only allow us to identify different types of militarisation but to also study in more detail the complex interactions between the dimensions and their implications on violence and regime stability.

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