I. MEASURING POWER

Executive summary

The 2019 Lowy Institute Asia Power Index ranks 25 countries and territories in the Asia-Pacific in terms of their ability to exercise power. The Index is designed to be an analytical tool to sharpen the debate on the changing distribution of power in the region.

For the purposes of this Index, power is defined as the capacity of a state or territory to direct or influence the behaviour of other states, non-state actors, and the course of international events.

The Index addresses the multidimensional nature of power through evaluations of military capability and defence networks, economic resources and relationships, diplomatic and cultural influence, resilience and future resources. A country's overall power is its weighted average across the eight measures of power.

Quantifying power presents several key challenges. First, the relative importance of factors determining state power is subject to debate. Second, it is difficult to obtain reliable and comparable data across 25 countries and territories.

The selection of indicators for the Lowy Institute Asia Power Index was driven by an extensive literature review and expert consultations designed to address these methodological hurdles. As such, each indicator represents a carefully selected proxy for a broader category of variables often more difficult, if not impossible, to measure comparatively.

The Index consists of 126 indicators drawn from original Lowy Institute research and hundreds of publicly available sources. A distance-to-frontier approach is used to compare a country's results with the best performing and worst performing countries in each dataset. The method reflects the notion that power in international relations is relative, measured as comparative advantage in a given frame of reference.

This report provides further information about the methodology behind the Lowy Institute Asia Power Index.

Geographical scope

The Index covers 25 countries and territories in the Asia-Pacific region, reaching as far west as Pakistan, as far north as Russia, and as far into the Pacific as Australia, New Zealand, and the United States.

Major 'external' actors with strategic interests in Asia, such as Russia and the United States, have been included in the Index if they participate in both the ASEAN Regional Forum and the East Asia Summit.

Taiwan is included in the Index as a self-governing territory claimed by the People's Republic of China. It conducts its own foreign policy and has its own military, making it necessary to include Taiwan in the Index as an actor that affects the distribution of power in Asia.

South Asia	Southeast Asia	East Asia	Pacific
Bangladesh	Brunei	China	Australia
India	Cambodia	Japan	New Zealand
Nepal	Indonesia	Mongolia	Russia
Pakistan	Laos	North Korea	United States
Sri Lanka	Malaysia	South Korea	
	Myanmar	Taiwan	
	Philippines		
	Singapore		
	Thailand		
	Vietnam		

Figure 1: Countries included in the Lowy Institute Asia Power Index

What is power?

For the purposes of this Index, power is defined as the capacity of a state or territory to direct or influence the behaviour of other states, non-state actors, and the course of international events. At its most rudimentary, power is the capacity to impose costs and confer benefits that shape the choices of others.

In international relations scholarship, classical realists such as Hans Morgenthau regard the quest for power as inherent in the conduct of international relations between states. It is pursued for different interests, but centres around the ability to affect outcomes in a state's favour.

Power is a relational quality. It is a comparative advantage set in a given frame of reference made of multiple actors, with independent and often competing interests.

As criteria for assessing power in international relations change, so do the proxy indicators that shape estimates of power. Our goal has been to identify distinct dimensions of power that are intuitive, designed to make a clear point, and capture variations in the distribution of power within and between countries.

To reflect the multidimensional nature of power, we evaluate it through eight thematic measures. These measures are comprised of 30 thematic sub-measures and 126 indicators in total.

Measures of power

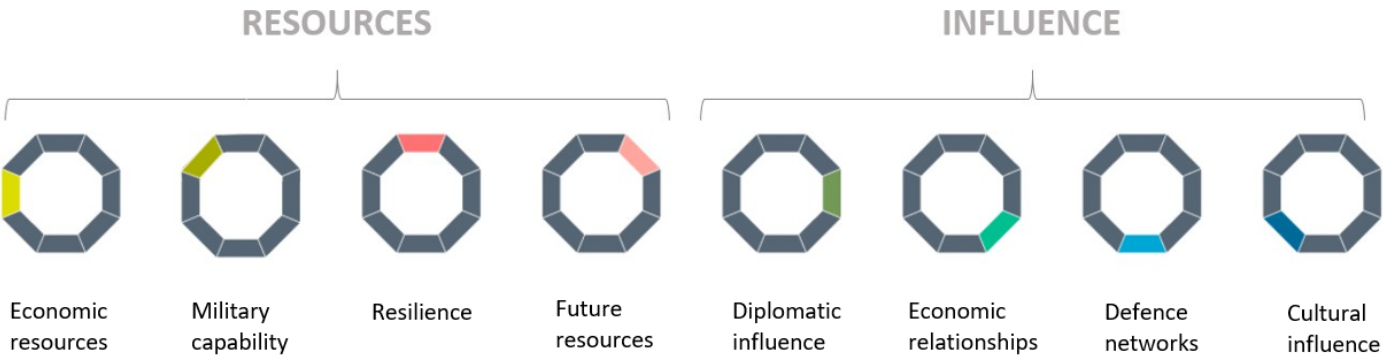

Figure 2: Eight measures of power

***Economic resources*:** Core economic strength and the attributes of an economy with the most geopolitical relevance; measured in terms of GDP at purchasing power parity (PPP), international leverage, technological sophistication and global connectivity.

- Size: The economic weight of a country as reflected by its GDP, which is the total value of all final goods and services produced annually within an economy. Purchasing power parity exchange rates are used to allow for a reliable comparison of real levels of production between countries.
- International leverage: Resources that give governments enhanced financial, legal and sanctioning powers abroad. These include global corporations and internationalised currencies, as well as sovereign wealth funds, export credit agencies and official reserves.
- Technology: The technological and scientific sophistication of countries. This is measured through indicators such as labour productivity, high-tech exports, supercomputers, renewable energy generation and input variables including R&D spending.
- Connectivity: The capital flows and physical means by which countries connect to and shape the global economy, including through international trade, global inward and outward investment flows, merchant fleets and international aviation hubs.

***Military capability*:** conventional military strength; measured in terms of defence spending, armed forces and organisation, weapons and platforms, signature capabilities and Asian military posture.

- Defence spending: Annual spending on military forces and activities. This sub-measure looks at current resources devoted to maintaining, renewing, replacing and expanding military capability, measured in terms of military expenditure at market exchange rates and estimated defence-sector PPP rates.
- Armed forces: Total active military and paramilitary forces, readiness and organisation. This sub-measure is principally focused on the size of armed forces, but also takes account of their combat experience, training and preparedness, as well as command and control structures.
- Weapons and platforms: A country's stock of land, maritime and air warfare assets and capabilities. This sub-measure consists of a number of proxy indicators for capability across the three domains and assesses the sophistication of weapons and platforms.
- Signature capabilities: Military capabilities that confer significant or asymmetric tactical and strategic advantages in warfare. These include ballistic missile capabilities, long-range maritime force projection, intelligence networks, and defensive and offensive cyber capabilities.
- Asian military posture: The ability of armed forces to deploy rapidly and for a sustained period in the event of an interstate conflict in Asia. This sub-measure consists of qualitative expert-based judgements of a country's ability to engage in either a maritime or continental military confrontation in the region.

***Resilience*:** The capacity to deter real or potential external threats to state stability; measured in terms of internal institutional stability, resource security, geoeconomic security, geopolitical security and nuclear deterrence.

- Institutional stability: Institutional factors that enhance domestic governance and provide protection from external interference in internal affairs. This sub-measure includes indicators assessing government effectiveness, political stability and the absence of internal conflict.
- Resource security: Secure access to energy and other critical resources essential to the functioning of a country's economy. This sub-measure looks at dependency on energy imports, energy self-sufficiency levels, refined fuel security and the supply of rare-earth metals.
- Geoeconomic security: The ability to defend against other states' economic actions on a country's geopolitical interests and economic activity. This sub-measure looks at an economy's diversity of export markets and products, as well as its levels of dependency on primary trade partners and global trade.
- Geopolitical security: Structural and political factors that minimise the risk of interstate conflict and enhance a country's territorial security. This sub-measure includes indicators such as population size relative to neighbours and geographic deterrence based on landmass, as well as active border disputes and legacies of interstate conflicts with neighbours.
- Nuclear deterrence: Strategic, theatre and tactical nuclear forces that can be used to deter potential aggressors by threatening a retaliatory nuclear strike. This sub-measure assesses nuclear weapons range, ground-based nuclear missile launchers and nuclear second-strike capabilities.

***Future resources*:** The projected distribution of future resources and capabilities, which play into perceptions of power today; measured in terms of estimated economic, defence and broad resources in 2030, as well as working-age population forecasts for 2045.

- Economic resources 2030: Estimated future economic size and capabilities. This is measured by forecast GDP at purchasing power parity in 2030 and the Beckley formula for estimating economic power; multiplying forecast GDP by forecast GDP per capita.
- Defence resources 2030: Estimated future defence spending and military capability enhancements. This sub-measure consists of two indicators. The first looks at forecasts of absolute levels of military expenditure in 2030, holding the current ratio of defence spending to GDP constant. The second looks at expected gains in military expenditure as a proxy for future investments in military capability above replacement levels.
- Broad resources 2030: Estimated score for a country's broad resources and capabilities in 2030. This sub-measure estimates broad resources in 2030, based on every country's current ratio of GDP and military expenditure to their aggregate score for economic resources, military capability and resilience.
- Demographic resources 2045: Demographic variables which are expected to contribute to future GDP beyond 2030. This sub-measure consists of a forecast of the working-age population (15–64) in 2045 as well as the expected labour dividend from gains in the working-age population adjusted for quality of the workforce.

***Diplomatic influence*:** The extent and standing of a state's or territory's foreign relations; measured in terms of diplomatic networks, involvement in multilateral institutions and clubs, and overall foreign policy and strategic ambition.

- Diplomatic network: The regional and global reach of a state's or territory's diplomatic offices, measured in terms of total number of embassies, high commissions, permanent missions and other representative offices.
- Multilateral power: A state's or territory's participation and diplomatic clout in multilateral forums. This sub-measure examines membership in select summits, diplomatic clubs and intergovernmental organisations, as well as financial contributions to the United Nations and development banks, and voting alignment with other countries in UN resolutions.
- Foreign policy: The ability of government leaders and foreign policy bureaucracies to advance their state's or territory's diplomatic interests. This sub-measure aggregates qualitative expert-based judgements of how effectively leaders pursue their country's diplomatic interests, their demonstrated level of strategic ambition, and the wider efficacy of a country's foreign policy bureaucracy.

***Economic relationships*:** The capacity to exercise influence and leverage through economic interdependencies; measured in terms of trade relations, investment ties and economic diplomacy.

- Regional trade relations: The ability to influence other countries through bilateral trade flows and relative dependencies. This sub-measure focuses on an economy's relative importance as an importer, exporter and primary trade partner for other countries, based on annual bilateral trade flows.
- Regional investment ties: The ability to influence other countries through foreign direct

investment flows and relative dependencies. This sub-measure focuses on an economy's relative importance as a source and destination of foreign investment for other countries, based on ten-year cumulative flows of foreign capital investment.
- Economic diplomacy: The use of economic instruments to pursue collaborative interests and beneficial geopolitical outcomes. This sub-measure tracks economic diplomacy through free trade agreements and outward foreign assistance flows.

***Defence networks*:** Defence partnerships that act as force multipliers of autonomous military capability; measured through assessments of alliances, non-allied partnerships and arms transfers.

- Regional alliance network: Number, depth and combined strength of defence alliances in the region. This is measured in terms of codified security guarantees, military personnel deployed in Index countries, joint military training exercises, arms procurements from allied partners and combined operation years with allies.
- Regional non-allied partners: Diversity and depth of non-allied defence partnerships in the region. This sub-measure assesses defence consultation pacts, foreign deployments between non-allied defence partners, joint military training exercises, combined operation years and arms procurements from non-allied countries.
- Global arms transfers: Arms trade patterns indicative of global security partnerships and competitive defence industries, measured in terms of annual arms trade flows and number of arms export recipients over a five-year period.

***Cultural influence*:** The ability to shape international public opinion through cultural appeal and interaction; measured in terms of cultural projection, information flows and people exchanges.

- Cultural projection: Cultural influences and exports that help to enhance a country's reputation abroad. This sub-measure looks at online search trends in the region, exports of cultural services, global brands, and the international status of a country's passports, cities and heritage sites.
- Information flows: The regional appeal of a country's media outlets and universities. This sub-measure looks at the online search trends in the region for selected national news agencies, newspapers, television and radio broadcasters, as well as the number of inbound international students from the region enrolled in tertiary education.
- People exchanges: The depth and influence of a country's people-to-people links in the region. This sub-measure tracks the size of regional diasporas, and the attractiveness of countries as travel and emigration destinations.

Resources and influence

The eight measures of the Index fall into two broad dimensions:

Resources measures: The first four measures of the Index – *economic resources*, *military capability*, *resilience*, and *future resources* – provide assessments of a country's material capabilities and robustness, which are requisite factors in the exercise of power.

Influence measures: The last four measures of the Index – *diplomatic influence*, *economic relationships*, *defence networks*, and *cultural influence* – assess a country's active levels of influence primarily in other Index countries, lending the Index its Asian focus.

The Power Gap

Countries can be overperformers or underperformers in Asia relative to resources, irrespective of where they place in the rankings for overall power. The Power Gap measures the difference between a country's overall power and what its power might be expected to be given its available resources. The difference between actual and predicted power scores effectively reveals how well each country converts its resources into influence in Asia.

Overall power represents a weighted average of a country's performance across the resource and influence measures. We use the same weighting structure to determine expected power scores; however, we substitute aggregate influence scores with predicted aggregate influence scores. The model used to determine predicted influence is an ordinary least squares regression, where our observations are the countries included in the Index. The regression line represents the relationship between the 25 Index countries' aggregate resources and their aggregate influence scores.

Our analysis assumes that the variance between predicted and actual aggregate influence scores is a reliable proxy for every country's ability to leverage its resources into influence in Asia. Countries with outsized influence relative to their resources have a positive Power Gap score. Conversely, countries that exert undersized influence relative to their share of resources register a negative Power Gap score.

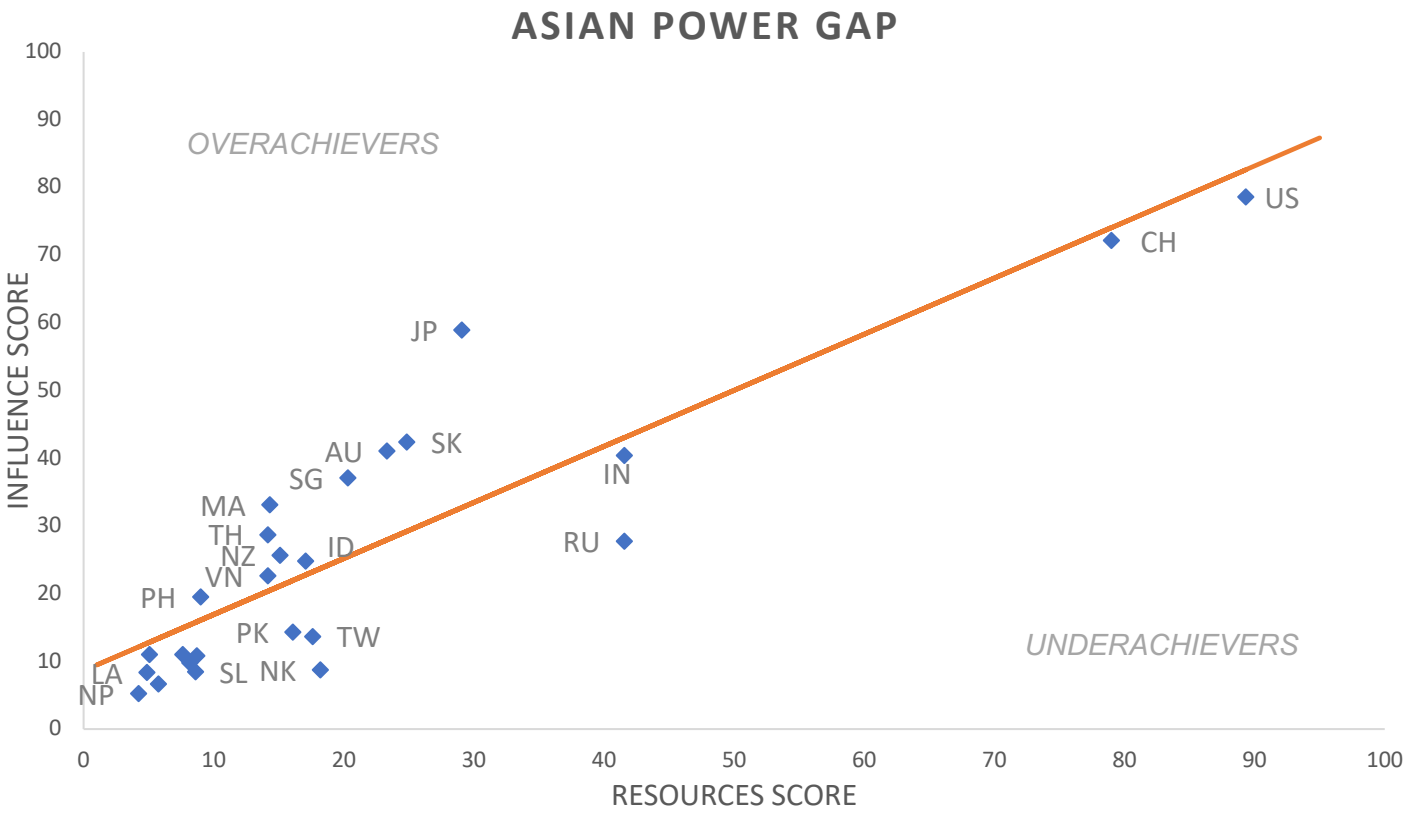

Figure 3: Power Gap across 25 countries

Countries situated above the regression line have outsized influence relative to their resources. Overachievers can be assumed to make more efficient use of their limited resources to wield broad-based influence in the region, for example through their alliances and diplomatic networks. They may also register a net positive Power Gap if their aggregate influence is high relative to a declining relative share of resources.

Conversely, countries that fall below the regression line exert undersized influence relative to their share of resources. Underachievers can have less influence than expected in the region due to their position on the geographical periphery of Asia. Or they may be geopolitical outsiders whose power is expressed through a singular strength in *military capability* but is otherwise hampered by diplomatic and economic isolation. They may also be emerging countries with unrealised potential to exert influence due to internal institutional and political factors.

Repeating the Power Gap model with every annual Lowy Institute Asia Power Index will allow for a more detailed longitudinal study of possible factors contributing to the Power Gap in Asia.

Methodology updates in 2019

The 2019 Asia Power Index marks the second iteration of the Lowy Institute's Index, bringing with it an expanded methodology and a range of new interactive features on the digital platform. The 2019 edition includes three new sub-measures: energy security and nuclear deterrence in the *resilience* measure, and broad resources 2030 in the *future resources* measure. The updated Index also includes 13 new indicators, ranging from renewable energy generation and refined fuel security, to UN voting alignment and qualitative assessments of strategic ambition. To ensure year-on-year comparability, the 2018 data from the original edition of the Index has been run through the updated model and the results updated accordingly. This allows the Index to track trends over time, using the updated methodology across all editions.

Notes on trends

With a second year of data collected, the Asia Power Index is able to begin tracking year-on-year changes to country results. In the 2019 edition of the Index, country performances are assessed in two ways: by rank changes and by score trends. Rank changes occur when one country overtakes another in the overall power, measure or sub-measure rankings. Changes to a country's ranking are considered significant in all cases when it comes to analysing results. Due to the distribution of results, ranking changes are more likely to occur for countries that rank relatively low in the Index. This is because the distance to the next country's score tends to be small, compared to countries sitting near the top of the rankings, where power differentials between countries tend to be greater. Countries may also register a score trend, which indicates whether a country's score has improved, worsened or remained stable between last year's results and the latest figures. A country can experience a rise or drop in its score without registering a change in its

ranking. Likewise, a country's rank can change even without movement in its score if the countries ranked above or below experience a change in their performance. Ultimately this reflects that power is measured in relative terms, where a country's results depend on both its own performance but also the performances of its peers.

II. DATA TREATMENT

Indicator Selection

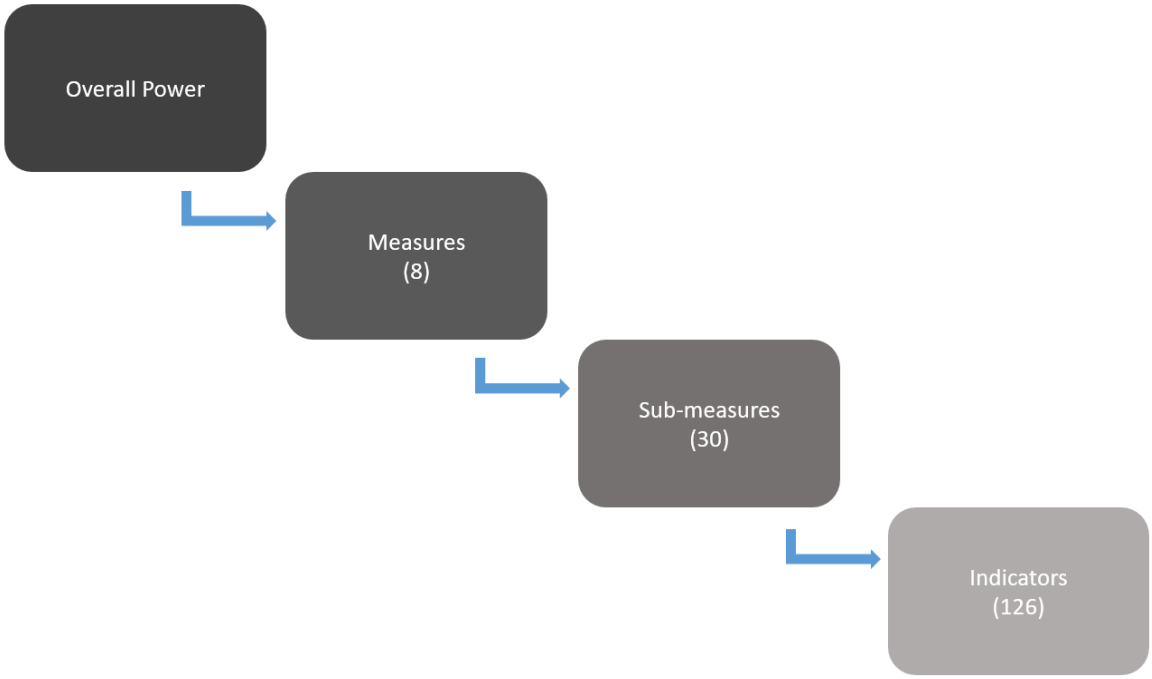

Figure 4: Hierarchy of measures, sub-measures, and indicators

Indices work by modelling wider trends using selected indicators as proxies. With 126 indicators to assess power in 25 countries, the robustness of the Asia Power Index lies in the depth and breadth of the variables considered.

A broad range of possible indicators for the Index were identified and subsequently narrowed down over a 12-month period through an extensive literature review as well as consultations with experts in the different thematic fields covered by the Index.

In addition to thematic factors, various practical factors were considered when making the final selection of indicators: (1) the indicator's suitability as a proxy for a wider basket of variables; (2) the availability of data across the 25 Index countries and territories; and (3) the year of publication of the data. For the four influence measures, we also looked at the degree to which indicators captured data specific to the Index region and can therefore be considered more directly relevant to measuring influence in Asia.

Data was drawn from original Lowy Institute research and hundreds of publicly available sources. A full list of indicators and their sources is included at the end of the 2019 Asia Power Index Pocket Book.

Normalisation

The methodological framework of the Index is informed by the OECD's Handbook on Constructing Composite Indicators. A distance-to-frontier approach is used to compare a country's results with the best-performing and worst-performing countries in each dataset. The distance-to-frontier method allows for different indicators to be made comparable across a diverse set of metrics, while preserving the relative distance among the original data values. The method also reflects the notion that power in international relations is relative, measured as a comparative advantage in a given frame of reference.

Normalisation is used at indicator level, and again at sub-measure level, to ensure cross-comparability of the composite scores across the Index. The weighted averages of the sub-measure scores are used to determine the scores for the measures and overall power.

Temporal coverage

The Asia Power Index seeks to present, as much as is statistically possible, a snapshot of power in Asia as it is constituted today. In calculating the Index scores, we use the most recent data available for each indicator and country. This allows the Index to reflect the best information that is available at the time we calculate the rankings and, therefore, to provide the most recent estimate of power in Asia.

For the 2019 Asia Power Index, 99% of data points relate to the year 2016 and onwards. The majority of the Index's data – 51% – relates to the years 2018 and 2019, while 35% relates to the year 2017. Less than 1% of the data relates to 2015 and prior. *Figure 5* shows the temporal coverage of the data collected, illustrating the distribution of the Index's data across different years.

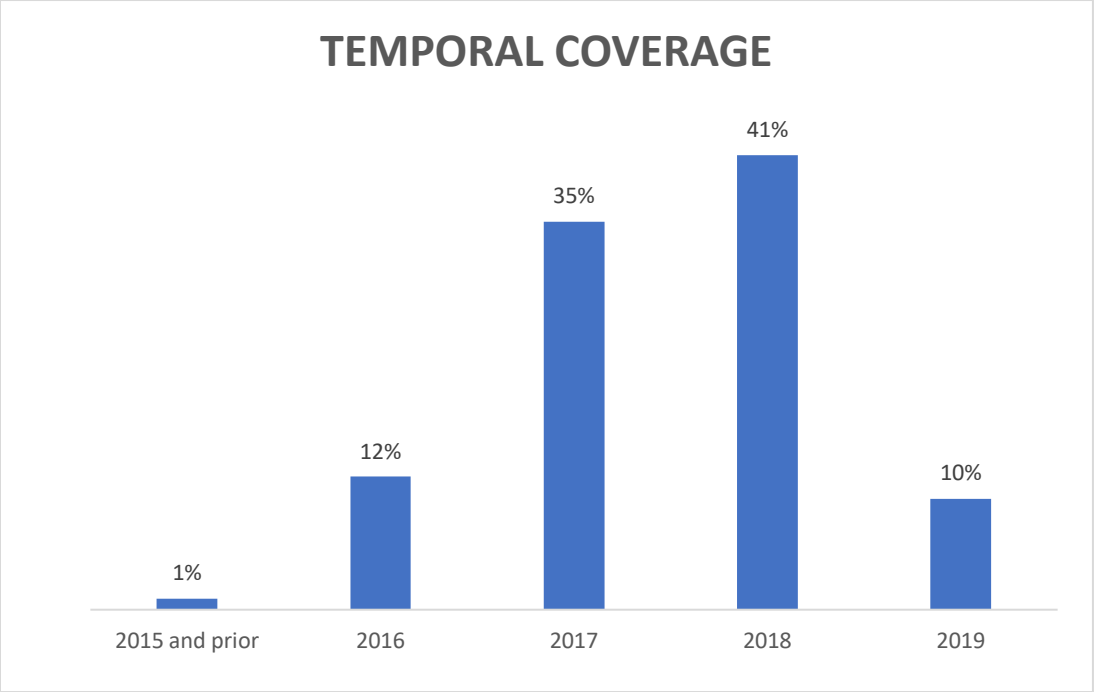

Figure 5: Temporal distribution of Index data

Qualitative data

The vast majority of the Index comprises of quantitative indicators. However, in a small number of cases, qualitative assessments were used to either address a dearth of hard data or nuance quantitative 'rack and stack' indicators. Of 126 indicators, 13 consist entirely of expert-based input. These are used to support assessments of *military capability* and *diplomatic influence*. The Index team identified a geographically balanced group of academics, analysts, and former policymakers and asked them to complete standardised surveys. A total of 18 experts helped provide input for *military capability* qualitative indicators – with a minimum of 4 experts per country – and 39 experts provided input for the *diplomatic influence* indicators, with at least 9 experts per country. A three-point scale, as demonstrated below, was used to avoid the risk of arbitrary and non-comparable qualitative input associated with larger multiple-choice scales. The average of all respondent answers was normalised in the same way as quantitative indicators.

Sample question

Training, readiness and sustainment

Are armed forces optimally trained and prepared for sustained operations in the event of an interstate conflict?

A. Yes, they are optimally trained and prepared for sustained operations in the event of conflict.
B. Armed forces are somewhat trained and prepared for conflict, but not for sustained operations.
C. No, they are insufficiently trained and prepared, and incapable of sustained operations.

Missing data imputations

As with any index covering a range of countries and indicators, there will inevitably be gaps in the data. Data imputations are used where a dataset does not cover all 25 countries of the Index. Across the Index, less than 2% of data points are imputations.

Three imputation techniques are used where particular countries have missing data points in the Lowy Institute Asia Power Index.

First, where one source does not cover all 25 countries, alternative sources are used. For example, the Taiwan Statistical Data Book by the National Development Council was used where data for Taiwan was not separately reported in major international databases. This may result in small methodological discrepancies in the way data points are reported by different sources. Caution is exercised to ensure the description of the imputed data closely matches the other data. As the preferred method, this type of imputation is used the most – 27 data points, or less than 1% of the Index's data, rely on an alternative source.

The second form of imputation relies on identifying a highly statistically correlated alternative variable, for which there is data, and matching it to the indicator which is missing data. For example, the sophistication of North Korea's export portfolio was estimated on the basis of the number of products in its export portfolio – a highly correlated variable – in the export structure of most countries. This method is used for 10 data points, or less than 0.32% of the Index's total data.

The third form of imputation used for missing country data points relies on expert-based input. In small number of cases, we imputed a value of zero where the data point for a particular country is assessed by an expert as being nil or negligible. In other cases, such as estimating North Korea's R & D spending as a percentage of GDP, three country experts were asked to choose from three plausible statistical scenarios, or come up with an estimate of their own. The values were then averaged and rounded to the nearest thousand to obtain the imputed value. As the most speculative method, this type of imputation was only used six times, equivalent to 0.2% of the data, and is clearly labelled as a notional estimate on the digital platform.

Review – three stages

The model underwent three stages of review. First, the analytical assumptions and findings were submitted to an extensive peer-review process. Second, a team of fact-checkers verified that the raw data points and their normalised scores were factually correct, and drew on the latest available data at a given point. Third, PwC provided a limited integrity review of the spreadsheets and formulas used to calculate the eight measures of the Index.

Measure	Mean	Standard Deviation	Min	Max
Overall power	**23.74**	**20.25**	**4.69**	**84.52**
Economic resources	15.56	24.66	0.29	93.00
Military capability	23.07	22.53	0.65	94.71
Resilience	36.39	18.60	14.19	85.31
Future resources	14.33	22.91	0.45	85.63
Diplomatic influence	44.61	24.25	12.80	96.23
Economic relationships	19.04	22.95	0.00	97.51
Defence networks	23.89	20.85	1.77	86.02
Cultural influence	21.97	20.84	1.49	86.66

Figure 6: Summary statistics of the 2019 Lowy Institute Asia Power Index

III. WEIGHTINGS

The Lowy Institute has assigned a set of weightings to the measures, sub-measures, and indicators that reflect its analysis of which components of power are most important. The weightings for the measures are outlined in *Figure 7* and those for sub-measures are shown in *Figure 8*. The weightings are value judgements that have an effect on the overall country rankings. They reflect our analytical assumptions which are situated within the range of consensus available in the academic literature and among experts in the fields covered by the Index.

Power is often expressed as a situational advantage, so the importance of each measure will vary depending on context. To the extent possible, our weightings take account of the dimensions of power considered most advantageous given the current geopolitical landscape of the region.

The Lowy Institute's weightings are only one of many possible approaches that are justifiable on different grounds. An innovative calculator on the digital platform of the Index enables users to adjust the measure and sub-measure weightings. The weightings calculator allows users to decide which aspects of power they consider most important and reorders the rankings on that basis.

While seemingly more objective, we do not equally weight our measures and sub-measures: first, because we include a wide variety of different indicators, in line with our multidimensional view of power; and second, because some variables are more important than others for the exercise and projection of power. Equal weighting is justifiable when an index covers a limited set of indicators; in such cases an argument that variables are of equal importance can be made. However, for an Index as conceptually wide-ranging as the Asia Power Index it makes little sense.

The sensitivity analysis at the end of this section shows that our approach to weighting has minimal effect on countries' overall power rankings and our findings. This is because the large number of indicators, and the variation across countries within any given indicator, are quantitatively more important than our weighting scheme.

Rationale

	Measures	%
Resources (55%)	Economic resources	17.5
	Military capability	17.5
	Resilience	10
	Future resources	10
Influence (45%)	Diplomatic influence	10
	Economic relationships	15
	Defence networks	10
	Cultural influence	10

Figure 7: Weightings of measures

Economic power is the sum of a country's *economic resources* and its *economic relationships*, which combined amount to 32.5% of the Index. This recognises the utility of economic capabilities in their own right and the role of *economic relationships* as one of the principal conduits of influence in the region.

Similarly, military power represents a combination of resources and influence, assessed in terms of autonomous military strength, weighted at 17.5%, and the extent and depth of a state's *defence networks*, weighted at 10%. Together these manifestations of hard power constitute 27.5% of the Index. Their use, or threatened use, are crucial considerations in decision-making in times of war and peace.

Resilience – the ability to withstand real or potential threats to state stability – is assigned a 10% weighting as a prerequisite for durable international power. The absence of *resilience* hampers the ability of countries to conduct an effective and independent foreign policy and can make them much more vulnerable to outside influence. Similarly, *future resources*, premised on projecting current trends into the future, is weighted at 10% to reflect its hypothetical nature.

The remaining two measures, *diplomatic influence* and *cultural influence*, together account for 20% of the Index. It is worth noting that *defence networks* and *economic relationships* have been accorded their own measures as distinct categories of diplomatic activity. The number of sub-measures in each measure is approximately equal to the overall value of the measures to which they belong.

Measures		Sub-measures	%
Resources	Economic resources	Size	40
		International leverage	20
		Technology	20
		Connectivity	20
	Military capability	Defence spending	20
		Armed forces	20
		Weapons and platforms	25
		Signature capabilities	25
		Asian military posture	10
	Resilience	Institutional stability	17.5
		Resources security	17.5
		Geoeconomic security	17.5
		Geopolitical security	17.5
		Nuclear deterrence	30
	Future resources	Economic resources 2030	25
		Defence resources 2030	25
		Broad resources 2030	30
		Demographic resources 2045	20

Influence	Diplomatic influence	Diplomatic network	33
		Multilateral power	33
		Foreign policy	33
	Economic relationships	Regional trade relations	35
		Regional investment ties	35
		Economic diplomacy	30
	Defence networks	Regional alliance network	40
		Regional non-allied partners	40
		Global arms transfers	20
	Cultural influence	Cultural projection	40
		Information flows	30
		People exchanges	30

Figure 8: Weightings of measures and sub-measures

Weightings at the indicator level

At the indicator level, we use discrete weighting options. More than two-thirds of the indicators are assigned their default weighting (x1), meaning they are weighted equally within their respective sub-measures. For a minority of indicators, we have adjusted weights downwards or upwards in three categories: x0.5, x1.5, and x2. This means all indicators used in the calculation of the Index fall between half and double their default weighting.[1] An indicator with a weight of x2 is twice as significant in affecting the result of the sub-measure as an indicator with a weight of x1.

Adjusted weights for the indicators were determined by four factors: (1) the particular relevance of a variable according to the literature and our own analysis; (2) whether the data is quantitative or qualitative, with qualitative indicators relying on conjecture weighted less than quantitative data; (3) the degree to which the indicator captures data specific to the Index region and can therefore be considered more directly relevant to measuring power in Asia; and (4) in cases where indicators offer closely related or overlapping but not identical information on the same issue.

[1] In one case, we assigned x.25 weights as a result of breaking down a single composite qualitative variable into its component parts. Our organisation indicator under the armed forces sub-measure is weighted x0.5. It is based on expert assessments of (a) combat experience, and (b) command and control structures – both relevant to the ability of armed forces to function in a well-organised manner in the event of an interstate conflict. Rather than present a single score, we broke the indicator down into its two sub-components for display purposes. Separately, there are three illustrative indicators in the *future resources* measure with weightings displayed as x0 on the website. These indicators – consisting of baseline years – exist only for comparative purposes with the 2030 and 2045 projections. They are not used for calculating the Index scores and are not included in the overall tally of 126 indicators.

The fourth factor is the most common reason behind assigning half the default weighting (x0.5) for particular indicators. For example, in the institutional stability sub-measure, internal conflict years and high-intensity internal conflict years (more than 1,000 battle-related deaths annually) are both proxies for underlying institutional fragility factors. They offer different assessments, yet are correlated with each other. We address this collinearity by assigning them jointly the weight of a single indicator. This allows us to keep both indicators in the sub-measure, retaining the unique information they give while alleviating double-counting issues.

A full breakdown of the weightings assigned at indicator level is included at the end of the 2019 Asia Power Index Pocket Book.

Sensitivity analysis

In this section, we illustrate that our weighting approach has little effect on countries' overall power rankings based on the 2018 edition of the Asia Power Index. This is because the large number of variables, and the variation across countries within the same variable, are quantitatively more important than our weighting scheme.

We tested the impact of the Index's scores and rankings by comparing our weighting approach with equally weighting variables, first at measure and sub-measure levels, and then at all levels. We also look at how the Index's single most important indicator affects the overall power scores and rankings by replacing GDP at purchasing power parity (PPP) with GDP at market exchange rates in the *economic resources* measure.

Equal weightings at measure and sub-measure levels

Figure 9 plots, on the vertical axis, countries' overall power rankings derived by equally weighting the measures and sub-measures. The overall power rankings using the Lowy Institute weighting approach are represented on the horizontal axis. While there are some minor changes to rankings, the overall correlation in the two approaches is strong. Equally weighting the measures and sub-measures sees many countries experience minor changes in their overall power score (ranging from a minimum of -2.9 to a maximum of 4.9 points). How these changes impact the rankings varies. Changes in the middle part of the ranking distribution are expected because it is more densely populated by countries of similar scores, resulting in a greater sensitivity to weights. However, only three countries – New Zealand (+2), North Korea (+2), and Russia (-2) – report an absolute change greater than one place in their overall power ranking.

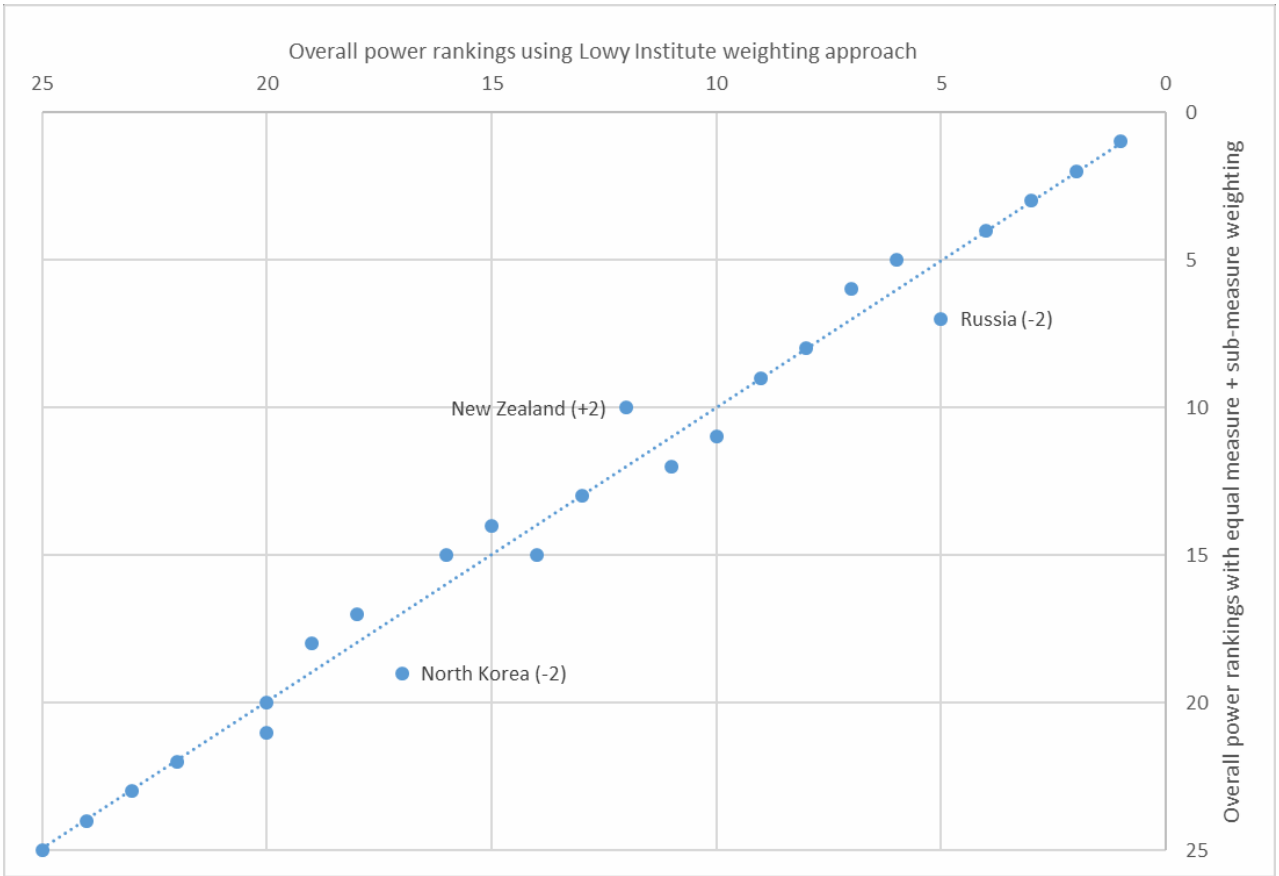

Figure 9: Comparison of equal weightings at measure and sub-measure levels and Lowy Institute weightings (2018 Asia Power Index)

Equal weightings at all levels of the Index

Figure 10 reports the variations in rankings comparing, on the vertical axis, countries' overall power rankings derived by applying the default weights to all variables in the Index, down to the indicator level. Overall power rankings using the Lowy Institute weighting approach are shown on the horizontal axis. Again we observe that higher levels of uncertainty are concentrated in the middle part of the distribution of rankings. The most volatile countries in the rankings – reporting a change in ranking by more than one place – are New Zealand (+3), Brunei (+2), Mongolia (+2), North Korea (-2) and Russia (-2). While we observe changes in the rankings, the overall correlation in the two approaches remains very strong.

What *Figures 9* and *10* demonstrate is that the overall power rankings of the Lowy Institute Asia Power Index are overwhelmingly affected by variations in the variables themselves, with weights attached to the component parts of the Index playing a secondary role in determining the final results.

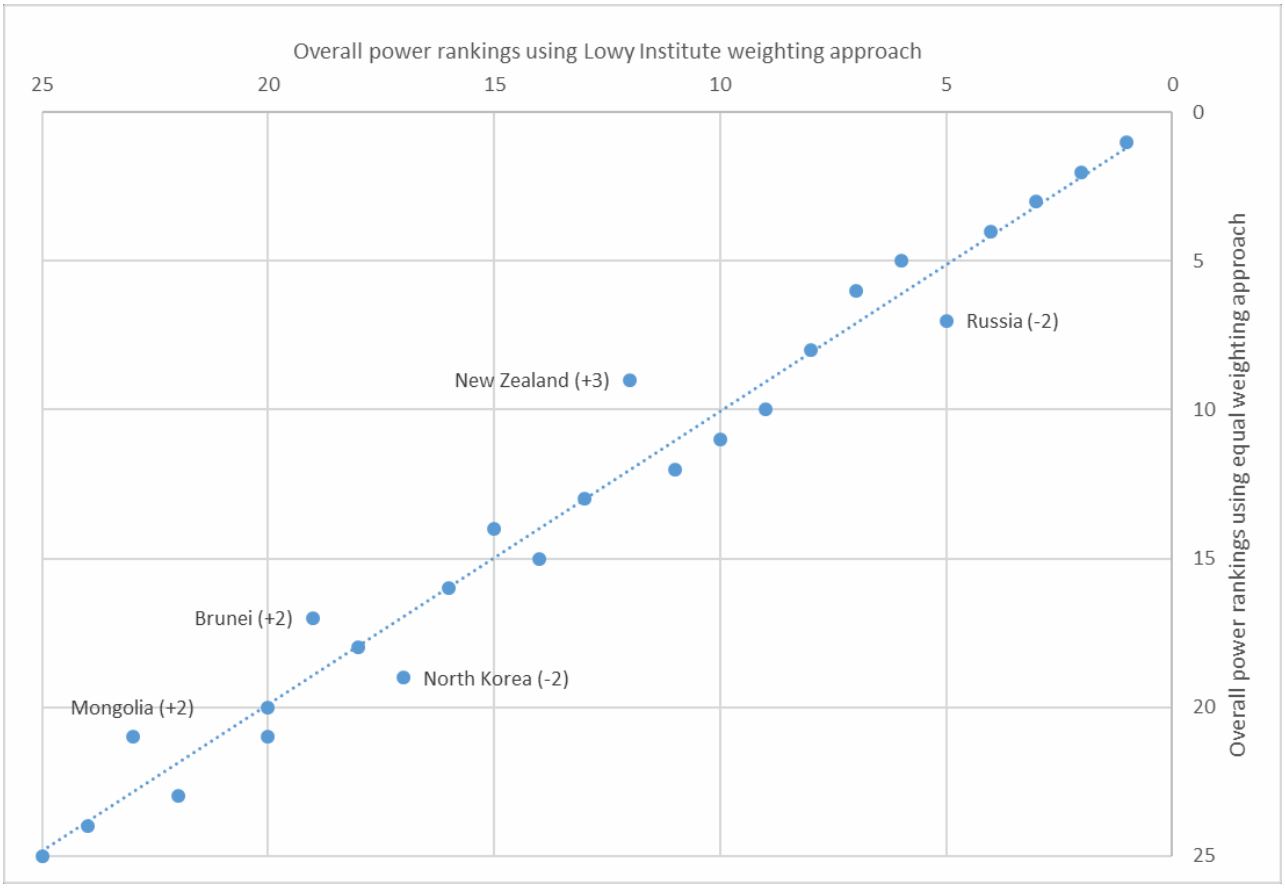

Figure 10: Comparison of equal weighting for all variables and Lowy Institute weighting (2018 Asia Power Index)

Indicator selection: GDP at purchasing power parity (PPP) vs market exchange rates

Our final sensitivity analysis looks at the effect on the overall power rankings if we replace the Index's single most important indicator with an alternative means of measuring GDP.

The Index opts for reporting GDP at purchasing power parity (PPP) exchange rates to allow for a reliable comparison of real levels of production between countries. However, an alternative means of measuring the value of all final goods and services produced within an economy is at prevailing US-dollar market exchange rates (MER). Determining which rate, PPP or MER, is most reliable for comparative purposes is the subject of debate and depends also on the specific aim of the comparison. The two approaches come up with different results for which countries have the largest economies in the region because the former controls for variations in currency exchange rates. The Asia Power Index reports many other monetary indicators – including investment and trade flows as well as arms transfers – in US dollars using current market exchange rates as a means of assessing a country's presence and purchasing power in international markets. In doing so, we believe that we have struck an appropriate and defensible balance taking stock of the merits of both approaches.

However, owing to the relative importance of economic size for the Index, in *Figure 11* we test the impact of the Index's scores and rankings by replacing GDP PPP as an indicator with GDP MER in the *economic resources* measure. The vertical axis plots countries' overall power rankings using GDP MER, while the horizontal axis represents the official overall power rankings using GDP PPP.

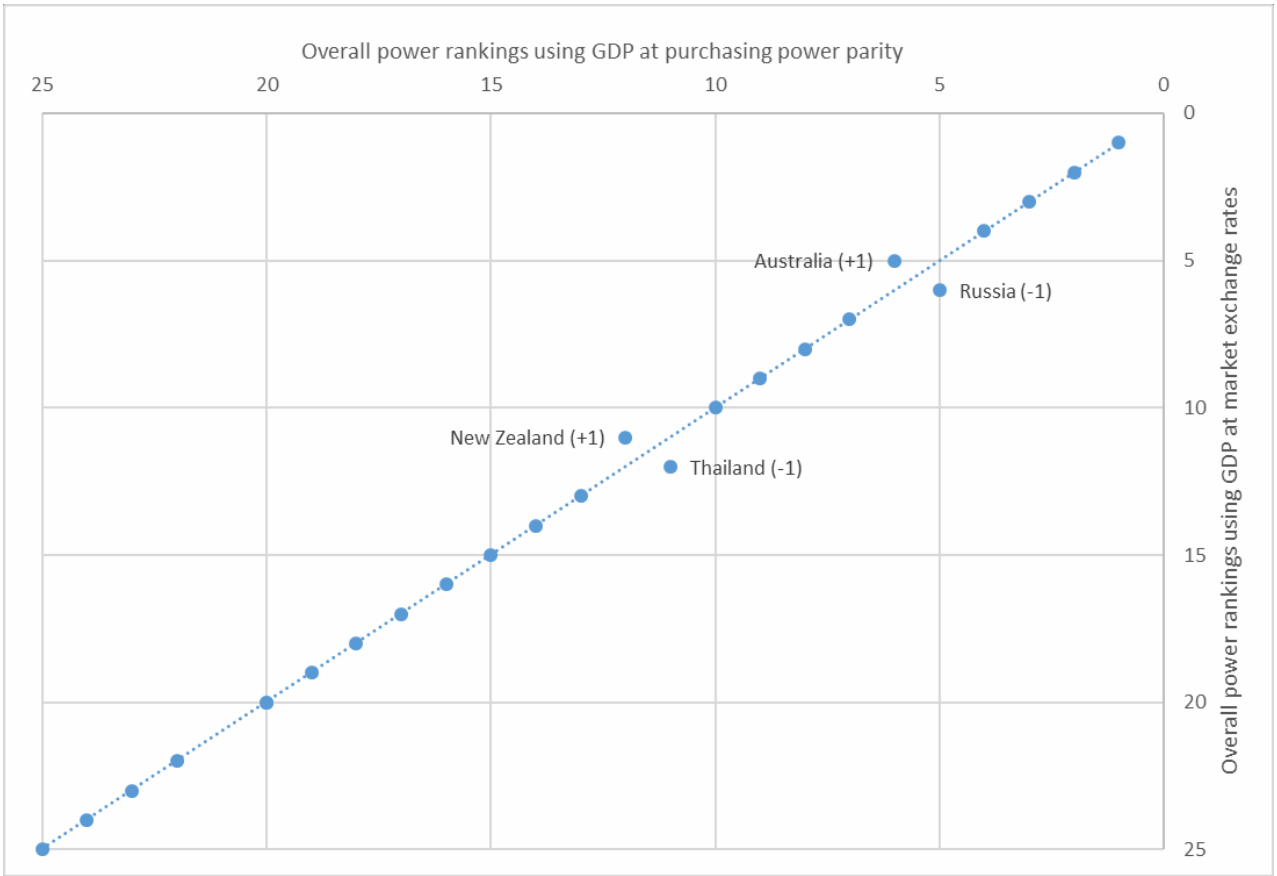

Figure 11: Comparison of overall power rankings using GDP at purchasing power parity (PPP) and at market exchange rates (2018 Asia Power Index)

We observe that the choice of GDP PPP or GDP MER for the Index's single most important indicator does little to affect the overall power scores and rankings. Using GDP at market exchange rates sees many countries experience minor changes in their overall power score (averaging at a minimally perceptible -0.3 points, and ranging from a minimum of -3.8 to a maximum of 1.5 points). Only four countries in the Index register a change in overall ranking, with Australia overtaking Russia and New Zealand overtaking Thailand.

This third sensitivity analysis proves that the Index's large number of indicators, and the average variation across countries within them, are quantitatively more important than our choice of GDP measure.