SOVEREIGN RISK MANAGEMENT: A RATIONALIST EXPLANATION OF PUTIN'S AND TRUMP'S RISK TAKING BEHAVIOR AND ITS CONSEQUENCES

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Abstract

It goes without saying that nowadays corporate leaders should perform their activity within the concept of sustainable development. The United Nations detail on their homepage (sustainabledevelopment.un.org) what this means. But corporate leaders sometimes face headwind from their governments. Therefore it is important to understand the reasons for such governmental decision making. Two prominent cases are the presidents of the USA and Russia.
Firstly, two seemingly unrelated topics of Russian politics are investigated. It is shown that under expected utility maximization the assumptions of an unbiased oil forward market and a risk-acceptant attitude (strictly convex utility function) of president Putin are sufficient to explain Russia's open position in oil and the bailout of Rosneft. Secondly, actions of president Trump are considered. Again, a risk-acceptant attitude is able to explain his campaign and to conform with his statements. Thirdly, international negotiations over Ukraine between two risk-acceptant presidents are considered. It is proven that the chances for a negotiated settlement have shrunken with the election of Trump and might now even be nil. Fourthly, a tentative outlook on international economics (trade war), finance (regulation) and politics (climate action) is performed.

Keywords: Putin, Trump, Sovereign Risk Management, Conflict in Ukraine, Trade War, Climate Action

1. INTRODUCTION

It goes without saying that nowadays corporate leaders should perform their activity within the concept of sustainable development. But corporate leaders sometimes face headwind from their governments. Therefore it is important to understand the reasons for such governmental decision making. To provide focus we look at risk-taking decisions. It will turn out that climate action can be subsumed thereunder.

Corporate risk-taking is an evergreen topic in the finance literature[1] and leads to an interest in top management's risk attitudes. In contrast there is little research on sovereign risk management[2]. We contribute to this field by looking at two prominent cases. We look at past decisions of president Putin and Trump and model the involved risk attitudes. Thus, we try a rationalist explanation[3] of past behavior in order to forecast future developments in international economics, finance and politics. We start with the case of Russia and repeat some already published results for the reader's convenience[4]. The material on Trump is new and relates to the mentioned results.

Beside the literature quoted there is no comparable material so far. Our approach is to highlight past risk-taking decisions and to look for a risk-attitude, which can explain these. We do so for presidents Putin and Trump and use the formal apparatus of expected utility theory. This allows us to prove some propositions. Thus equipped we dare to look into the future.

[1] For a recent example see Bernile, Bhagwat, and Raghavendra (2017).
[2] For an overview see Dana and Sadler (2012).
[3] The model follows the approach by Fearon (1995).
[4] See Lehrbass and Weinhold (2016).

2. RUSSIA'S RISK TAKING

Firstly, we will investigate the Russian decision not to hedge its well-known oil price exposure by making use of expected utility theory. Secondly, Russia's bailout of Rosneft is subsumed under this model.

2.1. Russia's oil price risk management

Whereas the application of expected utility theory to hedging decisions has a long tradition[5], the application to international affairs is more recent and was initiated by De Mesquita (1980). We take two of his original assumptions and apply them to the case of Russian decision making. These decisions can be viewed (a) as if they are the product of a single, all important decision maker [i.e. the leader]; (b) decision makers are rational expected utility maximizers.

In case of Russia both assumptions can be defended.

On (a):

According to Russia's chief propagandist even a decision about the use of nuclear arms "will be taken personally by Mr Putin" (Economist, 2015). Nevertheless Putin has to cope with certain limitations on his power. It is for instance well-known that he cannot afford to lose support of the oligarchs. In fact certain oligarchs were key in furthering his career. But as long as these few people are not impacted too much, there is a significant degree of freedom to decide. This is captured by the above assumption.

Clearly the Russian state takes numerous major actions every year. It is out of scope of this article to investigate all of them. But the topics under consideration rank among the most important ones and can be linked to the Russian president. Since one of Putin's buddies from St. Petersburg by the name of Igor Setschin heads Rosneft[6], we may assume that Putin knows about the positioning in oil and is interested in the fate of Rosneft personally.

On (b):

There are two Nobel Prize awarded theories of decision making under uncertainty: Expected Utility Maximization (EUM) and Prospect Theory (PT)[7]. There are many reasons why we prefer the first theory.

Firstly, Kahneman notes that prospect theory is a simple decision-theoretic theory that does not apply to international relations[8].

Secondly, the axioms underlying EUM are more convincing to us than those of PT. Take for example the handling of probabilities. Denote the chances to win a war by deploying army 1 by P1 and for using army 2 by P2. For exposition assume that P1 > P2. Under EUM it is an elementary rule (axiom) that army 1 would be preferred to army 2 by the decision maker. Given few other axioms the authors of EUM have shown that there exists a utility function and that finding the optimal decision (e.g. army) is equivalent to EUM, i.e. picking the one which yields highest expected utility. In the calculation of expected utility the probabilities would be taken as such, e.g. as calculated by intelligence functions. In contrast, PT applies a "weighing function" to the probabilities, which transforms the given probabilities for the calculation of the value of a prospect. This function serves to capture the misunderstandings of people when coping with uncertainty. We do not see a reason why the Russian leader should not take these probabilities as such, but weigh them. Doing the latter would be irrational. More specifically Von Neumann and Morgenstern proved that any weighing, which is not proportional to the given probabilities leads to inconsistencies in decision making[9].

Thirdly, while one could apply PT without weighing, the reference point is a crucial concept of PT which cannot be done without. The problem with the reference point is its arbitrariness. For instance, it is not clear whether a hedged or unhedged position in oil should be chosen as reference point of the Russian leader. As the choice of the reference point regularly impacts the results of PT, its arbitrariness is seen as a detriment.

Fourthly, EUM is today one of the most important theories in the social sciences. Most important EUM serves as a tool to prescribe how decisions should be made – given elementary rules of rationality (such as the above ranking of armies). The scientific journals are filled with applications of EUM to derive optimal decisions (on production, hedging, etc.).

Fifthly, the rationality of the Russian president should be out of question in the light of his education as a KGB officer. On top it cannot be ruled out that the conflict in Ukraine is no accident but part of a grand strategy[10].

Furthermore let us assume as in De Mesquita (1980) that the "leader's welfare" is the argument of the utility function u (.) to be maximized. Since future oil prices are uncertain, the leader maximizes expected utility. The leader's welfare is certainly a function of governmental tax income, which again is a function of the revenues from selling oil[11].

To avoid misunderstandings we do not assume that the leader is a steward for the general welfare of his citizenry[12]. Our approach is in alignment with a recent, more detailed analysis of Russian foreign policy, which highlights Putin's attempts to avoid becoming a third rank state. Governmental tax income is a means to buy more and better equipment for Russian troops, which thereby can be ignored less easily[13].

To keep things simple we denote the amount of the sovereign's oil production by x in units of barrels (bbl) and the uncertain oil price by p in units of US-Dollar ($). The leader maximizes the following expected value over a certain time horizon:

$$E[u(xp)] \tag{1}$$

E [.] denotes the expectation operator using the subjective probability distribution as seen by the

[5] One of the early publications is Ethier (1973).
[6] Rosneft is the biggest publicly listed oil company in the world.
[7] Expected Utility Maximization was founded by von Neumann and Morgenstern (1944) and Prospect Theory by Kahneman and Tversky (1979).
[8] This was pointed out to the author by de Mesquita. We are grateful for this hint.
[9] See the hint in Kahneman (2011) on page 312.
[10] See the so-called "Ukraine Plan" as leaked by Novaya Gazeta (Grozev, 2015).
[11] To keep things simple we do not make the tax function explicit.
[12] This perspective should not come as a major surprise. We hint at the article by Mironov (2013) and the book by Dawisha (2014).
[13] The detailed analysis is by Monaghan (2008).

leader. For exposition we assume a horizon of one year, which makes x the annual oil production.

As a representative of the hedging instruments available we introduce a one-year futures contract, which can be bought or sold at today's known futures price level of f in units of $/bbl – for instance at the Intercontinental Exchange (ICE).

The leader certainly does not have a 'crystal ball' to foresee future oil prices. Many studies have investigated whether oil-futures prices can be treated as expected spot oil prices and have reached a positive conclusion[14].

Hence, we assume that the futures price f is an unbiased estimator of the future oil price p, i.e.:

$$f = E[p] \quad (2)$$

The last bit of notation is the decision variable h, which is the amount of barrels sold forward at the current futures price f. For instance, if the leader chose to hedge fully, we would have $x = h$.

What is effectively chosen is the outcome of the following decision problem of the leader:

$$\max_h E[u(xp + h(f - p))] \quad (3)$$

The only difference to equation (1) is the addition of the profit or loss term from hedging with futures. This simple model implies a proposition for the leader.

Proposition 1

(i) The leader will hedge fully if he is risk-averse.
(ii) If he is risk-seeking a full hedge is the worst decision. Hence, he will leave the oil exposure unhedged.
(iii) If he is risk-neutral it does not matter whether a hedge is in place.

For proof see appendix.

Thus, the non-hedging of the Russian oil exposure could be explained by either a risk-neutral or risk-acceptant attitude of the leader. But before we can apply this proposition we have to defend its unbiasedness assumption as expressed in equation (2).

In theory this assumption could be checked by asking the Russian leader for his oil price expectations and comparing them to the current oil forward price curve. It is clear that this is out of question. As an available approximation we look at the expectations, which were expressed by the Bank of Russia governor[15]. Firstly, the expected levels were close to the then current futures quotes. Secondly, leading analysts are quoted by the governor. It is common practice that – where available as liquidly traded instruments - forward prices are taken as best estimates for future spot prices – even by experts[16].

With this support for the unbiasedness assumption we can draw a conclusion from the proposition. The Russian leader either has a risk-acceptant or a risk-neutral attitude. This intermediate result is next checked against other available evidence.

2.2. Russia's bailout of Rosneft

The media[17] report that Russia's central bank is accepting corporate bonds issued by Russia's biggest oil company Rosneft as collateral from its debtors, i.e. commercial banks. Thereby the already big exposure of the Russian banking system to commodity related companies is increased. By assumption the central bank acts in alignment with the leader. So what does this bailout tell us about the risk attitude of the leader?

Certainly, this decision cannot be reconciled with a risk-averse attitude, because this would call for diversification of credit risk and not for concentration. Risk-acceptant or risk-neutral attitudes again appear as viable candidates to explain the observed behaviour.

There are media reports on the specific conditions under which the central bank is taking the bonds as collateral. It is reported that they were taken at face value[18]. The fact that the interest which investors are charging Rosneft in these bonds (i.e. the coupon) is below that of Russian sovereign debt[19] rules out a risk-neutral attitude. In other words: The expected credit loss from holding these bonds is <u>not</u> compensated by the coupon - as would be required by a risk-neutral decision maker[20].

Hence, the bailout of Rosneft can neither be explained by a risk-averse, nor a risk-neutral attitude of the Russian leader. This leaves us with the risk-acceptant attitude of the Russian leader as the best common explanation of not hedging the oil exposure and bailing out Rosneft.

3. TRUMP'S RISK TAKING

Whereas Putin is in office since 1999 Trump's inauguration has been in 2017. Hence, we may come from Russia's risk taking to Putin's risk attitudes as we have done above, but have to consider Trump's vita to get insights and cannot look at the U.S. so far.

In the case of Trump it might seem harder to defend not using PT. One reason is that Trump's victory has been explained by PT applied to his voters[21]. In a nutshell it is claimed that Trump succeeded in framing the stakes of the presidential election in terms of losses for a significant portion of the U.S. citizens. According to PT this makes these voters likely to be risk seeking.

But we do not apply PT to Trump himself and hint at the arguments already given above. For instance Trump has also been educated in a rational tradition at the Wharton School of the University of Pennsylvania. On top there is the fact that he has survived many years in business. Finally there are many recent instances where he acts in a fully rational manner. For example in February 2017

[14] For instance Alquist and Arbatli (2010) concluded that "treating oil-futures prices as the expected future spot price is a good first approximation".
[15] On 11 Dec 2014 the central bank expected "average oil prices to be $ 80 per barrel during the next three years. This average price results from consensus forecast of the leading analysts" (Nabiullina, 2014).
[16] "It is commonplace in policy institutions, including many central banks and the International Monetary Fund (IMF), to use the price of NYMEX oil futures as a proxy for the market's expectation of the spot price of crude oil" (Alquist and Kilian, 2010).
[17] One source is Kuznetsov (2014).
[18] For instance in Gallucci (2014).
[19] Stated in Guriev (2014).
[20] Implicit in this reasoning is the assumption that Rosneft has a higher probability of default than Russia. One fact backing this assumption is that Rosneft seeks help from Russia – and not the other way round.
[21] For instance see the blog by Heintz (2016) which refers to Quattrone and Tversky (1988). The explanation of Trump's victory specifically makes use of the convex part of the utility function.

Trump attempted to strengthen support for his protectionist trade policy by 'cooking the books'. It is reported that he made an effort to get the U.S. trade flows recalculated to show larger deficits[22]. But what is his risk attitude under EUM?

In his top-selling book[23] he stated that "money was never a big motivation for me, except as a way to keep score. The real excitement is playing the game". Obviously, this expresses a risk-acceptant attitude.

Let his initial wealth be w and consider a game where a fixed amount of money m has to be paid today to get the chance to receive a future random payoff *z*. Let us define the net-payoff by $y = z\text{-}m$ and ignore discounting for the sake of exposition. If the game is fairly priced we know that the first moment of the net-payoff equals zero, i.e. $E\ [y] = E\ [z\text{-}m] = 0$. Irrespective of fair pricing we have the property that $Var[y] = Var[z]$.

According to EUM the value of the game is $E[u(w+y)]$. It is well known that a utility function can be approximated by a Taylor expansion as follows, where *R* signifies higher order terms:

$$E[u(w+y)] = u(w) + u'(w)E[y] + \\ + 0.5u''(w)Var[y] + R \quad (4)$$

A game is attractive if it adds expected utility to the status quo. Since $E\ [u\ (w)] = u\ (w)$, a game is attractive if the terms following *u* (w) as a total are positive. For any risk attitude we have $u' > 0$. In the sequel we ignore the *R*-term as is often done for the sake of convenience. So the difference in risk attitudes comes from the second derivative u''.

3.1. U.S. campaign game

Still in October 2016 it was widely believed that Trump's chances of winning were close to nil[24]. Nevertheless it is reported that Trump invested USD 66 mn of his own money into the campaign. On the one hand one has to check what $E(y)$ is like. The USD 66 mn can be readily identified with the variable m. But what are the payoffs from being president of the U.S.? Firstly, there is the salary of the president which is roughly half a million USD. Multiplication with the 8 years maximum time in office yields USD 4 mn. In the U.S. there are boundaries between Trump's personal and official business, which limit the amount of additional payoffs. Back of the envelope calculations lead to the payoffs necessary to shift $E[y]$ from negative to zero figures. With a ten percent chance of winning the additional payoff has to be USD 660 mn less the salary amount. Had Trump used a fifty percent figure the amount would have shrunken to USD 132 millions? But this is still an outrageous figure for a Western democracy[25]. Although we could argue for a negative $E[y]$, we do not and merely assume $E[y] = 0$.

Hence, with a risk-neutral or risk-averse attitude Trump would not have run for president, because $u''=0$ or $u''<0$, i.e. the last term cannot compensate the term led by u'.

Since Trump ran for president, it can be deduced that the additional expected utility was positive. Since $Var[y]$ is positive, this can only be the case if $u''>0$. Hence, the expressed risk-acceptant attitude can be cast into the apparatus of EUM via assuming a strictly convex utility function.

The Taylor expansion in equation (4) helps to point out an interesting detail. With a 50% chance of winning the variance is at its maximum (i.e. $Var[y]$ is highest). It might be sensible to assume that Trump had used a 50% of winning for his own calculations. Thus a lower payoff is needed, which makes the model more compatible with the existing political system, and the variance term is at its maximum, allowing more modest assumptions about the size of u''.

The above result can be generalized beyond the Taylor expansion. As is well-known from EUM a risk-acceptant individual values a game higher than its expected value. With non-positive $E[y]$ - as in the case of the campaign game - only the thrill of the game makes it attractive.

3.2. Real estate games

One of Trump's deals even made it into the Journal of Finance[26]. Not only for this deal there were negative cash-flows from the real estate. Again this renders $E[y]$ non-positive and the above argument could be repeated. But this time we have to be more cautious because it is hard to know whether the cash-flows could be expected to be negative at the time of the investment decision. Instead of diving deeper into the past we now move on to forecasting.

3.3. Conflict in Ukraine

One of Trump's first interactions with Putin concerned the conflict in Ukraine[27]. He expects Russia to return Crimea to Ukraine, which is still unacceptable for Putin. The interesting question in terms of risk management concerns the chances for military conflict.

Military conflict is inefficient because it destroys resources. Therefore, rational individuals seek to avoid military conflict. It should be noted that this is only due to reasons of efficiency and not moral principles.

Taking the approach by Fearon[28] we show that risk-acceptance can explain why it is especially challenging to find a peaceful solution for the conflict in Ukraine and why this has become worse with the election of Trump.

Let *D* be the monetary value of the region under dispute and Ci the costs of war for sovereigns *A* and *B*. The proportion of the region, which is controlled by *A*, is denoted by *Y*. Note, that this is now a capital *Y*. Sovereign *A* prefers *Y* closer to 1 (i.e. 100%). The chances to win a war (i.e. to get $Y=1$) are signified by the probability *P*. Hence, war is a Bernoulli random variable with outcomes $Y=1$ with *P* and $Y=0$ with $1\text{-}P$ from the perspective of *A*.

We take the probability *P* as given and do not try to specify a conflict success function[29].

[22] For instance imports that are simply passed through (i.e. become exports) shall be counted as plain imports. For more detail see WSJ (2017).
[23] We refer to Trump's book 'The Art of the Deal' (1987).
[24] For instance see Washington Post (2016).
[25] We refer to the income during presidency. In the sequel an ex-president might be able to earn much more money as the case of Obama shows.
[26] It was the Taj Mahal Casino. This was not the only case where Donald Trump had to struggle with his creditors (Miller, 1991).
[27] See for instance Reuters (2017).
[28] As laid out in Fearon (1995).
[29] A conflict success function (Hirshleifer, 1995, also Garfinkel and Skaperdas, 2007) specifies how military resources of one party translate into

In the case of risk-neutrality sovereign A calculates its expected value of war as:

$$E[YD - C_A] = PD - C_A \quad (5)$$

From B's perspective the expected value is:

$$E[(1-Y)D - C_B] = (1-P)D - C_B \quad (6)$$

Proposition 2

As long as both Ci are positive there is a negotiated proportion *Z*, which is preferred by both sovereigns to war. The monetary amount *ZD* is in the interval (bargaining range):

$$(PD - C_A, PD + C_B) \quad (7)$$

For proof see appendix.

One surprising insight is that even if sovereign *A* is sure to win (i.e. *P = 100%*) there is an interest to avoid the costs of war. This gives the opportunity for *B* to get at least *a* - presumably rather small - fraction of the region's value *D* or a compensation payment.

But so far the proposition has shed light only on the consequences of risk-neutral attitudes of both parties. However, in case of the Russian leader the conclusion has been a risk-acceptant attitude. This gives rise to a third proposition.

Proposition 3

The chances for a negotiated settlement shrink if party *A* becomes risk-acceptant. The interval (bargaining range) gets smaller.

For proof see appendix.

It makes sense to identify party *A* with Russia. This allows casting current efforts of international politics into the above model framework. A comparison of the bargaining ranges under risk-neutrality and with a risk-acceptant party *A* is shown in the following table:

Table 1. Bargaining ranges

<table>
<tr><td colspan="2"></td><td colspan="2">Bargaining range with risk-acceptant A</td><td></td></tr>
<tr><td></td><td colspan="3">Bargaining range under risk-neutrality</td><td></td></tr>
<tr><td>0</td><td>PD-C_A</td><td>GD-C_A</td><td>PD+C_B</td><td>1</td></tr>
<tr><td>B's favorite outcome</td><td colspan="3"></td><td>A's favorite outcome</td></tr>
</table>

Proposition 4

The chances for a negotiated settlement shrink if party B becomes risk-acceptant, too. The interval (bargaining range) gets smaller than before.

For proof see appendix.

A comparison of the bargaining ranges under risk-neutrality and with risk-acceptant parties *A* and *B* is shown in the following table:

Table 2. Bargaining ranges

<table>
<tr><td colspan="2"></td><td>Range with risk-acceptant A and B</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2">Bargaining range with risk-acceptant A</td><td></td></tr>
<tr><td></td><td colspan="3">Bargaining range under risk-neutrality</td><td></td></tr>
<tr><td>0</td><td>PD-C_A</td><td>GD-C_A</td><td>PD+C_B</td><td>1</td></tr>
<tr><td>B's favorite outcome</td><td colspan="3"></td><td>A's favorite outcome</td></tr>
</table>

What is not visible in the table, but evident from the proofs in the Appendix, is that the range might shrink to zero if the degree of risk-acceptance gets too high for at least one of the involved parties.

One might object that party B is not the U.S. but Ukraine, but presumably this conflict might boil down to U.S. vs. Russia. Hence, we may forecast that the chances for a negotiated settlement haven shrunken with the election of Trump and might now even be nil. This allows a pessimistic outlook for international politics and also international economics and finance as will be spelled out next.

3.4. International trade and regulation

It is well-known that Trump thinks of international trade as a zero-sum game. This is similar to the conflict modelled above, where the sum was fixed by the variable D. Independent of his views is the fact, that trade war is inefficient, too.

Let D be the monetary value of international exports (incl. banking services) and Y be the share of the U.S. This time party A can be identified with the U.S. and B stands for the rest of the world. Depending on the assumptions about B either proposition 3 or 4 applies.

The world has established institutions like the WTO or the Basel Committee to achieve progress and stability in international economics and finance. Obviously stability is of little interest to a risk-acceptant president, who rather views regulation as business prevention. Therefore it can be expected that Trump will continue increasing risk. As of June 2017 the financial markets do not seem to share this view.

3.5. Climate change

Climate change is a fact and related academic literature is abundant. Capping global warming is a risk mitigating strategy because above an increase of two degrees Celsius the world moves into really unknown territory. What is already visible is the increased frequency of extreme weather conditions. Obviously the variance of temperatures is increasing due to climate change. But an increased variance is liked by a risk-acceptant president, who rather views climate change as a Chinese invention. Therefore it can be expected that Trump will continue to further climate change. Other presidents have started to follow the example of Trump. In light of the above detrimental climate action by Putin would come as no surprise.

the probability of winning for that party. More details on this concept can be found in Anderton and Carter (2009, p. 246).

4. CONCLUSION

Seemingly unrelated topics of Russian politics have been investigated. It was shown that under expected utility maximization the assumptions of an unbiased oil forward market and a strictly convex utility function – representing a risk-acceptant attitude of the Russian leader – are sufficient to explain the open position in oil, the bailout of Rosneft and the difficulties to settle the conflict in Ukraine peacefully.

Also it was shown that Trump's running for president cannot be explained by a risk-averse or – neutral attitude whereas a risk-acceptant attitude does not only explain this decision but also fits to his self-portrayal.

As a consequence the chances for negotiated settlements of international disputes in economics finance and politics shrink. A tentative forecast is that the two leaders will keep up and increase risk: In case of Trump a cut back in banking regulation and furthering of climate change conform to a risk-acceptant attitude. The case of North Korea is another recent example where Trump shows his dislike of risk-decreasing diplomacy. In case of Putin Russia's military power can be expected to be used to increase instability as this conforms with a risk-acceptant attitude, too. All of this certainly makes it harder for corporate leaders to perform their activity within the concept of sustainable development.

The approach taken can be applied to corporate leaders as well. Thus consistency in decision making might be increased. On top of it potential dangers might be identified: A (e.g. non-hedging) CEO might turn out to be risk-acceptant, which makes sustainable corporate development a bigger challenge.

But there are also limitations of our approach. It might be that the investigated individual is less rational than presupposed. For instance it could be the case that not all the axioms underlying EUM are fulfilled. Also it could be the case that a decision situation is not amenable to mathematical modelling. Hence, there is room for future research.

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APPENDIX

Proof of proposition 1

We start with (*i*). Risk-aversion means that the utility function is strictly concave. A full hedge reduces *xp+x (f-p)* to *xf*, which is non-random. Due to assumption (2) this is equal to *xE[p]*. With the help of Jensen's inequality from probability theory one sees that getting the expected welfare for sure is the best outcome for a risk-averse leader, because:

$$E[u(xp)] < u(E[xp])$$

The case of (ii) implies a strictly convex utility function. The inequality reverses. Thus getting the expected welfare for sure is the worst thing for a risk-acceptant leader, which is why he will avoid hedging.

A risk-neutral decision maker maximizes *E[xp+h(f-p)]*. Insertion of (2) gives *E[xp+h(E[p]-p)]*. Since *E* is a linear operator the term following the control variable h vanishes. What remains is *xE[p]* for any choice of *h*. Hence, it does not matter.
Q.E.D.

Proof of proposition 2

The proof is as in Fearon (1995) and given to make this article whole and for convenience of the reader. The left-hand side of the interval is trivial, because a *Z* bigger than *A*'s expected value is clearly preferred by *A* to going for war. The right-hand side follows from the same logic as seen by *B*.

$$\begin{aligned} &(1-Z)D > (1-P)D - C_B \\ &\Leftrightarrow -ZD > -PD - C_B \\ &\Leftrightarrow ZD < PD + C_B \end{aligned}$$

Q.E.D.

Proof of proposition 3

Let's consider the case of *A* being risk-acceptant. This implies the following inequality:

$$E[u(YD - C_A)] > u(PD - C_A)$$

Let's denote the amount of the certainty equivalent share in the region *D* by *G* and define it implicitly via:

$$E[u(YD - C_A)] = u(GD - C_A)$$

As a consequence of *u( )* being increasing, the certainty equivalent of going to war is bigger than the expected value. This increases the left-hand side of the interval and shrinks the set of negotiated proportions.
Q.E.D.

Proof of proposition 4

Let's consider the case of *B* being risk-acceptant and recall that in this case B assigns a value to the game, which is higher than the expected value. Let us denote this additional value by *V*. The right-hand side as seen by *B* changes accordingly.

$$\begin{aligned} &(1-Z)D > (1-P)D - C_B + V \\ &\Leftrightarrow -ZD > -PD - C_B + V \\ &\Leftrightarrow ZD < PD + C_B - V \end{aligned}$$

Q.E.D.

Remark

Proofs of propositions 3 and 4 are essentially exploiting the same fact. To keep it interesting a slight variation in the reasoning has been applied.