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ON THE THEORY OF SHARING RISKS IN PUBLIC-PRIVATE PARTNERSHIP (PPP) IMPLEMENTATIONS

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К ВОПРОСУ ТЕОРИИ РАСПРЕДЕЛЕНИЯ РИСКОВ ПРИ РЕАЛИЗАЦИИ ГОСУДАРСТВЕННО-ЧАСТНОГО ПАРТНЕРСТВА (ГЧП)

In this article, a theoretical model for analyzing the equilibrium between profit level and risk in a PPP project is described. Examining the real PPP cases, we usedweighted averages because of the missing data. The equilibrium in a PPP project can only be achieved if the partners analyze the project thoroughlyenough to come to a mutual agreement on the risks and profits involved in the project. Insufficient arrangements and misunderstanding may lead to disappointment and possibly sabotage the whole PPP project. Apart from the theoretical analysis, some practical cases of sharing the risks in PPP projects are presented in this article.

PPP; RISK SHARING; MICRO-ECONOMICS; FORTUM; NEGOTIATION CURVE.

Рассматривается теоретическая модель, анализирующая равновесие между уровнем прибыли и рисками при осуществлении проектов государственно-частного партнерства. Равновесие в проектах может быть достигнуто только при условии, что партнеры детально проанализируют выгоду и риски от будущего сотрудничества, а затем придут к взаимному соглашению по этим вопросам. Представлены практические примеры распределения рисков в проектах.

ГЧП; РАСПРЕДЕЛЕНИЕ РИСКОВ; МИКРОЭКОНОМИКА; FORTUM; КРИВАЯ ПЕРЕГОВОРОВ.

Short literature analysis

According to the British Broadcasting Corporation (BBC, 2003), «any collaboration between public bodies, such as local authorities or central government, and private companies tends to be referred to as public-private partnership (PPP)».[1]

The European Commission (European Commission, 2003) identified four principal roles of the private sector in PPP schemes:[2]

– Providing additional capital;
– Providing alternative management and implementation skills;
– Providing value added to the consumer and the public at large;
– Providing better identification of needs and optimal use of resources.

According to the report, there is no unique model for a PPP arrangement. Each project will separately define what is suitable and what is required.

There are many formal models and analyses of different types of PPP arrangements, see e.g. Savas.[3] Bennett et al.[4] and Beauregard.[5] These present one- or two-dimensional spectrums of PPP models based on the degree of private and public involvement.

Nowadays, there are laws on PPP in 69 territorial entities of Russian Federation. Mostof them are just declarations. The laws and documents do not cover all possible PPP forms.[6] In February 2013, experts rated territorial entities of Russian Federation according to their readiness to implement projects via public-private partnership. The most developed region is Saint Petersburg (with 7.8 rating), the least – Chukotka (0.0 rating). By 2013, there have been over 300 public-private partnership projects in Russia.[7]

Austin listed the elements of a strategically successful public-private partnership arrangement. These are listed in Tab. 1.

[1] BBC (2003).
[2] European Commission (2003).
[3] Savas E.S. (2000).
[4] Bennett et al. (2000).
[5] Beauregard (1997).
[6] Gevorkjan&Litvinova (2013).
[7] Gagarin &Dvinjanin (2013).

Table 1

Elements of a successful PPP-arrangement[8]

a. Clear meaning
b. Equal mission, strategy and values
c. Additional value production
d. Understanding of the meaning of cooperation
e. Communication between partners
f. Idea of continuous learning
g. Commitment to cooperation

Canoy et al. emphasize that risk sharing arrangements within PPPs provide an instrument for creating incentives for both parties to increase efficiency of the project.[9] Analyses of risk sharing in general in PPP arrangements as well as examinations of PPP models in regional industrial policy have been presented, for example, by Tenhunen.[10]

Risk-return analysis in PPP projects

It is quite common to make practical calculations of risk value using the following formula:

$$R = p \cdot C,$$

where R = Risk value in currency; p = the probability of risk occurrence ($0 < p < 1$); C = the costs impact of the risk in terms of currency.

The formula presumably attempts to simply replicate the result. Assuming p and C to be independent, the expected risk $E(R)$ would correspondingly be

$$E(R) = E(p)\ E(C)$$

In general,

$$\partial E(R) / \partial(E(p) > E(\mathrm{C}) > 0$$

$$\text{and } \partial E(R) / \partial(E(m) > E(p) > 0.$$

The expected risk value may differ between the public sector entity and the private sector entity. Thus, the expectation of risk value of the private sector entity $E(R_e)$ is not necessarily equal to the expectation of the public sector entity $E(R_f)$. If the risk analysis is done properly in cooperation, these expected values are practically equal.

The expected rate of private returns in the PPP project $E(i_e) = E(i)$ may also not necessarily be the same from the point of view of the private sector entity $E_e(i)$ and the point of view of public sector entity $E_f(i)$. However, in this analysis we assume that the project benefits analysis is conducted together so that these two are equal $E_e(i) = E_f(i) = E(i)$.

Private Sector Standpoint

From the private sector entity's standpoint, a PPP project has to adequately balance the expected risks and the expected rate of return. The relationship between risk and return has long been shown in economic literature.[11] Private sector entities have a risk/return indifference, above which their investment decision becomes positive. For example, private sector entities will not accept excessive traffic risk if tolls are capped at relatively low levels.

According to the Federal Highway Administration (2012), private sector entity's willingness to accept a particular risk also depends on its ability to manage the risk, the existence of sufficient benefits to compensate for the risk, and the clarity of the contractual dispositions transferring the risk.[12]

From the point of a private sector entity, the higher the expected risk $E(R_e)$ is, the higher the required expected rate of return $E(i)$ grows. Mathematically, this can be expressed via private sector utility curve

$$U_e = U_\mathrm{e}\{E(i),\ E(R)\};$$

$$\frac{\partial E(U_\mathrm{e})}{\partial E(i)} > 0; \quad \frac{\partial E(U_\mathrm{e})}{\partial E(R)} < 0.$$

A constant utility curve (indifference curve) can be expressed via total differential

$$dU_\mathrm{e} = \left\{\frac{\partial E(U_\mathrm{e})}{\partial E(i)}\right\} dE(i) + \left\{\frac{\partial E(U_\mathrm{e})}{\partial E(R)}\right\} dE(R) = 0$$

from which we see that on the constant utility curve

$$\frac{dE(i)}{dE(R)} > 0.$$

[8] Austin (2000).
[9] Canoy et al. (2001).
[10] Tenhunen (2007).

[11] For example, Friedman M. – Savage L.J. (1948), Pratt (1964) and Sharpe W.F. (1964).
[12] Federal Highway Administration (2012).

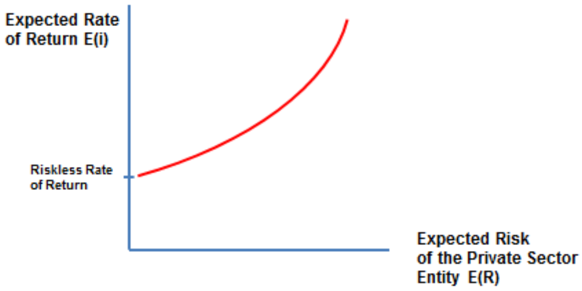

Fig. 1. Constant utility risk/return relation for the Private Sector Entity

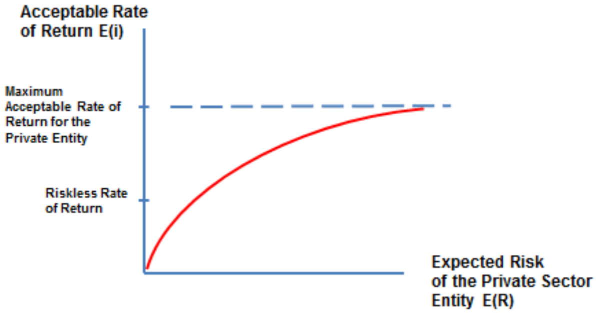

Fig. 2. Constant utility risk/return relation for the Public Sector Entity

Risk aversive behavior implies that on the private sector entity`s indifference curve, the second derivative is positive[13]

$$\frac{\partial\left\{\frac{dE(i)}{dE(R)}\right\}}{\partial E(R)} > 0.$$

For the visual representation of this dependence see Fig. 1.

Public Sector Standpoint

From the public agency's standpoint, PPP projects are supposed to include stages for transferring the project risks to private enterprises. The more risk is planned to be transferred to the private sector; the higher rate of return will be allowed for the private sector entities. However, a maximum for the expected private sector returns is defined by the public sector, according to the identified expected risk level of the PPP project (see Fig. 2).

For the Public Sector Entity, on the constant utility curve would be

$$dU_f = \left\{\frac{\partial E(U_f)}{\partial E(i)}\right\} dE(i) + \left\{\frac{\partial E(U_f)}{\partial E(R)}\right\} dE(R) = 0,$$

where $\frac{dE(i)}{dE(R)} > 0.$

However, reducing the maximum rate of return causes the second derivative to become negative on the indifference curve.

$$\frac{\partial\left\{\frac{dE(i)}{dE(R)}\right\}}{\partial E(R)} < 0.$$

[13] Friedman M. – Savage L.J. (1948), Tobin (1958).

Theoretical Equilibrium

Risk allocation can be envisioned as defining an equilibrium point, where the level of expected risk and the expected private sector return is acceptable for both the public agency and the private sector entity. Transferring all the risk to the private sector would significantly increase the private sector entity's required rate of return on investment.

The equilibrium can be reached based on risk-reward trade-offs. Both the public and the private sectors have tolerance levels for risk and returns. A balanced risk-reward profile is needed for the PPP arrangement to be considered attractive by both public and private sector entities (see Fig. 3).

In the equilibrium, the ratio of marginal utilities of both of the agreeing partners is equal, which mathematically means that

$$\frac{\left\{\frac{\partial E(U_e)}{\partial E(i)}\right\}}{\left\{\frac{\partial E(U_e)}{\partial E(R)}\right\}} = \frac{\left\{\frac{\partial E(U_f)}{\partial E(i)}\right\}}{\left\{\frac{\partial E(U_f)}{\partial E(R)}\right\}}.$$

Divergent analysis of the partners

Assuming that the risk analysis is not done properly in cooperation, this would mean that the expectation of the risk value of the private sector entity $E(R_e)$ is not necessarily equal to the expectation of the public sector entity $E(R_f)$. In theory, there are two new possibilities: $E(R_e) > E(R_f)$ and $E(R_e) < E(R_f)$.

When the private sector entity proposes higher risks for the project than the public sector entity $E(R_e) > E(R_f)$, the expected rate of return of the private sector entity would not accept the rate of return which is proposed by the public sector entity. This may cause the planned PPP project to lapse (see Fig. 4).

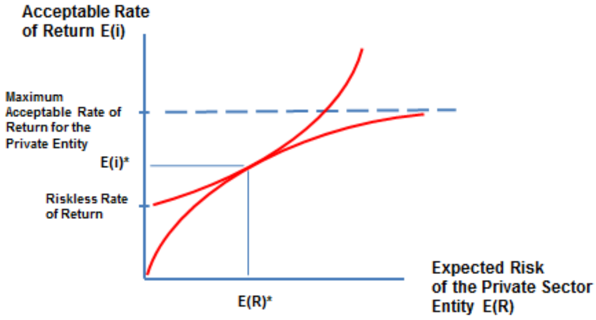

Fig. 3. Risk/Return Equilibrium in a PPP Project

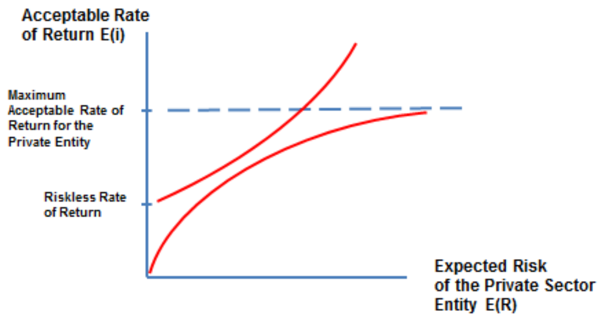

Fig. 4. Risk/Return Dis-Equilibrium in a PPP Project when $E(R_e)>E(R_f)$

Following the definition $E(R) = E(p)E(C)$, the activities to settle the situation caused by the dis-equilibrium may cover discussions to find a common understanding of the expected probability of risk occurrence $E(p)$ and/or the expected costs impact of the risk in terms of currency $E(C)$. For example, the risks included in $E(C)$ may be covered by a proper assurance from the insurance company. Risks included in $E(p)$ may be divided between the private and the public sector entities within the project. This would mean, for example, defining limits for costs coverage for the agreeing partners.

When the private sector entity proposes lower risks for the project than the public sector entity $E(R_e) > E(R_f)$, the expected rate of return of the private sector entity would pass underneath the rate of return proposed by the public sector entity. This gives the planned PPP project possibilities; however, problems may arise while accomplishing the project. The PPP agreement can be done on various optional levels, while the utility curves clearly overlap each other. The expected rates of return $E_e(i)$ and $E_f(i)$ differ as well (see Fig. 5).

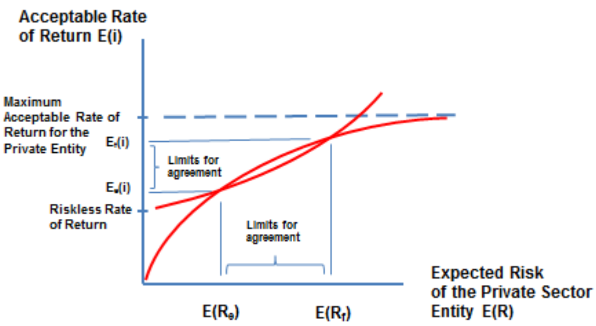

Fig. 5. Risk/Return Dis-Equilibrium in a PPP Project when $E(R_e) < E(R_f)$

In the situation above, deeper mutual analysis of the risks in the PPP project should be conducted before agreements are signed to avoid problems while accomplishing the project.

As the expected rate of private returns in the PPP project $E(i)$ may not necessarily be the same from the point of view of the private sector entity $E_e(i)$ and the point of view of public sector entity $E_f(i)$, the differences in estimated rewards may cause similar difficulties in structuring a PPP project. These can be analyzed correspondingly.

OAO Fortum (Russia) case

Background. Fortum Oyj is a Finnish energy company that operates primarily in Nordic countries, Russia, Poland and the Baltic Rim area. The company's activities include electricity and heat production, sales and distribution, power plant operation and maintenance services, as well as other energy-related services. The company's main products are electricity, heat and steam. In 2012, Fortum's sales totaled € 6.2 billion and comparable operating profit was € 1.7 billion. Fortum has around 10.400 employees. Fortum was listed on the NASDAQ OMX Helsinki in 1998.

In Russia, Fortum Oyj operates in Urals and Western Siberia. Both in Tyumen and Khanty-Mansiysk area, where industrial production is dominated by the oil and gas industries, and in Chelyabinsk area, which is dominated by the metal industry, electricity demand increased marginally in the second quarter compared to the same period of the previous year. Fortum's operations in Russia are focused on power and heat generation and sales. Fortum's Russian Division includes OAO Fortum and Fortum's slightly over 25 %-holding in TGC-1 that operates in north-west Russia.

In the future, the integrating European and fast-growing Asian energy markets may provide additional growth opportunities to Fortum.

Early in 2008, Fortum acquired a majority in the territorial generating company, TGC-10 company in an auction arranged as part of the Russian power sector liberalization. OAO Fortum (former TGC-10, ownership today around 95 %) currently comprises nine power plants, mainly gas-fired combined heat and power (CHP) capacity. Its operations are based in the metal producing area of Urals and the oil and gas rich Western Siberia. The company also owns and operates trunk heat networks in several cities in Russia. The electricity produced is sold on the wholesale market while heat is soldon the local markets.[14]

The Investment. At the time of TGC-10 acquisition, Fortum applied to the Russian Government`s Capacity Supply Agreement (CSA) to invest in the construction of eight modern power plant units, of which Nyagan newest unit is the largest so far.

The acquisition and investment program combined, Fortum`s Russian investments will amount to about €4.3 billion (net assets in Q2/2013 were €3793 million plus some €490 million which is the remaining part of the investment program) by the end of 2014. It is about a third of all Finnish investments in Russia since the fall of the Soviet Union in 1991.

The new capacity of eight new units in the ongoing investment program will amount to approximately 2400 megawatts (MW). This is supposed to increase power generation capacity of Fortum Russia by 85 % and is therefore a key driver for solid earnings growth in Russia.

The investment program is to be completed by the end of 2014 and according to Fortum, begins to produce earnings properly. In autumn 2013, the mid-point of the investment has been introduced, but four large power plant units are still to be commissioned. According to Fortum plans and goals, the run-rate of the annual operating income (EBIT level) is some € 500 million within its whole Russian division during 2015.

The acquisition caused criticism in Finland, because the acquisition price was considered to be too high, the power plants in Russia were considered to be too old and Russia was considered to be uncertain market. The criticism increased when the economy was getting worse and the electricity demand fell rapidly.

This meant that commercial risks of the investment were about to prove true although there is a lot of metal industry, gas industry and oil industry in the Ural area and Western Siberia which had to guarantee the demand for electricity.

Electricity and Capacity Markets in Russia. The day-ahead market is the central place for electricity trade in Russia. In 2011, a total of 213 buyers and 51 producers of electricity were registered as participants of the day-ahead market. The total amount of electricity traded on the day-ahead market was 864.9 TWh which constitutes approximately 80.5 % of all electricity volumes traded in the wholesale market (incl. regulated contracts, day-ahead market, balancing market) in 2011. The total market turnover was around €18.4 billion.[15] Thus, the average price of electricity on Russian markets was around 2.13 cents per kWh. In January-June 2013, the average electricity spot price, excluding capacity price, increased by 11 % to RUB 1.020 (920) per MWh (some 2.55 cents per kWh) in the First price zone.

Generators receiving capacity payments should convey full readiness to deliver the amount of electricity indicated in their accepted capacity bids (this requires only the readiness for production of the mentioned capacity). One of the criteria is checking the correspondence of volumes of electricity submitted to unit commitment procedure and day-ahead market and capacity accepted by the results of capacity market.

Participation in the capacity market and the capacity payments is different for the old and new generation. New generators get regulated fixed capacity payments, while the old generators compete in Competitive Capacity Auctions (CCA).

Russia's electricity sector reform was accompanied by a huge need for new investment in the generation sector. During the first period of the reform in 2010–2015, the development of new generation capacity was governed through

[14] All numbers and pieces of information based on Fortum Corporation website and Interim Report Q2/2013.

[15] Satu Viljainen, Mari Makkonen, Olga Gore, Dmitry Kuleshov (2013, 1 and 2).

government regulation. Investors have obligations concerning punctual commissioning of new generation while the government guarantees a return on invested capital for ten or twenty years starting from the year of commissioning of the power plant (thermal power plants have ten years guarantee, and the nuclear and hydro power plants have a twenty years guarantee). The capacity payments are regulated with fixed monthly payments. The capacity payments for new thermal power plants vary from €12500–30000 /MW per month, depending on the type and location of the new power plant. The present capacity mechanism in Russia is meant to be temporary, and it is designed to solve the problem of the immediate need for new investments in the generation sector. In 2010–2015, 40 GW of new generation will be launched through this mechanism.[16]

The sales, capacity payments and operating profit of OAO Fortum. The Nyagan power plant of OAO Fortum will produce approximately 9.8 TWh annually, after all three units have been commissioned. Based on prices between 2.13–2.3 cents per kWh, this means annual electricity energy sales of some €210–230 million. Apart from sales, the capacity payments will be added.

The CSA capacity payments received by OAO Fortum have had a positive impact on the company results. The comparable operating profit (including the CSA payment sand reversal of a CSA provision totaling €10 million) was €61 million in the first half of 2013 (correspondingly 52 million the first half in 2012). The comparable operating profit in 2012 was totally €68 million.

The average capacity payments for new capacity received by OAO Fortum have been almost €15.000 /MW/month during 2012 and 2013.[17] Thus, the CSA payments based on the Nyagam production unit (1250 MW) will be some €19 million /month (2012) and some €36 million /month (2013) for the whole investment program (2400 MW).

According to the CFO of Fortum Group Markus Rauramo, Fortum`s CSA-backed investment program is to be completed by the end of 2014, reaching about €500 million operating profit (EBIT) in run-rate during 2015.[18] This point of view may include expectations of increasing electricity prices.

The power generation capacity of OAO Fortum in Russia was 3400 MW at the end of the year 2012 (in June 2013 it was 3825 MW).[19] Based on the investment program, the new capacity for electricity production will exceed 5100 MW in 2015.

OAO Fortum agreed with the Russian Government that the new capacity built after 2007 would receive guaranteed capacity payments and capacity support for 10 years. The agreed CSA structure basically guarantees a level of income for the new units. In case Fortum makes higher spread on electricity, CSA payments will be smaller, and vice versa. The CSA compensation levels are revised three years and six years after the commissioning of the units. So the CSA levels change. The CSA compensations are defined in order to ensure an adequate return on investment for Fortum.

A large part of the operating profit of OAO Fortum in 2013 is based on the CSA capacity payments made by the Russian government. This clearly has balanced the risks of the huge investment. The CSA payments for new capacity may vary slightly each year, because they are linked to Russia's long-term government bonds with a maturity of 8–10 years.

The expected return on net assets (RONA)

The return on net assets(RONA) of the Fortum Russian Division has been about 3 % in 2012 and 3.3 % during the last twelve months from 1.07.2012 to 30.06.2013. The net assets of Fortum Russian Division were some €3.8 billion at the end of 2012 as well as on 30.06.2013. After the investment program has been finished, the net assets of Fortum Russia Division will be some €4.3 billion. Based on Fortum estimates, the EBIT €500 million would mean that the average rate of return will roughly be 10–12 % (500/4300 · 100 = 11.6 %) annually in the future. The EBIT Q2/2012 was €77 million. The comparable EBITDA of the Fortum Russia division Q2/2013 has been some €200 million.

[16] Satu Viljainen, Mari Makkonen, Olga Gore, Dmitry Kuleshov (2013, 1 and 2)

[17] Calculated from the FortumOyj Interim Report Q2/2013.

[18] CFO Markus Rauramo (19.07.2013).

[19] All numbers and pieces of information based on the FortumCorporations website and Interim Report Q2/2013.

Combining the risk variables of the investment

Fortum's extensive investment program in Russia is subject to possible penalties that can be claimed if the new capacity is substantially delayed or agreed. Major terms of the capacity supply agreement (CSA) are not otherwise fulfilled. The provision for possible current penalties amounts to €50 million. Paid penalties during Q1–Q2 2013 amounted totally to €16 million. Of course, there exist several risks which are classified and listed, for example, by Ke & Wang & Chan & Lam (2009).[20]

Here we will generalize the practical model presented by Savvakis (2012),[21] who followed Herzt (1979), introducing the linear relation analysis between correlated risk measures. As we have noted before, the risks in Fortum's huge investment are versatile.

We shallcollect all relevant risk measures to an aggregate risk measure. We shallassume that all of the involved separate risk measures[22] are uncorrelated. Also all the p_i's and C_i's ($i = 1, 2, ..., n$) are assumed to be uncorrelated. Then we can express the expected currency value of all relevant risks together, with the expectation of the aggregate measure $E(R)$ as follows:

$$E(R) = \sum E(p_i)\, E(C_i),$$

where $E(p_i)$ = the expected probability of risk occurrence ($0 < p < 1$) of the risk i ($i = 1, 2, ..., n$); $E(C_i)$ = the expected costs impact of the risk iin terms of currency ($i = 1, 2, ..., n$).

The formula presumably attempts to simply replicate the reality.

$E(R)$ reflects to the agreed capacity payments CSA to OAO Fortum. These are negotiated between the agreeing parties, based on mutual risk evaluations.

The Negation Curve can be mathematically formulated as follows:

$$\text{CSA} = f\{E(R)\} \text{ where } (\partial \text{CSA}/\partial R) > 0.$$

In case risks are zero, the offered CSA payments will be zero as well. On the other hand, we know that there is a maximum which the Russian Government can accept (≈€30000 /MW/m). OAO Fortum has agreed a level of some €15000 /MW/m). These points describe the Negotiation Curve detailed enough (see Fig. 6).

[20] Ke & Wang & Chan & Lam (2010).
[21] Savvakis (2012, p. 9).
[22] See the analysis of Ke & Wang & Chan & Lam (2010).

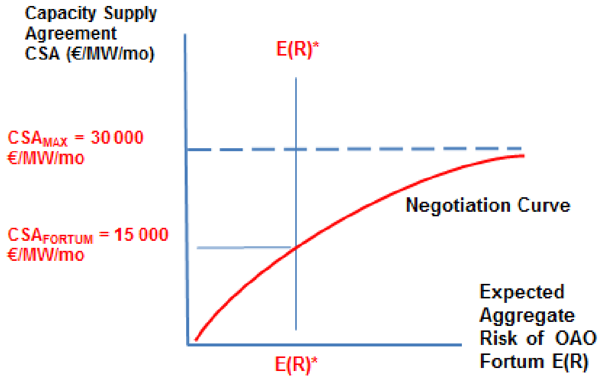

Fig. 6. The Negotiation Curve

Formulating this way, the level of CSA (€/KW/month) would be an output measure which can be a reflection of the expected aggregate risk in currency value, calculated from several original investment risk variables. The PPP negations can thus be based on choosing an acceptable level for CSA payments for both agreeing parties.

However, we need to take a note that in reality there still exist many risks which cannot be covered by the CSA arrangement. The range of investment risks is especially wide.[23]

The PPP arrangement of OAO Fortum (Russia)

When we insert the OAO Fortum case into the framework presented earlier, we have the situation described in Fig. 7.

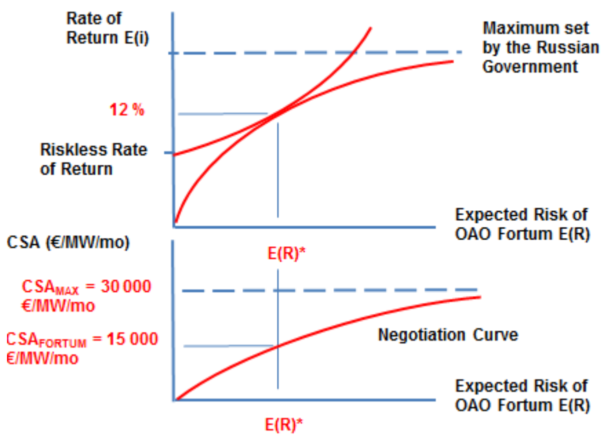

Fig. 7. Capacity Supply Agreement (CSA) based on expected risks of OAO Fortum

[23] See, for example, the classification and analysis of Ke & Wang & Chan & Lam (2010).

The agreement line in Fig. 6 is assumed to be defined by the constant utility risk/return relation of the Russian Government.

The CSA arrangements have had an important role in balancing the risks of the OAO Fortum new investment. The rate of return of the new investment seems to be about 12 %, given the fact that CSA payments from the Russian government are on the level of 15000 €/MW/month.

In case OAO Fortum had been expecting a higher risk level, they would have asked for higher CSA payments. However, not more than CSA_{MAX} ≈ 30000 €/MW/m would have been accepted to the agreement. In case the risk evaluation was be mutual, the Russian Government might have accepted also other alternatives based on the negotiation curve. In case of zero risks expected mutually, the PPP parties would not have CSA payments at all.

Disclaimer. The analysis in this case study has been done independently from Fortum. The content does not represent the opinion, forecasts or predictions of Fortum or its management. Any liability of Fortum as to the content, accuracy or completeness of the information is hereby excluded.

Conclusion. In this article we have analyzed Public-Private Partnership arrangements mainly based on the micro-economic theory. Based on the analysis, we can suggest that a detailed mutual planning stage (including mutual risks analysis and expectations of the benefits) should precede the project agreement.

Above we have introduced a science-based method to share the risks and profit level in a PPP project in practice by introducing the negotiation curve as a tool for defining acceptable levels in a project.

The PPP agreement itself should include the following items:

– making the PPP agreement to define partial occupancy and gradual transfer of ownership;
– allowing third partners to hire (or lease) the object for alternate uses;
– using a portfolio approach by joining several objects;
– designing the objects innovatively proper for many kinds of uses;
– assuring acceptable rate of return of the private investments by public subsidies;
– areal tool (or tools) for sharing the risks between the private and the public entity in the project.

When expectations of the project risks and project rewards are similar on both sides, it is possible to find a solution for the sharing of risk in a PPP project. In the equilibrium point, the ratio of marginal utilities of both of the agreeing partners equals.

There are also methods for reducing the risk by practical methods which we have shown above.

As larger construction projects in general, larger PPP plans can also be divided into many stages, where each stage separately can form an independent PPP project.

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