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Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania 51/3, 113-122

2018

UNIWERSYTET SZCZECIŃSKI
WYDZIAŁ NAUK EKONOMICZNYCH I ZARZĄDZANIA

Studia i Prace WNEiZ US
nr 51/3 2018

DOI: 10.18276/sip.2018.51/3-10

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FINANCIAL RISK EVALUATION FOR INTERNATIONAL SUPPLY CHAIN PROJECTS

ABSTRACT

The article presents the basic aspects of financial risk in international supply chain projects. The aim of the article is to draw attention to the fact that no method has so far been developed to measure this risk and to evaluate projects for rejection or acceptance, taking into account a possible bankruptcy of the entity implementing such projects. Thus, the basic risk measures are presented and the Foster-Hart measure is proposed for such a measurement, showing its basic features and advantages. In addition, it is pointed out that the instrument allowing the assessment of projects offers real options that can be put to value during projects and be used as part of the financial risk measurement of international supply chain projects.

Keywords: projects, risk measures, risk assessment, Foster-Hart measure, real option

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Introduction

The main feature of all projects is their uniqueness and complexity, while their management is a discipline of planning, organizing and managing resources, in order to successfully complete specific project goals (Vanhoucke, 2012). Analyzing this management process in the first place, one should take into account the fact that they often have a high financial value and last for quite a long time. In addition, projects are by their nature much more exposed to risk than products. With all this in mind, project risk management is gaining importance, and is supported by many tools and techniques. These include, for example, risk analysis, risk registers, risk models and active risk management (Boyce, 2003). All of them are used to achieve the ultimate goal of project risk management, that is, its completion on time, taking into account the specifics and budget.

The literature research carried out clearly indicates that no coherent concept supporting the risk management process for international supply chain projects has been developed, a concept that may find its justification in real life. This type of project was chosen because it is characterized by many different types of risks which significantly reduce the success of projects. The aim of this article is to fill the cognitive gap through general presentations of the essence of financial risk management of such projects, by define the instruments which can be used in this process. Needs analysis will be done through critical analysis of literature and scientific reflection. In order to be able to achieve the intended goal, the concept of a project and its respective phase should first be defined in order to be able to identify the most important risks that are associated with it. As a result, it is possible to identify instruments that will support the financial risk management process of projects. This procedure is reflected in the structure of this article.

1. Supply Chain Projects and Project Phases

There are actually a lot of standard definitions of a project. ISO 21500:2012 (BS ISO 21500, 2012) defines a project as follows: "A project consists of a unique set of processes consisting of coordinated and controlled activities with start and end dates, performed to achieve project objectives. Achievement of the project objectives requires the provision of deliverables conforming to specific requirements". Similar

definitions are given by the Project Management Institute (PMI, 2013) and PRINCE2 (PRINCE2, 2012). In companies, projects may be a suitable form of organization for different purposes or categories: engineering, manufacturing etc. In addition to these typical categories of projects, projects in supply chain management may be specifically defined and should be the focus of the following discussion. Chopra and Meindl (2010) state that a supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer's request and the Supply Chain Process Cycle consists of order, replenishment, manufacturing and procurement cycle. Such supply chains may be established for ongoing deliveries of products or for a specific demand of a customer – which does not necessarily mean end customer. There are several possibilities to design projects but large orders might be defined as projects as well, especially if they are orders for other (investment) projects. Such projects are unique, especially if customized products are ordered. They create, as their results, the delivered product and possibly services. Supply chain projects start at the supplier side with a request or a call for bids and end with the payment after delivery, if no additional service is agreed. Each project could be split into phases like order and delivery. Overall, the mentioned supply chain actions in each cycle, whether from the perspective of the buyer or the seller, seem to fulfill each characteristic of a project. In addition, supply chain projects may reach a high complexity because of the large number of stakeholders involved, the variety of legal aspects and international issues like culture or currencies.

Each project is exposed to risk and real-world risks induce financial risks which may create major return problems for a company and lead, in the worst case, to insolvency. Although most of these risks must be managed directly in real-world processes, financial risk management may support the detection of risks, the measurement of financial impacts and the risk handling, using financial instruments. Looking at risks of a project it seems to be evident to identify the points in time when risks occur. A feasible approach to analyze and specify these times or periods within a project is to assign them to the project phases. A variety of phase models are readily available. Looking at supply chain projects for large orders from a sales perspective, it is hard to define standards and degree of detail. In the context of this paper, the following phases should define a standard supply chain project from the seller's perspective in accordance with the general phase definitions mentioned:

1. Request/call for bids
2. Requirements, calculation and offer

3. Negotiation and contract
4. Start of project activities
5. Production
6. Delivery and payment
7. Test and approval
8. Project closure

As it is shown, the phases defined depend on the subject of the project. Kerzner (2017) states that a project life cycle also may be split into phases like concept, planning, definition and design, implementation and conversion.

2. Financial Project Risk

Every project is exposed to risks which may endanger the success of a project. Especially high financial risks occur due to large scale, complex financing structure and long run times (Eiteman, Stonehill, Moffet, 2013).That is why nearly every standard defines risk management as an important part of general project management. Risk management includes the stages of planning, identifying, analyzing, responding and monitoring with controlling (Kerzner, 2017) for the same applies to the specific aspect of financial risk management. But when trying this, we shall need to identify the risks before. Risks in general may be classified in market risks (sales markets and procurement markets, like price risks, supplier risks, contract risks, quality risks), financial risks (like risks of liquidity, credit, interest and exchange rate changes), economic risks (like political, legal or societal risks), corporate governance risks and operational risks (Gleißner, 2017). In supply chain projects, there are a number of risks related to external effects, the company as a whole, overall project or to one of the mentioned phases only (Benaroch, 2002). The identification of risks of a specific (supply chain) project is hard to be standardized as each project is unique. There is a large variety of tools suggested to support this identification (Cooper, Gray, Raymond, Walker, 2005). This shows that risk identification is difficult, which is why one should concentrate on major risks, special risk classes and risks with large financial impacts. Looking at supply chain projects of large orders, specific risks with financial impacts are those which cause additional costs (Kumar, 2002) or endanger the cash flows on the financing side. One special factor endangering cash flows is the change of points in time of each planned payment. Therefore, particular

risks in this context are the rejection of offers, uncertain project development due to agile planning, (multiple) prolongation of the project, (multiple) delays caused by production problems, supply or approval bottlenecks or expansions, abandonment (due to failure, etc.), where in general delay, expansion and abandonment seem to be the most important ones (see e.g. Kendrick, 2009). Especially in international contexts, the specific financial risk of foreign exchange has to be taken into account.

If all major risks are identified in a risk portfolio, they need to be analyzed. For this reason, the risks are to be measured and aggregated. It seems to be useful to assess the risks in an aggregated form first to find whether total risks like shortfalls exist, which should lead to a decision against starting the project. Later on, detailed risks of all phases should be established and assessed.

3. Risk measures used for evaluation

The coordination of the risk management process should include, among other things, two stages, i.e. measurement and risk assessment. They should be preceded by identification, which is what the previous section of this article dealt with. Such an approach allows for measurement, which is quantification of risk, while the objective evaluation of its level is extremely difficult from the perspective of the evaluator. In the process of financial risk management, a variety of risk measures can be used. The most important and best-known of the above-mentioned include:

- portfolio risk calculated using the Markowitz model (Markowitz, 1952);
- the risk of the rate of return on the asset and portfolio (measured by the variance) as part of the single-indicator model (Sharpe, 1963);
- coherent risk measures (Artzner, Delbaen, Eber, Heath, 1999), which include the so-called ES (Expected Shortfall) indicator;
- VaR (Value at Risk) – a tool that allows us to determine how much money should be used to secure investments in risky assets (Linsmeier, Pearson 2000);
- other known models, for example: variance-covariance method (Deutsch, 2002) and Monte Carlo Simulation (Haralambides, 1991).

Their general presentation of the measures was made in tabular form, including the most important disadvantages.

Table 1. The most known risk measures and their disadvantages

Type of measure	Disadvantage
Markowitz model	It is not monotonic.
Sharpe model	Measure allows only risk approximation.
Coherent risk measures	They must meet certain four axioms and they don't take into account a possible bankruptcy.
VaR	It is not a measure.
Other models	They don't take into account a possible bankruptcy.

Source: own study based on literature research.

The review of the measures presented is dictated by the need to consider the fact that none of them takes into account a possible bankruptcy of the investor – and from the perspective of the project – its contractor. This flaw may be considered an argument requiring rejection the measures in the case of using in the financial risk management process of projects. Based on the literature research, it was recognized that the most useful measure that can help support the financial risk management process is the Foster-Hart measure, which has many unique features. These include subadditivity, monotonicity, objectivity and universality (Foster, Hart, 2009) and the possibility of pointing out too risky investments and ventures related to the impact and outflow of cash, which may lead to the bankruptcy of the investor. In addition, its aforementioned features allow including foreign currency investments in the scope of the analysis, and can be treated as a dynamic measurement of risk (Hellmann, Riedel, 2015).

Foster-Hart's risk measure takes the form of the following formula for the risky enterprise "g"): $E\left[\log\left(1+\frac{1}{R(g)}g\right)\right]=0$, where g is the result of the investment being income generated with a certain probability at the end of the investment period and $R(g)$ is the critical value of wealth, also a measure of investment risk of project "g". The result of the solution presented in the equation is interpreted taking into account the relation between the value of $R(g)$ and the current level of the investor's wealth. Therefore, there are two possible cases:

– if $R(\mathrm{g})$ is higher than the current level of an investor's wealth, then the "g" undertaking is considered too risky and leads the investor to bankruptcy;

– if $R(g)$ equals or is lower than the investor's current level of wealth, then the undertaking is considered acceptable and increases the investor's assets.

The analysis of literature confirms that there is a need to design a financial risk management process for international supply chain projects using the Foster-Hart measure.

4. The financial risk assessment method of international supply chain projects

To support the financial risk management process of international supply chain projects, two types of instruments are needed. The first is an instrument that will allow us to measure risk, including in foreign currencies, taking into account the possibility of bankruptcy. As mentioned, the Foster-Hart Measure it is part of this. The other is a tool that will allow analysts to evaluate projects and support decisions on whether to accept or reject them. Based on the analysis of the literature devoted to the subject matter, it was stated that the latter includes the real option, which was presented for the first time in the 1970s (Myers, 1977). They are divided into three main categories (Damodaran, 2014, p. 255):

– Option to Delay a Project;
– Option to Expand a Project;
– Option to Abandon a Project.

The aforementioned options can change the decision on a project in case new information appears. What's more, they are a response to the disadvantages and limitations of traditional methods of business valuation and assessment of investment projects. For this reason, real options complement the classic and well-known methods of project analysis with additional elements, often decisive for joining a given investment project. Using the option, during the course of time. it is possible to modify the decisions. Summing up, we can state that real options understood in this way, refer to strategic benefits and other values that give right to all cash flows during the project, taking into account expenditures.

Problems associated with the use of risk measures have been presented in the earlier parts of this article. Considering the most important features that they should have, the Foster-Hart Measure seems to be the most appropriate measure supporting the financial risk management processes of projects. The question that now arises is how we can combine the use of the Foster-Hart Measure and real options for the risk

evaluation? After considering the essence of the latter, the measure should be used within specific decision stages once the project has been accepted. Acceptance of the project should take place under the assumption of specific real option values. This approach will allow to calculate the result of the Foster-Hart Measure formula with projected cash flows and previously obtained real option values. It is worth mentioning that this measure can be used at any time when modifications to the decision are being considered, resulting also from real option valuations or various risks. At the same time, it is mainly important that in each case, the result of the formula will allow us to assess whether the company's financial resources will constitute sufficient collateral against bankruptcy. If these resources are too low, then the project should be rejected despite the recommendation of real options.

Conclusions

The analysis of the literature on the subject allows to conclude that although there are many measures of risk, only one of them allows for taking into account a hypothetical bankruptcy. Mainly this feature and the ability to analyze investments and projects in foreign currencies are the reasons that recommend the use of the Foster-Hart Measure as part of the financial risk management process of international supply chain projects. The article shows that this process should be supported also with the help of real options, which are tools that verify projects, also along their duration. It was mentioned that a combination consisting of such options and the Foster-Hart Measure is possible to build.

Although literature, sometimes very extensively, deeply characterizes project risks and their phases, no study has been found devoted to the use of tools presented in the article as part of specific phases. Therefore, an effort should be made to develop a model that will allow the use of a combination of these tools to make decisions. As it is known, there are many different types of projects, however, through the level of complexity and size and the negative impact of risks, the analysis is limited to the large international supply chain project. For this reason, it is worth carrying out detailed analytical studies on the use of the two tools described in the framework of specific stages of project implementation. The considerations developed can therefore be acknowledged as a contribution to further quantitative research, because it is advisable to analyze the presented problem in detail, using mathematical and statistical methods.

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POMIAR FINANSOWEGO RYZYKA DLA MIĘDZYNARODOWYCH PROJEKTÓW ŁAŃCUCHA DOSTAW

Streszczenie

W artykule zaprezentowano podstawowe aspekty ryzyka finansowego dla projektów łańcucha dostaw. Celem artykułu jest natomiast zwrócenie uwagi na to, że nie opracowano metody pozwalającej na pomiar tego ryzyka oraz na ocenę projektów pod kątem odrzucenia lub akceptacji, przy uwzględnieniu możliwości bankructwa podmiotu realizującego takie projekty. Przedstawiono więc podstawowe miary ryzyka i zaproponowano miarę Fostera-Harta dla takiego pomiaru, ukazując podstawowe jej cechy oraz zalety. Ponadto wskazano, że instrumentem pozwalającym na ocenę projektów są opcje realne, które można wyceniać w trakcie trwania projektów i wykorzystywać w ramach pomiaru ryzyka finansowego projektów łańcucha dostaw.

Słowa kluczowe: projekty, miary ryzyka, ocena ryzyka, miara Fostera-Harta, opcja realna

Kody JEL: G23, B26