USING NET PRESENT VALUE METHOD IN ECONOMIC EFFICIENCY ANALYSIS FOR FOREST PLANTATION: PROBLEMS AND SOLUTIONS

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SUMMARY

This paper discussed limitations in perception and application of Net Present Value (NPV) method in economic and financial analysis for forest plantation. Starting point of the discussion is a common fact in forest plantation that, while financial efficiency assessments based on NPV criterion of the forest plantation projects are satisfactory, most of the forestry state owned enterprises and other forestry units are facing huge financial difficulties. The author pointed out that, the reasons for that contradiction are significant errors in NPV method's application. They are: Ad hoc selection of forest planting rotations; ignorance of risk premium; irrelevant treatment of inflation; and overuse of NPV per hectare. Consequently, NPV method has been failed to give a correct criterion for economic and financial assessment in forest plantation. Since the errors are right placed in teaching materials and legal documents, negative impacts caused by misusing of the method are long lasted and exaggerated. Based on the problems analysis, the author proposed the solutions for each issue: simultaneously solving problems of planted forest rotation period and NPV identification; including of risk premium in discount rate; consistently handling of inflation factor and price's type in NPV calculation; and using of an appropriate set of criteria in economic and financial assessment. In the author point of view, the proposed solutions are rather simple and ready to use, the most concern is laid in a full awareness towards the existence of the problems and an immediate responses by people engaged in related academic and practical fields.

Keywords: Discount rate, economic efficiency, forest plantation, net present value.

I. INTRODUCTION

Net Present Value (NPV) is considered as the most appropriate criterion and widespead use in economic efficiency analysis for long term investment in general and forest plantation in particular. Instruction and guide for computing and using the criterion can be found in many publications, for practical and academic purposes.

With this common use, it is natural to expect an accurate method and appropriate application of the criterion in theory and practice. However, there is a clear contradiction in financial efficiency assessment and reality of financial status of the forest plantation units. Looking at the documents, papers reported financial efficiency assessment in forest plantation projects throughout the country, we hardly see any case of low financial efficiency based on NPV criterion[1]. At the same time, very low efficiency in forest plantation is found in most state owned enterprises and other forestry units (NASC, 2015).

That contradiction in practice implies that, with the current way of using NPV method for economic and financial analysis, NPV would be a mistaken criterion for financial efficiency in forest plantation.

This paper aimed to examine limitations in NPV method used for economicefficiency assessment by discussing the selection and interpretation of NPV's components and calculation method. It turns out that there exist significant errors in identification and application of the planted forest rotation, the way to handle risk, inflation and overuse of per hectare NPV. Based on the problems identification and analysis, the paper suggests necessary amendments to improve NPV method in economic and financial assessment. Although the solutions are targeted to forest

[1] See, for example Hoang Lien Son (2016)

plantation sector, some of the proposed amendments can be applied for other fields of investment analysis.

II. RESEARCH METHODOLOGY

As a discussion paper, the main method used in this study is critical analysis without mentioning particular addresses. Nevertheless, some data or publications are still appeared in the paper, and they should be considered as for illustrative purpose only.

For the discussing NPV method, in this paper, we follow the common formula for NPV calculation in forest plantation project analysis:

$$NPV = \sum_{t=0}^{N} \frac{B_t - C_t}{(1+r)^t} \qquad (1)$$

Where:

B_t, C_t: Revenue and costs occur at year t throughout the forest plantation period;

N: Rotation period; that is, the length of time to harvest planted forest, in year.

r: Discount rate, normally referred as normal interest rate;

The most widespread use of NPV is as a criterion for economic and financial assessment in the feasibility analysis, to make decision on whether or not to undertake a forest plantation project. That is, the NPV analysis is carried out ***before*** actual project activities taken place.The discussion in this paper on identifying and using NPV criterion for economic and financial efficiency analysis is in that context.

III. RESULT AND DISCUSSION

3.1 Making assumption on forest plantation rotation

The first problem in NPV use comes from the *adhoc*assumption on the planted forest rotation.

To compute NPV in the stage of project proposal, the length of the planted forest rotation (N) is commonly assumed to be known parameter. The most popular way to make assumption on rotation period is the common practice or experience gained from some "reliable" sources. However, there is no sound ground for that practice: optimal period (that is, the best time to harvest the planted forest) is an important factor andshould be treated as endogenous variable in economic efficiency analysis. To see that, we look at the classical problem of optimal period identification in forestry economics:

The most well-known criterion for solving problem of optimal period of planted forest harvesting is maximization of the discounted net revenue from an infinite rotations – the Faustmann - Pressler – Ohlin model (Lofgren, 1983):

$$Max\ V(T) = \sum_{t=0}^{\infty} NPV_t \qquad (2)$$

Where:

V(T): Total net revenue from an infinite rotations;

T: Optimal period (this is N in formula for NPV calculation);

NPV_t: Net Present Value obtained from rotation period t.

That is, in solving this problem, NPV(t) is a function of optimal period T, T is allowed to be varied to get maximized total discounted NPVs from all rotations of planting forest. In other words, it is NPV to be used for identifying rotation, rather than taking the planted forest rotation as known to compute NPV.

Therefore, NPV and rotation period are mutually dependent and should be simultaneously identified within framework of solving the optimal period problem. Following are some methods can be used:

- Allowing forest planting rotations (T) to be changed in a practical range (such as 5, 7, 9, 11 years), calculating NPV(T) accordingly, then select the best T by using the criterion of maximizing total NPV from all rotations in land

allocation period (for the details, see Nguyen Quang Ha and Duong Thi Thanh Tan, 2016).

- Solving optimal period problem by using multi-objective optimization technique. This is a rather technically complicated. However, with increasing availability of specialized software, such as the free online MINBUS software, the method becomes much more practically applicable (see Nguyen Quang Ha, 2017 for details).

3.2. Handling the risks

The way to deal with risks in NPV methods has been clearly shown in many publications, for example Warren (1982), Hardacer et al (2004)... However, in Vietnam, not much attention has been paid on this issue, both in theoretical and practical works.

In economic and financial analysis using NPV method in Vietnam, the only treatment of risks is undertaking sensitivity analysis. In thesensitivity analysis, NPV is calculated with allowing changesin some main factors such as input and output prices, productivity, and interest rate. The sensitivity analysis shows the elements for which NPV is most sensitive and allows the decision makers to examine the likely effects of the worst, best, and most likely assumptions concerning the outcome of a project. Clearly, thoseinformation is useful for assessment of the project feasibility and hence, sensitivity analysis is necessary. However, it is not enough to handle the risk problem in economic and financial assessment in forest plantation. The reason is that, while sensitivity analysis allows to compare possible NPVs with that of base case, but with current method of NPV calculating, the value of base case's NPV is not accurate, resulted from an error in interpretation of discount rate.

Since discount rate has the root of time value of money, it seems straight forward to interpreter as "interest rate". Because of this interpretation, the common way to select discount rate for a specific forest plantation project is the average of the normal borrowing interest rate from the funding sources[2]. Once normal interest rate is chosen, the discount rate consist of two components:

i) Real interest rate, and

ii) Inflation rate.

This application of discount rate is not appropriate for commercial forest plantation, a sector that heavily affected by social, natural and economic factors such as encroachment, fire, diseases… By its nature, commercial forest plantation alwaysassociates with non-diversifiable risks. Discount rate, interpreting as investor's expected returns to make them indifferent in receiving an amount of money today and in the future, should include compensation for non-diversifiable risk. Therefore, adding risk premium to discount rate is the basic way to handle the risk in NPV method.

Although there has been no risk surveys undertaken by any Vietnamese agencies so far, a very good preference of risk premium can be found in Fernandez et al (2014). Their paper reports the result of the market risk premium survey, covering 88 countries, periodically undertaken every two years. In this report, market risk premium used for Vietnam is reported as 10.3, shown in Table 01. In our point of view, this could be a reliable source to use for risk premium component in discount rate identification.

[2] For example, discount rate used for forest pricing, in accordant to the Government Decrees 48/2007/ND-CP is average normal borrowing interest rate applied by local branches ofcommercial banks operating in the forest site's area.

Table 01. Market risk premium (MRP) used for selected countries in 2014

Unit: percent

Country	MRP	Country	MRP
Philippines	8.1	United State	5.4
Thailand	8.0	Spain	6.2
Indonesia	7.9	Germany	5.4
China	8.1	UK	5.1
Pakistan	11.1	Italy	5.6
Vietnam	***10.3***	Japan	5.3

Source: Pablo Fernandez, Javier Aguirreamalloa and Luis Corres (2014) "Market Risk Premium used in 88 countries in 2014: a survey with 8,228 answers", IESE Business School, June 20, 2014.

3.3. Handling inflation

The interpretation and identification of discount rate as normal interest rate cause another error with regard to handling inflation in many applied NPV method in practice. Infeasibility analysis offorest plantation projects, it is convenient to use price level at present time (that is, the price at the time undertaking the analysis) and normal interest rate is used both for discounting future cash flows and compounding the past cash flow (if any). As inflation rate is included in normal interest rate, discounting future cash flows at fixed price is a double exclusion of inflation and clearly, is not correct. With regard to the past cash flows (that is, in the case there are some costs incurred or benefits received before the time undertaking analysis), since those cash flows are often calculated by using actual price, the inclusion of inflation rate in discount rate is appropriate. Nevertheless, the use of a same rate for discounting future cash flow at fixed price and compounding past cash flow at actual price is not consistent and resulted in an inaccurate time value of money.

Correcting for the above error in handling inflation is straight forward: for discounting future cash flows, if the cash flow is calculated at fixed price, inflation rate component must be excluded from discount rate; for compounding past cash flows calculated in actual price, inflation rate should be included.

Another common error related to inflation handling in NPV method is that, because of using actual normal interest rate at the time undertaking project analysis, because of the fluctuation in inflation rate, the output of NPV calculation for the same forest plantation project would significantly be varied with the time at which the analysis job taken place. Clearly, that NPV output would provide a wrong evaluation of economic and financial efficiency of a long rotation forest plantation project.

In a country with highly unstable in inflation rate like Vietnam, where in last fifteen years, inflation rate hasranged from less than 1% to above 23%, as shown in Table 02, the problem becomes much more serious.

Table 02. Real interest rate, Inflation rate in Vietnam, 2001 – 2015

Unit: percent

Year	Real interest rate	Inflation rate
2001	6.57	-0.43
2002	3.93	3.83
2003	2.42	3.22
2004	0.45	7.76
2005	1.67	8.28
2006	2.40	7.39
2007	1.41	8.30
2008	-5.62	23.12
2009	3.63	7.05
2010	0.95	8.86
2011	-3.55	18.68
2012	2.29	9.09
2013	5.36	6.59
2014	4.83	4.09
2015	7.32	0.88
Average	2.27	7.78

Source: World Bank (https://data.worldbank.org/country/vietnam)

Our suggestion for solving the problem is, when inclusion of inflation rate in discount rate is needed (for example, for compounding past cash flows), the inflation should be calculated in a long run basis. That is, inflation rate should be computed as the average value of a long period, rather than using actual inflation rate at the time undertaking the project analysis.

3.4 The use of NPV per hectare

The last matter in using NPV criterion does not relate to calculation technique or procedure rather, it is about the way we look at NPV outcome. Since most data for NPV calculation is provided in per hectare norms, it is very common in practice that, NPV per hectare is computed and considered as the most important, even the only criterion for assessing financial efficiency. There is nothing wrong, except for the fact that, if total NPV (that is, the scale of the project) is not put in consideration, it would lead to the phenomenon that, while forest plantations is assessed to be highly financial efficient, the financial status of the enterprise is not so satisfactory. This is the case of most state owned forestry enterprises. Because of capital constraints, their forest planting scale is small. Consequently, total revenue and total profits are small, facing huge difficulties while all NPV assessments give a good picture of financial efficiency to forest plantation. Table 03 below is an illustration of that inconsistency, the data is withdrawn form a survey on State Owned Forestry Enterprises (SOFE) in Bac Giang province.

Table 03. Performance of four SOFEs in Bac Giang provice, the year 2015

Unit: thousand VND

No	Items	Luc Nam	Luc Ngan	Yen The	Mai Son	Avarage
1	Total revenue	3,546.76	8,266.06	14,792.30	2,487.41	7,273.13
2	Revenue from forest plantation	2,982.46	8,138.24	14,578.93	2,044.75	6,936.10
3	Total costs	3,380.62	7,496.60	14,410.34	2,427.43	6,928.75
4	Before tax profits	166.14	769.46	381.96	59.98	344.39
5	After tax profits	157.33	662.91	313.81	47.29	295.34
6	Total Assets (capital)	27,156.10	10,763.27	10,433.69	11,347.17	14,925.06
	Of which: Ower's assets (Equity)	3,275.54	6,906.21	2,368.57	1,901.97	3,613.07
7	Planted Forest area	2,610.33	2,949.20	1,997.27	809.40	2,091.55
8	Profits/Revenue percentage (%)	4.44	8.02	2.12	1.90	4.06
9	Return on Asset –ROA (%)	0.58	6.16	3.01	0.42	1.98
10	Return on Equity – ROE (%)	4.80	9.60	13.25	2.49	8.17
11	Revenue per hectare	1.14	2.76	7.30	2.53	3.32
12	NPV per hectare (at r = 11%)	2,138.00	17,450.00	14,365.00	n/a	11,317.67

Source: Pham Thanh Le et al (2016)

It is clear from Table 03 that, while NPV per hectare is positive and relatively big magnitude, indicating a good financially feasibility of forest plantation, all other criteria show a very weak financial status of the enterprises.

Apart from small scale, the conflict pictures of financial efficiency in forestry state owned enterprises measured by NPV per hectare and total annual profits are caused also by another factor: not all management costs are fully accounted in NPV calculation sheet, whereas those costs are of significant amount. Management costs in enterprises are relatively big, because of large and complex forest planting sites and complexities in production organization.

The recommended solution with regard to this problem is that, a better data should be collected for NPV calculation, in particular, indirect costs need to be fully projected. In financial feasibility analysis, more attention should be put on total project NPV, rather than only NPV per hectare. Also, for the case of production unit like enterprises, for which commercial forest plantation is the main sources of annual income, the annual revenue and profits is equally important, not only discounted value of a specific project, in financial feasibility analysis.

IV. CONCLUSION

NPV can be considered as of the most popular criterion used in economic and financial analysis for forest plantation. However, its terminology and methodology has been misinterpreted both in academic and practical context. Adhoc selection of forest planting rotations, ignorance of risk premium, irrelevant treatment of inflation, and overuse of NPV per hectare are found to be not trivial. In our point of view, with those problems in its application, the method have been failed to provide sound norms for decision making. The

negative impacts of misusing the method is long lasted and exaggerated as the errors are in place in teaching materials and legal documents. Correction for those errors, therefore, is really needed. Our solutions for each problem are not complicated, and ready to use. We strongly recommend a full awareness towards the existence of the problems and an immediate correction.

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SỬ DỤNG NPV TRONG ĐÁNH GIÁ HIỆU QUẢ KINH TẾ TRỒNG RỪNG: MỘT SỐ BẤT CẬP VÀ HƯỚNG GIẢI QUYẾT

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TÓM TẮT

Bài viết này thảo luận những hạn chế trong nhận thức và ứng dụng phương pháp NPV trong phân tích hiệu quả kinh tế trồng rừng. Xuất phát điểm của bài thảo luận là một thực tế khá phổ biến: trong khi các kết quả đánh giá hiệu quả tài chính dựa trên tiêu chí NPV của các dự án trông rừng rất khả quan, thì hầu hết các doanh nghiệp lâm nghiệp nhà nước và các đơn vị trồng rừng khác lại đang lâm vào tình cảnh tài chính hết sức khó khăn. Tác giả bài báo chỉ ra rằng, lý do của mâu thuẫn đó là các sai sót đáng kể trong ứng dụng phương pháp NPV. Các sai sót đó là: lựa chọn chu kỳ trồng rừng thiếu căn cứ, bỏ qua yếu tố rủi ro, xử lý không hợp lý yếu tố lạm phát, và sử dụng quá mức chỉ tiêu NPV trên một hecta. Do những sai sót đó, phương pháp NPV đã không đưa ra được một tiêu chí đúng cho đánh giá hiệu quả kinh tế và hiệu quả tài chính của trồng rừng. Do các sai sót đó nằm ngay trong các tài liệu giảng dạy và các văn bàn pháp quy, nên các hệ lụy của việc dùng sai phương pháp là lâu dài và ngày càng nghiêm trọng. Dựa vào kết quả phân tích, tác giả đề xuất các giải pháp cho từng vấn đề: phương pháp xác định chu kỳ trồng rừng và xác định NPV một cách đồng thời, đưa phần bù đắp rủi ro vào tỷ lệ chiết khấu, xử lý thống nhất yếu tố lạm phát và loại giá cả sử dụng trong tính toán NPV, và sử dụng tổng hợp các tiêu chí trong đánh giá hiệu quả kinh tế và hiệu quả tài chính. Theo tác giả bài báo, các giải pháp đề xuất là khá đơn giản, có thể sử dụng được ngay, nên vấn đề đáng quan tâm là ở nhận thức về sự tồn tại của các vấn đề và các phản ứng khẩn trương của những người làm việc trong các lĩnh vực liên quan, cả về học thuật và thực tiễn.

Từ khóa: Giá trị hiện tại ròng, hiệu quả kinh tế, trồng rừng, tỷ lệ chiết khấu.

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