**ANOTHER LOOK AT MUTUALLY EXCLUSIVE ALTERNATIVES WITH UNEQUAL LIVES AND REQUIRED RETURN**

**A PEDAGOGICAL COMMENT**

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# INTRODUCTION

A recent article in this journal [Jim Musumeci, 1999] offered a potential mistake in applying ‘equivalent annuity method” and “ replacement chain method” when mutually exclusive projects have unequal lives. The author stated that if the cost of capital for two mutually exclusive unequal lives projects is different the “equivalent annuity” and “replacement chain” methods may result in erroneous choices.

The purpose of this paper is to show that (1) the inherent assumption of equivalent annuity method (EAM) and replacement chain method (RPC) is that the projects must be in the same risk class and the same constant cost of capital, (2) any deviation from the above assumption will result in erroneous choices. Finally, the adjusted net present value (ANPV) is the only method that will result in correct choices for unequal lives projects with different risk class and cost of capital

Consider a project which has expected cash flows, CFt and NPV (T) with cost of capital r.

The NPV of an infinite stream of the project which is replicated every T years is equal to:



Equation 1 can be simplified as equation 2



It is often suggested a good ranking measurement for unequal lives projects is the equivalent annuity method (EAM) which is obtained by multiplying NPV (T, ) by the cost of capital. That is: Equivalent Annuity Method= ror



or



Equation 3 can be illustrated by using the Alternative A and B, used by Musumeci.

Table 1 Alternative A Alternative B

Year CFA CFB

0 -1000 -1000

1 482 420

2 482 420

3 482 420

4 420

NPVA (@10%) 198.66

NPVB (@12%) $275.69

EAMA (@10%) $79.89

EAMB (@12%) $90.77

RPCA (@10%) $544.31

RPCB (@12%) $562.24

EAMA /(10%) 798.85

EAMB /(12%) $756.38

Table 1 summarizes the result of the net present value, equivalent annuity and replacement chain methods and perpetuity value of EAM of the two projects at the cost of capital of 10% and 12% as reported by Musumeci. It is obvious that the Alternative B is recommended by NPV and RPC, and Alternative A with EAM perpetuity, as long as the cost of capital is 10% for A and 12% for B.

However, if projects have different risk and therefore different costs of capital, the EAM and RPC should not be used, because if two projects have exactly the same , then the one with the higher cost of capital (that is, the riskier project) will appear (incorrectly) to have the greater value.

# ADJUSTED NET PRESENT VALUE METHOD

The Adjusted Net Present Value (ANPV) is derived by multiplying Equation 2 by (r/r) and then simplifying as Equation 5.



or



# UNEQUAL LIVES PROJECTS WITH DIFFERENT COST OF CAPITAL

Applying Equation 5 to the above example yields an ANPV of $798.85 for project A and project B ANPV is $756.38. If the cost of capital for project B were 10%, the NPV, EAM, RPC, and ANPV would be equal to $331.34, $104.53, $907.84, and $1045.29 as shown in the above Table 2. It is obvious that the project B is a better alternative than A when the cost of the capital is 10% or 12% for both projects. This is the inherent assumption of EAM and RPC that the cost of capital must be the same for all of the projects. When the projects are in different risk class with different cost of capital then the ANPV results in correct decision.

## Table 2 Comparison of Alternative A and B at Different Cost of Capital

 Alternative A Alternative B

NPV (@10%) $198.66 $331.34

NPV (@12%) $157.68 $275.69

EAM (@10%) $79.89 $104.53

EAM (@12%) $65.65 $90.77

RPC (@10%) $544.31 $$907.84

RPC (@12%) $406.67 $562.24

EAM /(10%) $798.85 $1045.29

EAM /(12%) $547.09 $756.38

ANPV (@10%) $798.85 $1045.29

ANPV (@12%) $547.09 $756.38

# CONCLUSION

Musumeci has identified reasons that the equivalent annuity method and replacement chain method may fail when the projects have unequal lives with different cost of capital. However, the failure of these methods is due to erroneous assumption that was made in his paper. Both methods will result in the correct decision as long as the inherent assumptions of both methods are made correctly.

In this paper, it has been shown that the EAM and RPC result in correct decision as long as the assumption of methods (same cost of capital) is maintained. When the investments are in different risk class with different cost of capital, the Adjusted Net Present value is only method that will result in correct decision.

# REFERENCES

Jim Musumeci, “Another Look At Mutually Exclusive Alternatives With Unequal Lives And

Required Returns,” *Journal of Financial Education*, Spring 1999, Vol. 25, pp.18-20.