OFFSHORE BORROWING, SUPPORTED BY REAL OPTIONS THEORY AND NET PRESENT VALUE

KREMLJAK, Z.

Abstract: *In times of crisis and in general, it is very important how we invest, in which currency and at what time we use which option. Capital is bearable if it is also profitable. Of course, we have to monitor developments on the capital market and react in good time by repaying loans in the relevant currency and taking out new ones. The chapter, which is based on the theory of real options and appropriate borrowing, shows exactly the right way to borrow and repay so that we do not operate at a loss. The method used, the Net Present Value (NPV) method, based on real options theory, shows the appropriateness of the problem-solving approach. Two cases about investments are shown and discussed. Some suggestions about the investment strategies are given at the end of the chapter, which discusses potential advances in theoretical models, emerging trends in finance and technology, and the practical implications of evolving global financial landscapes, all of which are relevant to future research directions.*

Key words: *Real options, Net Present Value, Investment, Currency, Profit, Credit*

Authors´ data: Dr. Sc. **Kremljak**, Z[vonko], Private Researcher and Consultant, Hmelina 14, 2360 Radlje ob Dravi, Slovenia, EU, zvonko.kremljak@s5.net

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1. Introduction

In today's highly globalised financial world, companies often use offshore borrowing to gain access to different capital markets, optimise financing costs and mitigate risks. Offshore borrowing is the raising of capital in foreign markets, often through debt instruments such as bonds or loans, to take advantage of favourable interest rates, currency conditions and investor demand. As companies increasingly operate across borders, the need for cost-effective and flexible financing solutions has become critical to maintaining competitiveness and long-term sustainability. Deregulation of offshore borrowing directly causes an increase in foreign debt inflows (Brafu-Insaidoo & Biekpe, 2014).

To assess the profitability of offshore loans, two well-known financial analyses come into play: Net Present Value (NPV) and real options theory. NPV is a traditional method of evaluating investment decisions by calculating the present value of expected cash flows and allowing companies to assess the profitability of an offshore lending decision (Gotoh et al., 2022). However, NPV alone cannot fully capture the inherent flexibility and strategic value of financial decisions in uncertain and dynamic environments. Economic analyses help decision-makers in identifying the most suitable methodology before proceeding with the investment (Dranka et al., 2020, Zhang & Yin, 2023).

Real options theory complements NPV by incorporating the concept of managerial flexibility under uncertainty, similar to financial options in investment decisions (Balter et al., 2022). This framework recognises that decisions, such as the timing of offshore debt issuance or the ability to refinance on more favourable terms, can improve a company's financial strategy. By treating offshore debt as a set of real options, companies can better manage risks such as exchange rate fluctuations, interest rate volatility and regulatory changes. Investment decisions are not only about timing but also about size.

This paper aims to analyse the interplay between offshore borrowing, Net Present Value and real options theory in order to provide a comprehensive approach to decision-making in international finance. It will analyse how these theoretical models can be applied to maximise firm value while managing the risks associated with global financial markets. By combining traditional financial valuation and strategic flexibility, this study aims to provide valuable insights for companies considering offshore borrowing as part of their overall capital structure strategy.

This introduction provides the basis for a detailed discussion of offshore borrowing and links it to the theoretical concepts of Net Present Value and real options theory, also emphasising the importance of these models for strategic financial decisions.

2. Basics of Net Present Value

Net Present Value (NPV) is a financial metric used to assess the profitability of an investment or project by calculating the present value of future cash flows discounted back to the present using a specific discount rate.

Essentially, the NPV helps to determine whether the expected returns from a project, adjusted for the time value of money, will exceed the original investment. NPV calculations have appeared in textbooks as well as numerous peer-reviewed journal articles (Foley & Wang, 2024). The concept of the time value of money is central to NPV. It reflects the idea that a dollar today is worth more than a dollar in the future because you can earn interest or returns on that money over time. NPV captures this by discounting future cash flows to their present value using a discount rate that is often based on the company's cost of capital or a required rate of return. The traditional NPV rule optimises only the financial value (Toorop et al., 2024).

Mathematically, the Net Present Value is calculated by summing the present values of the expected cash flows (both inflows and outflows) over the life of the project. If the NPV is positive, the project is considered profitable, i.e. it generates more value than the costs incurred. A negative NPV indicates that the project would result in a loss, and a NPV of zero means that the project would cover its costs.

The net present value is favoured because of its ability to provide a clear decision-making aid. It takes into account both the amount and timing of cash flows, which makes it superior to other methods such as the amortisation period or the accounting rate of return. However, it requires an accurate prediction of future cash flows and an appropriate discount rate, which is sometimes difficult to estimate (Chambers, 2024).

3. Basics of real options theory

The success and applicability of the approach mentioned above is the reason why the methods for valuing financial options have been transferred to the valuation of flexibility in the context of investment projects in tangible assets (Dixit & Pindyck, 1995; Luehrman, 1998), e.g. investments in technology, production systems (Mandler, 2024) and the development of new products. This type of option valuation has been termed real options (Kogut & Kulatilaka, 2001). Real options are options that are linked to real assets and can be defined as the ability to respond to changing project circumstances (Coff & Laverty, 2001).

A simple analogy between investment projects and financial call options can be found in Tab. 1 (Luehrman, 1998). The majority of projects involve investments in tangible assets. Investing money in this type of business opportunity can be compared to exercising an option on a security share (Adner & Levinthal, 2004).

Real options		**Financial options**
Investment opportunity	**Variable**	Call option
Current value of cash flows	S	Current stock price
Investment expenditure	X	Exercise stock price
Possible time of decision to defer	$T-t$	Time to expiration date
Time value of money	R	Riskless return rate
Uncertainty of future cash flows	σ^2	Variance of returns on stock

Tab. 1. Comparison of investment opportunity and call option.

The current value of the assets created or acquired corresponds to the stock price (S) at the time the option is exercised. The amount of the financial assets utilised corresponds to the exercise price (X). The time available to a company to postpone a corresponding investment decision corresponds to the time until expiry ($T - t$). The uncertainty in the future value of the project's cash flows is equal to the standard variance of stock returns (Miller & Park, 2002). The time value of money in both cases is the risk-free rate of return (R).

Based on the abovementioned, the following can be summarized:

- Higher volatility of circumstances is therefore not reflected in greater losses, for they are limited with the original investment or investment in acquiring an option.
- Option offers practically unlimited possibilities to acquire benefits.
- Value of real option grows with available time interval, or time that is available for decision-making.

As it can be seen, real options are based on the same principles as financial options (Kulatilaka & Trigeorgis, 1994). However, despite the great similarity, they are not completely identical. Among major differences are the following:

- Real options can be used for investments in tangible assets.
- Financial options generally have a shorter life span, which is relatively easy to define.
- Financial options are linked to a type of underlying asset that can be traded on various markets. Therefore, this type of asset cannot have a negative value, which is not necessarily the case with real options.
- Real options are usually more complex. A given asset may contain several options.
- Exercise prices are clearly defined for financial options, whereas they can fluctuate randomly over time in the case of real options.
- The value of a real option and the optimal time to execute the option depend on the company's position in the market.

The value of an option results from the future behaviour of the underlying asset, e.g. the price of stock of the company, the price of commodities such as oil (Bollen, 1999) or the value of a project (e.g. a drug that has not yet been fully developed). The first step in the valuation of options is the prospect of future performance of the underlying asset value (Fig. 1). The number of possible groups of asset values is enormous (Maric & Grozdic, 2016).

In Fig. 1, Howell et al. (2001) show the past path of asset value and only four possible future paths. These are designed by combining expected future trend (prices that grow on a certain level) and a coincidental element. The principle that stock price movement through time has characteristics of geometric Brown movement is one of the most important ones. If today we knew what the future movement of value of underlying asset will be, we could know in detail the optimal time to exercise the option, the value on the expiration date and thus also its current value. We could lose the meaning of options – the value that comes from uncertainty.

Although we do not know which way the underlying asset value would travel we can imagine (and even more important, plan) a large number of possible future outcomes of asset value, where everyone results in different value of the option. If different option values, which come from possible ways, are appropriately combined, and if we take into account their probabilities, current value of the option can be determined.

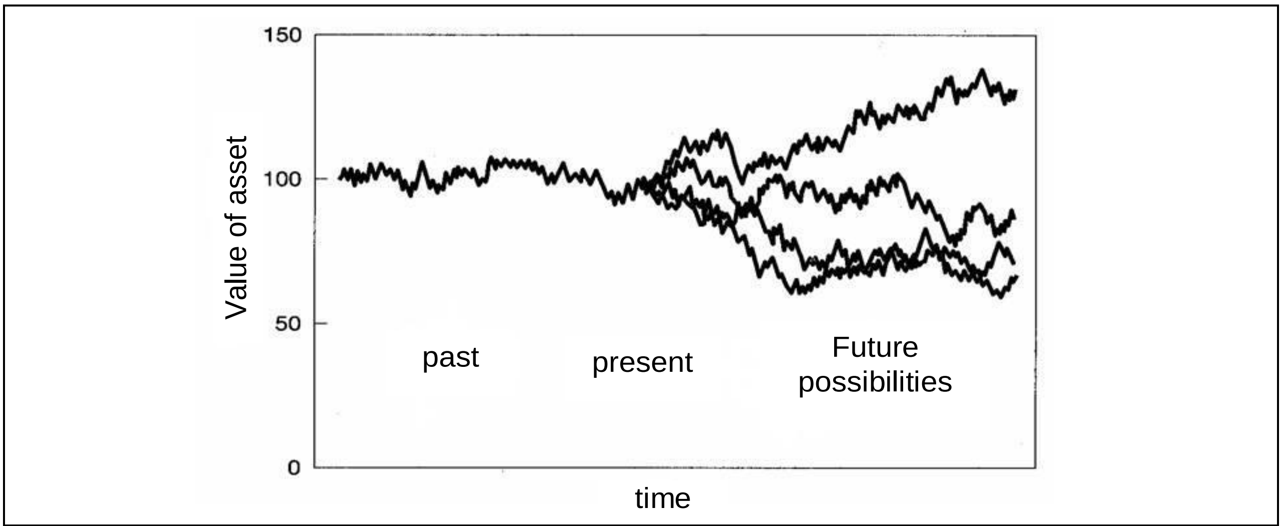

Fig. 1. Movement of asset's value in the future.

Basic model thus represents a coincidental walk, which is a basis for many financial theories. It is also used for financial yield on company stock where there is a rule that "market has no memory". When there is only one variable (yield per stock), coincidental walk is described as 'one-dimensional'. Based on the abovementioned data, one can see that defining the price variance of stock is one of the more important activities. Wrong definition quickly leads to overestimation of the option. Every change of state poses a question about offered options. Therefore, the knowledge and definition of real options are very important (Bowman & Moskowitz, 2001).

4. Financial options

Financial option is usually defined as the right to purchase or sell certain securities, for a price set beforehand and in a contractually specified deadline. In the context of options as financial tools, an option represents an agreement between two parties where the holder of the option has a right, which is not binding, to buy or sell under specified conditions. There are two basic types of options: call options and put options. A call option gives the holder the right to buy stock at a given price before or at a specified date (Trigeorgis, 1996). The price, for which the stock can be purchased, is called exercise price (X). In advance set final time for exercising of option is called expiration date (T). European type of call option allows purchase of securities on a specific expiration date, while American call option allows purchase at any given moment up to the specified expiration date. Buying stock represents an exercise of option. The buyer of a call option has to pay the right to buy. The amount of payment is called price or value of call option (C).

The value of call option (C) represents the difference between the exercise price and current price of the stock. The value of call option can be graphically presented as the function of stock price (S^*) (Fig. 2).

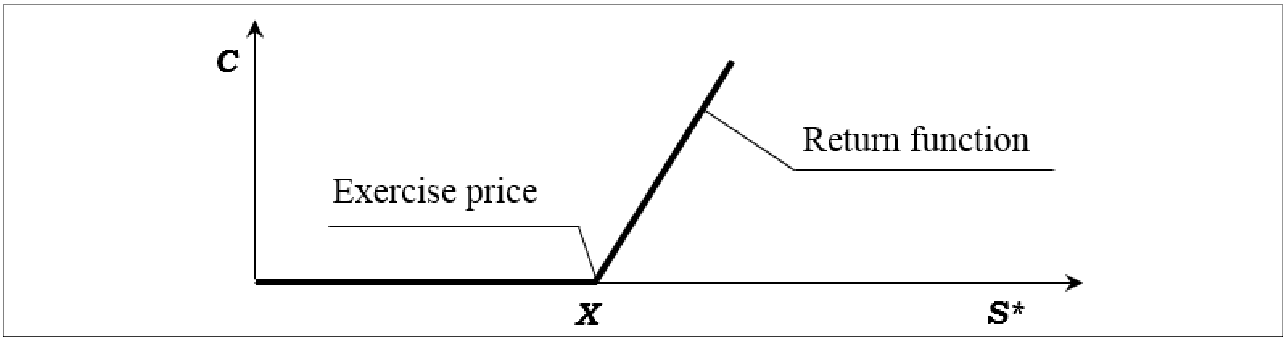

Fig. 2. The value of call option.

The buyer of call option for stock will have profit in the event that the stock price in the future grows. In the event that the price of the stock falls, the option holder will not exercise it, which means that he will not suffer loss, barring transaction costs. Because of this, the value of call option cannot be negative. One can presume that the current market price of stock with exercise price is (X), (S^*). The value of call option (C) is presented by the following equation:

$$C = Max\ [0, S^* - X] \tag{1}$$

Similarly, the put option (P) presents the right to sell stock at given price before or after the specified date (Trigeorgis, 1996). Graphically, the value of put option can be presented as shown in Fig. 3.

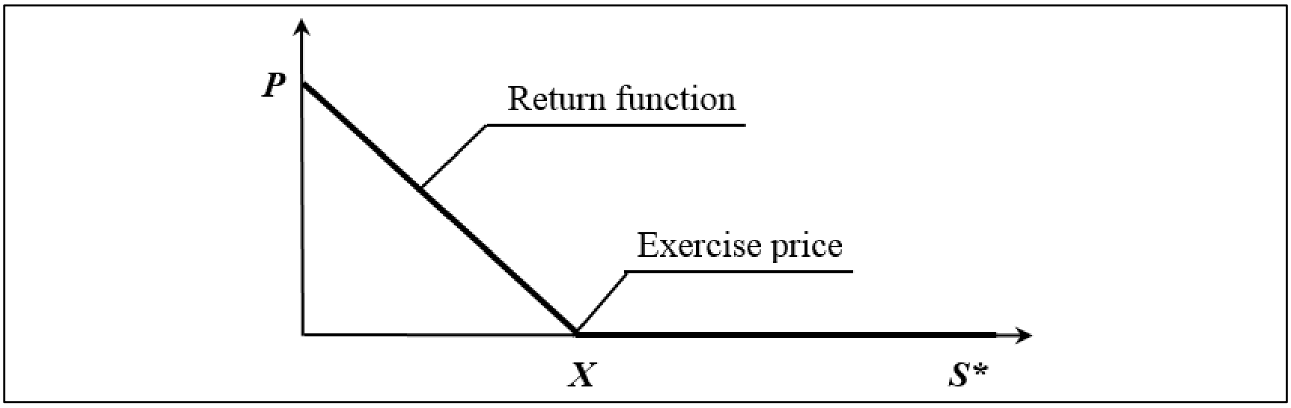

Fig. 3. The value of put option.

In call as well as in put options we differentiate between American and European types. American type of put option allows the sale of security at any time until expiration date, while European type of put option can be executed only on the expiration date. The holder of put option will have profit from exercise price in the event that the stock price (S^*) falls under the exercise price (X). The value of put option is shown in the equation below:

$$P = Max\ [0, X - S^*] \qquad (2)$$

The diagram in Fig. 3 shows that theoretical value of put option lowers by increase in the stock price and reaches the value zero (0) when the price of stock is equal to exercise price.

As mentioned before, in 1973 Black and Scholes formulated first successful model for evaluating financial options is now called Black-Scholes model (Howell et al., 2001). To make the model functional they accepted the following premises and limitations:

- there is no payment of dividends,
- interest rate is known and constant,
- there are no transaction costs,
- option can be realized only on expiration date (European type),
- stock prices follow expected stochastic diffusion process and cannot take negative values.

The calculated optional value is a function of five variables:

- current stock price S,
- exercise price X,
- time to expiration date T,
- annual interest rate for risk less investment,
- variances of price fluctuations of stock σ_X.

The model is useful for both call and put options. Thus the following function can be written $C = f(S, X, T, r, \sigma^2)$. Value of put option ($C$) is specified with the following equation:

$$C = S \cdot N(d_1) - \frac{X}{e^{r(T-t)}} \cdot N(d_2) \qquad (3)$$

where: $$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\sigma^2}{2}\right) \cdot (T - t)}{\sigma\sqrt{T - t}}$$

and $$d_2 = d_1 - \sigma\sqrt{T - t}\ .$$

$N(x)$ is standard cumulative normal distributional function; t is current time (Yeo and Qiu, 2003). The model based on the design of risk is less hedge. By buying stock and simultaneous sale of call options for these stocks, the investor creates risk less assets. Thus the profits from the sale of stock even out with losses from the buying of options and vice versa. The profitability of this kind of asset is equal to risk-free rate of return.

5. Case 1 of offshore borrowing

Suppose you are a European wheat farmer and you want to borrow to expand your operations.

You intend to borrow 10 million units in currency AA for 5 years. You face a rate of 12 % in AA-denominated loans. A Swiss bank, however, will lend at 9 % by way of Swiss-Franc-denominated loans. What should you do?

Borrow 10 million of AA? Repay 10×1.12^5 million AA in 5 years. Or:

Borrow 12.5 million CHF, and convert into AA? Repay 12.5×1.09^5 million CHF in 5 years.

The question is whether 10×1.12^5 million AA will be more than 12.5×1.09^5 million CHF?

Depends on the spot rate 5 years from now, which is uncertain. Decide to hedge this risk using the forward market.

Suppose the 5-year forward rate is 0.91632 AA / CHF.

$$F_T^{AA/CHF} = S_0^{AA/CHF} \frac{(1+r_T^{AA)})^T}{(1+r_T^{CHF})^T} \tag{4}$$

$$0.91632 = 0.8\frac{(1.12)^5}{(1.09)^5}$$

Paying back the 12.5×1.09^5 million CHF will require:

12.5×1.09^5 million × 0.91632 AA = 17.62 million AA

However, this is exactly what would have to be repaid under the AA loan since:

10×1.12^5 million AA = 17.62 million AA.

Hence, nothing has been gained by borrowing offshore! Why does this work?

Covered Interest Rate Parity:

This equivalence always holds and is known as covered (Hopkinson, 2016).

6. Case 2 of offshore borrowing

European manufacturer of heating equipment considers building a plant in Japan. The plant would cost Yen 1.3 billion to build and would produce cash flows of Yen 200 million for the next 7 years. Other data:

- Yen interest rate: 2.9 %,
- Currency AA interest rate: 8.75 %,
- Spot rate: Yen / AA: 83.86,
- Assumption: the investment is risk free.

Method I

Step 1: Forecast cash flows in Yen

Step 2: Discount at interest rate for Yen; gives *NPV* in Yen

Method II

Step 1: Forecast cash flows in Yen

Step 2: Convert cash flows into AA using implied forward rate

Step 3: Convert *NPV* in Yen into AA at spot exchange rate, giving *NPV* in AA

Year Forward rate	**2019** 83.86	**2020** 79.35	**2021** 75.08	**2022** 71.04	**2023** 67.22	**2024** **63.61**	**2025** 60.18	**2026** 56.95
Method I								
Cash flows (Yen)	-1300	200	200	200	200	**200**	200	200
Discount factor	1.000	0.972	0.944	0.918	0.892	**0.867**	0.842	0.819
PV (Yen)	-1300.000	194.36	188.88	183.56	178.38	**173.36**	168.47	163.728
Method II								
Cash flows (AA)	-15.502	2.520	2.664	2.815	2.975	**3.144**	3.323	3.512
Discount factor	1.000	0.920	0.846	0.778	0.715	**0.657**	0.605	0.556
PV (AA)	-15.502	2.318	2.252	2.189	2.127	**2.067**	2.009	1.952

Tab. 2. Initial data and calculation with both methods.

Method I: Present value = -Yen 49,230 million
Method II: Present value = -AA 590 m. = -Yen (590×83.86) m. = -Yen 49,230 m.
Both methods yield the same result!

Alternative Exchange Rate Forecast:
Suppose the corporate treasurer argues that the true value of investment is understated, because the market is too pessimistic about the Yen.

Assume the Yen appreciates 2.5 % p. a. faster than anticipated by the market. The results are given in Tab. 3 below.

Now the *PV* with Method II becomes AA 976 thousand or Yen 81,840 million. Now the project looks profitable.

Year / Time	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Forward rate	83.86	79.35	75.08	71.04	67.22	63.61	60.18	56.95
Method I								
Cash flows (Yen)	-1300	200	200	200	200	200	200	200
Discount factor	1.000	0.972	0.944	0.918	0.892	0.867	0.842	0.819
PV (Yen)	-1300.000	194.36	188.88	183.56	178,38	173.36	168.47	163.728
Method II								
Forward rate	83.862	77.367	71.375	65.847	60.747	56.043	51.702	47.698
Cash flows (AA)	-15.502	2.585	2.802	3.037	3.292	3.569	3.868	4.193
PV (AA)	-15.502	2.377	2.369	2.362	2.354	2.346	2.339	2.331

Tab. 3. Alternative calculation with both methods.

6.1 Capital Budgeting and Currency Speculation

Break down your project into two investments:

1. Borrow AA 15,502 million and convert it into Yen for Yen 1.3 billion; Zero-*NPV* project.
2. Invest the proceeds into plant for heating equipment:

Negative *NPV* (Yen -49,230 million).

Compare this with an alternative combination of two investments:
1. Borrow AA 14,915 million and convert it into Yen for Yen 1.251 billion.
2. Invest the proceeds into a 7-year bond with repayment of 200 thousand.
Positive *NPV* of AA 1,563 thousand, if optimistic treasurer is correct.
Hence, investing in plant has two consequences:

- Profit of AA 1,563 thousand on speculation on Yen.
- Loss of AA 587 thousand on plant.
- Net gain is 1,563 – 587 = AA 976 thousand.

7. Conclusion

Based on the abovementioned, the following can be summarized: Higher volatility of circumstances is therefore not reflected in greater losses, for they are limited with the original investment or investment in acquiring an option. Option offers practically unlimited possibilities to acquire benefits. Value of real option grows with available time interval, or time that is available for decision-making. There is no easy gain from offshore borrowing.

Important implication of covered interest rate parity:

- Use discount rate for relevant currency. It does not matter which one you take.
- Use consensus forecast of market.
- Do not delude yourself by taking a "view" on exchange rate.

Time of currency conversion is very important and has an impact on the profit.

In this chapter, we have looked at the complexities of offshore borrowing through the lens of real options theory and net present value. Both approaches provide valuable insights into decision-making under uncertainty and allow companies to manage the potential risks and rewards of international financing.

Real options theory extends traditional NPV analysis by incorporating flexibility in decision making, which is particularly important when it comes to offshore borrowing. The ability to postpone, expand or cancel investment projects can provide strategic advantages for companies, especially in volatile global markets. Offshore borrowing offer the opportunity to raise capital on favourable terms, but they also come with currency risks, interest rate fluctuations and regulatory challenges. By using real options theory, companies can adapt to changing market conditions and mitigate these risks while maximising potential returns.

Net Present Value, a cornerstone of financial decision-making, remains essential for assessing the profitability of offshore borrowing. A positive NPV indicates that the project or investment is likely to generate returns in excess of the cost of capital, underpinning the feasibility of offshore borrowing. However, the static nature of NPV does not take into account uncertainties or the flexibility of future decisions, so combining it with real options theory creates a more robust framework for evaluating offshore financing strategies. By integrating these two models, companies can gain a deeper understanding of the trade-offs associated with offshore borrowing.

Real options theory allows for dynamic management of uncertainty, while NPV ensures that the financial fundamentals of the project are sound. Together, they provide a comprehensive approach to optimising capital structure and investment decisions in the global financial landscape.

Ultimately, successful offshore borrowing depends on careful risk management, strategic flexibility and a solid financial foundation. Companies that harness the insights of real options theory and Net Present Value can better position themselves to take advantage of the opportunities offshore borrowing offers while minimising the risks associated with global financing.

The intersection of offshore borrowing, real options theory, and Net Present Value presents a fertile ground for further investigation. While real options theory accounts for flexibility in decision making under uncertainty, the evolving nature of exchange rate fluctuations and global macroeconomic changes requires more dynamic models. Future research could focus on developing improved models that more accurately account for currency risk in offshore borrowing, especially for firms operating in emerging markets or in regions with high geopolitical instability. A promising direction for future research is the development of hybrid models that seamlessly combine the simplicity of NPV with the flexibility of real options theory. Future studies could show how these models perform under different industrial conditions. Such models could provide clearer guidance to decision makers when evaluating complex investment opportunities that involve both immediate and future uncertain outcomes.

The rise of decentralised finance and blockchain technology is introducing new mechanisms for international borrowing and lending. Research could explore how these technologies are changing the risk-reward profile of offshore borrowing, and how corporates can utilise real options theory to manage uncertainty around regulatory change or market adoption. By exploring these areas, future research can provide deeper insights into the dynamic and evolving world of offshore borrowing and provide managers and policy makers with more sophisticated tools to manage financial uncertainty.

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