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Forward Contract-Based Decoupled Net Present Value

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Abstract

The decoupled net present value (DNPV) is a popular valuation method for long-term and complex investment projects. It is believed that this method provides a more accurate value than the traditional net present value method. Despite its popularity and accuracy, the DNPV method misvalues projects. This study shows DNPV's misvaluation by the put–call parity relationship and proposes to replace DNPV's synthetic insurance contract with a synthetic forward contract on the project's free cash flow. The forward contract-based DNPV (FDNPV) values the project exactly. In the case study of a gold-mining project, the risk-neutral and FDNPV values are equal, whereas the traditional NPV and DNPV values are lower than the risk-neutral value. This finding demonstrates FDNPV's exact valuation and DNPV's misvaluation.

Keywords: Capital budgeting, Project valuation, Risk premium, Time value of money

JEL Classifications: G13, G31

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1. Introduction

The decoupled net present value (DNPV) proposed by Espinoza (2014) and Espinoza and Morris (2013), is an alternative to the traditional net present value (NPV) method. While NPV aggregates the project's risk with the time value of money, DNPV decomposes the project's value into a time-value component and a risk-protection component. The time-value component corrects the undervaluation of long-term investments commonly found for NPV, whereas the risk-protection component enables investors to assess risks and the effectiveness of risk management measures (Espinoza, 2014). The application of DNPV in project valuation is simple. While DNPV discounts the expected free cash flows by the observed risk-free rate, the NPV uses the unobserved, risk-adjusted discount rate. It is difficult to estimate the risk premium, and investors do not agree with the estimate. Owing to the decomposition, the DNPV value tends to be more accurate than the NPV value (Dou, Liu, Xiao, & Pan, 2020; López-Marín, Gálvez, del Amor, & Brotons, 2021). This method is consistent with prospect theory (Tversky & Kahneman, 1991). Investors are loss-averse in theory, whereas DNPV transparently captures average investors' loss aversion attitudes (Espinoza, Rojo, Cifuentes, & Morris, 2020a).

DNPV has been applied in the valuation of long-term, complex investment projects such as solar energy project (Espinoza & Rojo, 2015), wind energy project (Piel, Humpert, & Breitner, 2018), and cargo ship projects (Schrader, Piel, & Breitner, 2018). Martínez-Ruiz, Manotas-Duque, and Ramírez-Malule (2021) used DNPV to value a photovoltaic solar energy project in Iran. The researchers found that the DNPV value was 2.3 times the NPV value. This finding is consistent with the observation of Buehler, Freeman, and Hulme (2008) of projects with unfamiliar risks. The risks perceived by investors are high, resulting in an inflated risk-adjusted discount rate and a low NPV value.

In a valuation of waste-to-energy projects in Iran, Shimbar and Ebrahimi (2017a) were aware of political risk and the fact that this project may be seized by the government. Owing to its nature, risk was modeled as a discrete variable, rather than continuous risks generally found in DNPV valuation. The researchers combined discrete and continuous risks for the valuation of the risk-protection component by incorporating a binomial tree in the analysis. This hybrid approach was later applied by Espinoza et al. (2020a; 2020b) to account for traffic volume risks in a toll-road project and climate-related risks in a power-plant project, respectively.

The DNPV's risk-protection component cannot account for all the influential risks of the project. Shimbar and Ebrahimi (2017b) and Nguyen, Almarri, and Boussabaine (2020) proposed alternative coefficients to adjust risk-protection premiums for absorbing the effects of omitted risks. Almansa and Martínez-Paz (2011) argued that the discount rate for environmental discounting should not be constant but should decrease randomly over time. López-Marín et al. (2021) applied the random-discount-rate approach to the DNPV valuation of pepper plantations in Spain to enhance the valuation accuracy.

Despite its increasing popularity and improved accuracy, DNPV misvalues projects. The risk-protection component is a synthetic insurance for protecting the downside risks of future revenue and free cash flows, as well as upside risks of future expenditures and costs. Effectively, synthetic insurance is put and call options against downside and upside risks, respectively. Although downside and upside risks are eliminated, the future protected value is still a random variable whose distribution is truncated at the protection threshold level. An insurance-protected project is not riskless.

This study shows that DNPV can overvalue or undervalue a project. To resolve this problem, synthetic forward contracts are substituted by synthetic insurance contracts for risk protection. The forward contract-based DNPV (FDNPV) provides the correct project value. This study uses a case study on a gold-mining project to demonstrate the application of the FDNPV method and compare its valuation results with those of traditional NPV, risk-neutral, and DNPV methods.

2. Decoupled Net Present Value

2.1 The Method

DNPV uses synthetic insurance contracts to protect against the risks of adverse movements of revenue, free cash flows, expenditures, or costs. This study limits its interest in the project's free cash flows. Let $\tilde{V}_\tau$ and $\tilde{P}_\tau$ be the free cash flow and insurance premium, respectively, on day t=τ>0. Today's value V_0 of the project is the DNPV in Equation (1) (Espinoza, 2014; Espinoza & Morris, 2013).

$$V_0 = DNPV = \frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau} - \frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau}, \quad (1)$$

where $E_0(\tilde{x}_t)$ is investors' expectation of random cash flow $\tilde{x}_t$. The discount rate y is the observed risk-free rate. For the insurance-protection threshold $\bar{V}_\tau$ for $\tilde{V}_\tau$, $\tilde{P}_\tau = Max\{0, \bar{V}_\tau - \tilde{V}_\tau\}$. The cash flow $\tilde{P}_\tau$ is effectively a payout of a put option, whose underlying and exercise prices are $\tilde{V}_\tau$ and $\bar{V}_\tau$, respectively. The option expires on day $t = \tau$. The protected free cash flow is $Max\{\tilde{V}_\tau, \bar{V}_\tau\}$, meaning that it will never fall below $\bar{V}_\tau$. Espinoza (2014) and Espinoza and Morris (2013) considered $Max\{\tilde{V}_\tau, \bar{V}_\tau\}$ as risk-free free cash flows.

22 Misvaluation of Decoupled Net Present Value

This study proves the misvaluation of DNPV using put-call parity (Stoll, 1969). Consider call and put options on free cash flow, $\tilde{V}_t$. The options set the exercise price for $\bar{V}_\tau$ and expiration for day $t = \tau$. With respect to put-call parity on day $t = 0$

$$V_0 = \frac{\bar{V}_\tau}{(1+y)^\tau} + C_0 - P_0, \quad (2)$$

where C_0 and P_0 are the current prices of the call and put options, respectively. Next, the study fixes $\bar{V}_\tau = E_0(\tilde{V}_\tau)$. Equation (2) becomes

$$V_0 = \frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau} + C_0 - P_0. \quad (3)$$

Thus,

$$V_0 = \frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau} - \frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau} + C_0 + \left(\frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau} - P_0\right) = DNPV + C_0 + \left(\frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau} - P_0\right). \quad (4)$$

The put price P_0 equals $\frac{E_0(\tilde{P}_\tau)}{(1+r_P)^\tau}$, where r_P is the risk-adjusted discount rate for the put option. As r_P is lower than y (Coval & Shumway, 2001), $\left(\frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau} - P_0\right)$ is negative. The term $C_0 + \left(\frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau} - P_0\right) > (<)\ 0.00$, so that $V_0 > (<)\ DNPV$. Therefore this study concludes that DNPV misvalues the project.

It is important to note that if the exercise price is $\bar{V}_\tau = V_0(1+y)^\tau$, $C_0 - P_0 = 0.00$ (Hull, 2018). For $E_0(\tilde{V}_\tau) \leq V_0(1+y)^\tau$, the DNPV necessarily undervalues the project. This condition is possible. For example, in the valuation of a gold mine project, investors uniformly expect gold prices to remain unchanged over time (Samis & Davis, 2014).

2.3 Forward Contract-Based Decoupled Net Present Value

2.3.1 The Design

Consider a portfolio H, consisting of a long position on the project's free cash flow and the short position of a synthetic forward contract. The forward contract sets the forward price for $\bar{V}_\tau$ and expires on day $t = \tau$. The current value of the portfolio is:

$$H_0 = V_0 - F_0, \tag{5}$$

where F_0 denotes the current value of forward contract. On day $t = \tau$, when the project pays free cash flow, the value of the portfolio is

$$H_\tau = \tilde{V}_\tau - \tilde{F}_\tau. \tag{6}$$

As the forward contract pays $\tilde{F}_\tau = \tilde{V}_\tau - \bar{V}_\tau$ on day $t = \tau$, the portfolio is perfectly protected.

$$H_\tau = \tilde{V}_\tau - \left(\tilde{V}_\tau - \bar{V}_\tau\right) = \bar{V}_\tau. \tag{7}$$

The protected free cash flow $\bar{V}_\tau$ is constant, known today to investors, and thus, riskless. From Equation (7), $H_0 = \frac{\bar{V}_\tau}{(1+y)^\tau}$.

The study fixes $\bar{V}_\tau = E_0(\tilde{V}_\tau)$. From Equations (5) and (7), it follows that:

$$V_0 = \frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau} + F_0 = FDNPV. \tag{8}$$

In Equation (8), the use of a synthetic forward contract in FDNPV decomposes the project value into the time-value and risk-protection components, as in DNPV. The time-value component is the same for $\frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau}$. The quantity $+F_0 = +\frac{E_0(\tilde{F}_\tau = \tilde{V}_\tau - \bar{V}_\tau)}{(1+r_F)^\tau}$ is the risk-protection component that parallels the quantity $-\frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau}$ of DNPV. The quantity r_F is the risk-adjusted discount rate for future contracts. Equation (8) ensures the correct FDNPV value.

2.3.1 Estimation of the Value of Synthetic Forward Contract

In FDNPV, the expected payout $E_0(\tilde{F}_\tau)$ is discounted by the risk-adjusted rate r_F. It is difficult to estimate r_F; which motivates the discovery of DNPV by Espinoza (2014) and Espinoza and Morris (2013).

This study recommends a risk-neutral method to estimate the F_0. This method has been applied in project valuation, for example, for research and development investment (Biancardi & Villani, 2017), natural resource investment (Haque, Topal, &

Lilford, 2014), renewable energy projects (Abadie & Chamorro, 2014), road and highway projects (Galera & Soliño, 2010), high-speed rail projects (Bowe & Lee, 2004), and real estate projects (Li, Chen, Hui, Xiao, Cui, & Li, 2014). Once risk-neutral processes for the project's risk factors are identified and their parameters are estimated, Monte Carlo analysis can be conducted to obtain F_0. Monte Carlo analysis of risk factors is also one of the techniques used to estimate DNPV insurance premiums (Espinoza & Morris, 2013).

3. Case Study: The KuisebSun Gold Project

This research uses the KuisebSun Gold project as a case study to demonstrate the application of the FDNPV method. The resulting values are compared with those from competing methods. The data on the project were from Samis and Devis (2014).

3.1 Background

The Kuisebsun-gold project is a development-stage mine in Namibia. The run-of-mine ore and recovery gold were estimated for 6.6 million tons and 545,000 troy ounces, respectively. Conventional open pits were chosen for mining, with an average rate of 946,000 tons per year. Construction began in 2007. It took 1 year to complete. The estimated operating period was 7 years, from 2008 to 2014.

3.2 Analysis of Free Cash Flows

Table 1 presents an analysis of the project's free cash flows. The project was jointly owned by the government, creditors, and shareholders; thus, corporate income taxes, royalty fees, interest charges, and principal repayments were not included in the analysis. The free cash flows in row (12) are investors' expectations.

3.3 Risk Analysis and Discounting

The only risk factor of the project is the random gold price $(\tilde{S}_t)$. In 2007, the price was 652.00 dollars per troy ounce. The analysis is performed in the real monetary terms as in Samis and Davis (2014). It is assumed that the price follows the geometric Brownian motion in Equation (9).

$$dS = \mu S dt + \sigma S dz. \tag{9}$$

The parameters μ and σ are the drift term and price volatility, respectively, and dz is the Wiener process. Volatility is 20.00% per year. Investors assumed a constant gold price over the life of the project, $\mu = 2.00\%$. The risk-free interest rate is 2.60%. The investors demanded a 5.00% risk premium to compensate for the project's risk, so that the risk-adjusted discount rate was 7.60%.

Table 1: Analysis of Free Cash Flows

Item	2007	2008	2009	2010	2011	2012	2013	2014
(1) Forecast Gold Price[a]	652.00	652.00	652.00	652.00	652.00	652.00	652.00	652.00
(2) Recovered Metal[b]	0.00	81.79	110.18	93.85	90.57	80.41	60.10	27.81
(3) Gold Revenue[b] = (1) × (2)	0.00	53.33	71.84	61.19	59.05	52.43	39.18	18.13
(4) Mining Costs[c]	0.00	13.84	17.53	19.70	20.05	13.74	0.92	0.50
(5) Milling Costs[c]	0.00	8.21	8.10	6.07	8.10	8.08	8.10	5.19
(6) General and Administrative Expenses[c]	0.00	3.24	3.22	3.22	3.20	3.02	3.04	2.49
(7) Smelter Mineral Deduction[c]	0.00	0.27	0.36	0.31	0.30	0.26	0.20	0.09
(8) Mineral Refining Cost[c]	0.00	0.38	0.51	0.43	0.42	0.37	0.28	0.13
(9) Capital Expenditure[c]	47.85	1.94	1.04	0.86	0.83	0.66	0.58	0.15
(10) Working Capital[c]	2.080	0.00	0.00	0.00	0.00	0.00	0.00	-2.080
(11) Total Cash Outflow[c] = (4) + … + (10)	49.93	27.88	30.76	30.59	32.9	26.13	13.12	6.47
(12) Free Cash Flow[c] = (3) – (11)	–49.93	25.45	41.09	30.60	26.16	26.30	26.07	11.67

Note: [a] = dollars per troy ounce, [b] = thousand troy ounces, and [c] = million dollars.
Source: Samis and Devis (2014).

3.4 Valuation Methods

3.4.1 Competing Methods

The study computes the value of the project using five methods: traditional NPV, Monte Carlo simulation NPV, risk-neutral NPV, DNPV, and FDNPV. The traditional NPV method provides a baseline value for a project. The Monte Carlo simulation method yields the same value as the traditional NPV method. As the risk-neutral NPV, DNPV, and FDNPV are analyzed by Monte Carlo simulation, the Monte Carlo simulation NPV method is conducted first to ensure that the programs work properly.

The value given by the risk-neutral approach is the most important. This is the theoretically correct value of the project (Harrison & Kreps, 1979). This study proposes that FDNPV improves upon DNPV. FDNPV provides the correct value, whereas DNPV misvalues the project. If this is the case, then the FDNPV value must equal the risk-neutral value. The DNPV value is necessarily different from the risk-neutral value.

3.4.2 Value Calculation

The traditional NPV method discounts the free cash flows in row (12) of Table 1 by a 7.60% risk-adjusted discount rate. Monte Carlo simulation to obtain the NPV value assumes the process—$dS = 0.02Sdt + 0.20Sdz$, for the gold price and discounts the resulting average free cash flows by the 7.60% discount rate. The discount rate is set at 2.60% for the average free cash flows in the risk-neutral method; it modifies the gold-price process to $dS = 0.026Sdt + 0.20Sdz$.

For the DNPV method, the expected free cash flows $\left(E_0(\tilde{V}_\tau)\right)$ are the values in row (12) of Table 1. The study fixes the protection levels $(\bar{V}_\tau)$ of DNPV's synthetic insurance contracts at the same levels $\left(E_0(\tilde{V}_\tau)\right)$. The risk-free discount rate is 2.60%. The expected free cash flows $\left(E_0(\tilde{V}_\tau)\right)$ for FDNPV are the same for DNPV. The forward prices of synthetic forward contracts are the expected free cash flows $\left(E_0(\tilde{V}_\tau)\right)$. Forward contracts are valued using the risk-neutral valuation method.

For all the methods that use Monte Carlo analysis, the simulation is iterated 100,000 times. Readers can obtain the Excel files containing detailed analyses from the corresponding authors upon request.

3.5 Valuation Results

Table 2 reports the project values from the five competing methods. The traditional NPV and Monte-Carlo simulation NPV methods yield project values of 93.98 and 93.71 million dollars, respectively. The two values are very close, suggesting the simulation program works properly. The NPV value of 93.98 dollars is the value in Samis and Devis (2014).

Table 2: Project Values from Competing Methods

Valuation Method	Project Value (Million Dollars)
Traditional Net Present Value	93.98
Monte-Carlo Simulation Net Present Value	93.71
Risk-Neutral Net Present Value	127.77
Decoupled Net Present Value	74.45
Forward Contract-Based Decoupled Net Present Value	127.09

Source: Authors' calculations.

The risk-neutral value is 127.77 million dollars, which is much higher than the traditional NPV value. This difference can be explained in part by the fact that investors' expected gold prices were lower than the prices expected by risk-neutral investors. Moreover, the 7.60% risk-adjusted discount rate might have been inflated. Investors did not know the project very well. Their perceived risk was high (Buehler et al., 2008).

The DNPV value is 74.45 million dollars. It is 53.32 million dollars lower than the theoretically correct value. In this case, DNPV undervalues the project. Undervaluation can be explained in two ways. First, the expected free cash flow was incorrect. The project is risky. The expected free cash flows should be higher than their risk-neutral counterparts to compensate for risk. Second, DNPV misvalues the project by the size of $C_0 - P_0 + \frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau}$. In this case study, $\bar{V}_\tau = E_0(\tilde{V}_\tau) < V_0(1+y)^\tau$, so that $C_0 - P_0 > 0.00$ (Hull, 2018). The misvaluation portion $C_0 - P_0 + \frac{E_0(\tilde{P}_\tau)}{(1+y)^\tau}$ is positive and large.

The FDNPV method gives a project value of 127.09 million dollars. The difference from the theoretically correct value is 0.68 million dollars. The Monte Carlo simulation yielded approximate results. The small difference is attributable to simulation errors. The FDNPV value was the correct value for the project.

Table 3 decomposes the project values, based on the DNPV and FDNPV methods, into protected-cash-flow and risk-protection components from years 2007 to 2014. The protected-cash-flow components are equal for the two methods. They are the expected free cash flows, discounted by the risk-free rate. The insurance values for the DNPV method are negative, whereas the forward contract values for the FDNPV are positive. The insurance values are the prices paid by investors to obtain the protection for project value. It is important to note that the protected cash flows are under-valued. They are estimated from the zero expected gold return. In the risk neutral world, however, the correct expected return is 0.60%. The positive forward contract values add to the protected cash flows for the FDNPV to deliver the correct project value.

Table 3 : Decomposition of Project Values, Based on the Decoupled Net Present Value and Forward Contract-Based Decoupled Net Present Value Methods

Year	Decoupled Net Present Value (Million Dollars)			Forward Contract-Based Decoupled Net Present Value (Million Dollars)		
	Protected Cash Flow	Insurance	Project Value	Protected Cash Flow	Forward Contract	Project Value
2007	-49.93	0.00	-49.93	-49.93	0.00	-49.93
2008	24.80	-4.12	20.67	24.80	0.32	25.11
2009	39.00	-7.76	31.25	39.00	0.74	39.75
2010	28.30	-7.88	20.42	28.30	0.93	29.24
2011	23.57	-8.57	15.00	23.57	1.17	24.74
2012	23.09	-8.28	14.81	23.09	1.28	24.38
2013	22.31	-6.60	15.71	22.31	1.15	23.46
2014	9.73	-3.21	6.52	9.73	0.62	10.35
Total	120.88	-46.43	74.45	120.88	6.21	127.09

Source: Authors' calculations.

4. Discussion

4.1 Risk-Neutral Method versus FDNPV Method

The study concludes that the FDNPV method gives the correct value of the project because the value is equal to that of the risk-neutral method. Moreover, the value of synthetic forward contracts is risk-neutral. Why is FDNPV needed, while investors can use the risk-neutral method to value the project in the first place?

On the one hand, the risk-neutral method cannot differentiate the time from risk values. On the other hand, FDNPV, such as DNPV, decomposes the project value into the time-value and risk-protection components. Investors can use the risk-protection component as a risk metric to understand the risks being taken in the project and to evaluate the performance of risk management and mitigation (Espinoza & Morris, 2013).

4.2 Limitations of Risk-Neutral Valuation for Synthetic Forward Contracts

The study recommends the application of a risk-neutral valuation for synthetic forward contracts. Risk-neutral valuations have the following limitations (Garvin & Cheah, 2004). First, the model is complex. The analysis can concentrate only on a few risk factors. Second, simple and popular processes, such as the geometric Brownian motion, cannot sufficiently describe risk factors. Third, risk factors may not be traded in the market.

The first limitation is resolved by Monte Carlo analysis, convenient software, and computing power. For the second limitation, realistic risk-neutral processes and parameter estimation techniques have been proposed in the literature (Schwartz, 2013). Even if data are unavailable and parameters cannot be estimated, close substitutes may be obtained from various sources (Li et al., 2014). Finally, for non-trading risk factors, the approach of Cheah and Liu (2006) can be applied. Trading of risk factors was not necessary.

4.3 Incorrect Expectations of Free Cash Flows

As free cash flows are unobserved, investors must expect them. Expectations can be incorrect and the project is misvalued. The low NPV and DNPV values in the case study were potentially driven by incorrect expectations. However, for FDNPV, the value is always correct, despite incorrect expectations.

To demonstrate this ability, let the correct expected free cash flow be $\bar{V}_\tau^*$. Investors' expectations $E_0(\tilde{V}_\tau)$ are incorrect. The forward price is set for $E_0(\tilde{V}_\tau) \neq \bar{V}_\tau^*$, such that the FDNPV is

$$FDNPV = \frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau} - F_0\left(E_0(\tilde{V}_\tau)\right), \quad (10)$$

where $F_0\left(E_0(\tilde{V}_\tau)\right)$ is the current value of the forward contract, whose forward price is $E_0(\tilde{V}_\tau)$. Note that $F_0\left(E_0(\tilde{V}_\tau)\right) = C_0\left(E_0(\tilde{V}_\tau)\right) - P_0\left(E_0(\tilde{V}_\tau)\right)$ (Hull, 2018). $C_0\left(E_0(\tilde{V}_\tau)\right)$ and $P_0\left(E_0(\tilde{V}_\tau)\right)$ are the current prices of call and put options, respectively. The two options have the same exercise price at $E_0(\tilde{V}_\tau)$. Substituting $C_0\left(E_0(\tilde{V}_\tau)\right) - P_0\left(E_0(\tilde{V}_\tau)\right)$ for $F_0\left(E_0(\tilde{V}_\tau)\right)$ in Equation (10) yields

$$FDNPV = \frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau} - C_0\left(E_0(\tilde{V}_\tau)\right) + P_0\left(E_0(\tilde{V}_\tau)\right). \quad (11)$$

The put-call parity imposes that $\frac{E_0(\tilde{V}_\tau)}{(1+y)^\tau} - C_0\left(E_0(\tilde{V}_\tau)\right) + P_0\left(E_0(\tilde{V}_\tau)\right) = V_0$.

5. Conclusion

The net present value method incorporates risk and time factors into a single risk-adjusted discount rate. It is likely that for long-term investments, the resulting value is incorrect. The DNPV decomposes the project value into time-value and risk-protection components; the observed risk-free rate is used for discounting. DNPV is believed to improve the accuracy of the valuation. Moreover, the DNPV's risk component enables investors to understand the risks associated with the project and to evaluate the performance of the project's risk management and mitigation.

This study appreciates the DNPV of its improved accuracy and risk indication. However, it notices the misvaluation of DNPV and shows such a condition by the put-call parity. Misvaluation is corrected by replacing the DNPV's synthetic insurance contracts with synthetic forward contracts. The FDNPV method was applied to evaluate the KuisebSun Gold project in Namibia. The FDNPV value equals the risk-neutral value, whereas the traditional NPV and DNPV values are lower than the risk-neutral value. As the risk-neutral value is the theoretically correct value of the project, the results for the case study illustrate the exact valuation of FDNPV and the misvaluation of DNPV.

It is recommended that the FDNPV method is used together with the traditional NPV method. The weighted average cost of capital, unadjusted for risk, is the discount rate (Espinoza & Rojo, 2015). If the project is chosen, its positive NPV ensures sufficient compensation for creditors and shareholders.

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