Fair value, equity cash flow and project finance valuation: ambiguities and a solution

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Abstract

Purpose – The literature on project finance appraisal contains several ambiguities mainly concerning the correct method of equity cash flow (ECF) determination. This vagueness can lead to serious misevaluation of these projects. The purpose of this paper is to present and justify a correct method of ECF determination for project finance evaluation.

Design/methodology/approach – Based on the analysis of the specificity of project finance ventures and the study of existing literature, the authors propose a coherent model of ECF estimation that avoids misevaluating project finance ventures.

Findings – This paper demonstrates that the potential dividends methodology of ECF estimation, used commonly in the corporate finance world, leads to the erroneous valuation of project finance investments. Moreover, simulations demonstrate that the scale of this misevaluation is an increasing function of the debt covenant duration, the required rate of return, and the investment outlay dispersion over time. The proposed model of proper project finance valuation, despite inconsistency with assumptions of the fair value concept, is best suited for project finance venture appraisal, taking into consideration the inherently specific timing of the ECF.

Originality/value – This paper rectifies, clarifies, and extends the range of existing solutions for the project finance valuation and the application of the concepts of actual dividends and potential dividends in different valuation contexts. Furthermore, it proposes a simple and coherent method to value project finance ventures. Additionally, it offers evidence of the scale of NPV misevaluation in project finance, which occurs when the potential dividends approach is utilized.

Keywords Investment, Valuation, NPV, Equity cash flow, Project finance appraisal

Paper type Conceptual paper

1. Introduction

The existing literature does not provide clear and unambiguous guidance regarding the most appropriate method of project finance valuation. There are, in our opinion, two main reasons behind this phenomenon. First, although the different methods commonly used to calculate free cash flow (FCF) and discount rates are expected to yield the same result (consistent with the Modigliani-Miller theorem), there is still an intense discussion regarding whether the so-called concept of potential dividends (PD) or actual dividends (AD) should be applied in valuation models. Second, even when the authors present valuation approaches that are specifically adapted to project finance, they differ in their detailed recommendations.

One of the assumptions in an NPV calculation using a PD approach is that the distribution of FCF does not affect the value of a company or a project because potentially undistributed FCF can be utilized to finance other projects with a positive NPV. Hence, the moment of FCF creation is treated as the moment of FCF availability to owners. In contrast to the PD methodology, Vélez-Pareja and Magni (2009) promote the application of the AD approach. This method assumes that FCFs that are not distributed (and are invested in liquid assets) should not be treated as AD "because only distributed cash flows add value for shareholders." Therefore, according to the authors, equity cash flow (ECF) ought to include only dividends paid and share repurchases minus any new equity investments. Application of the PD concept results in a different FCF pattern compared to the AD approach and, thus, in different valuation results.

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In our opinion, the PD method can be justified for the evaluation of projects conducted within a standard corporate finance structure, and we present arguments as to why valuators should consider the application of PD, at least in the process of fair value valuation. However, in a project finance setting, the use of PD leads to a systematic misevaluation of projects for the following reasons. First, in project finance, cash flows are unavailable to equity providers until the loan or bond covenants expire. As a result, during this period, the FCFs generated by a project and accumulated in the accounts of a special purpose vehicle (SPV) should not be recognized as distributable in NPV calculations. Second, concerning the project finance structure, capital expenditures should be accounted for when capital is transferred to a SPV. The real timing of an SPV's investment outflows from the equity holders' point of view is irrelevant. Additionally, the usual assumption of possible FCF reinvestment in the context of project finance is not satisfied.

The arguments for the unsuitability of the investment appraisal method, based on the PD approach for project finance appraisal, stem from the fact that an SPV-executing project finance investment constitutes an economically and legally independent entity that services liabilities only with FCFs generated by the project itself (Bis, 2009; Scannella, 2012). Additionally, in a classic project finance structure, the owners of an SPV do not provide any support beyond the equity required to create the SPV, and they are not responsible for the liabilities of an SPV beyond the amount of the investment (John and John, 1991). The key features distinguishing investments made within corporate finance and project finance environments and their consequences for valuation are presented in Figure 1.

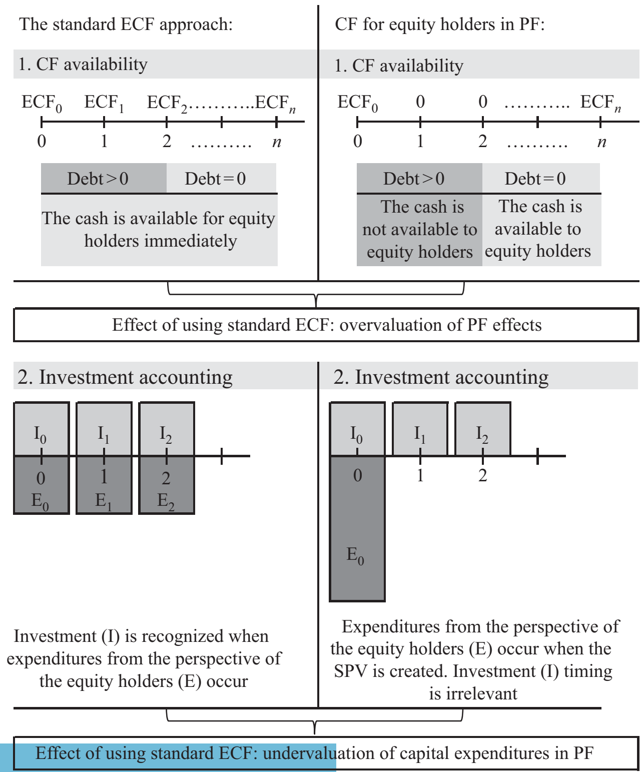

Figure 1.
Differences in the timing of cash flows and investment expenditures in corporate finance and project finance ventures

Our paper contributes to the existing literature in three ways. First, it rectifies, clarifies and extends the existing solutions for project finance valuations and the applications of AD and PD concepts in different valuation contexts. Second, we propose a simple and coherent method for the valuation of project finance ventures. Third, we present evidence on the scale of NPV misevaluation in project finance when the PD approach is utilized. For a proxy of the scale of misevaluation, we run several simulations in realistic scenarios.

The remaining parts of the paper are organized as follows. In Section 2, based on the literature, we provide theoretical backgrounds for the PD valuation approach. We explain its adequacy in fair value valuation and its inadequacy in the project finance world. In Section 3, we propose a simple and coherent method of project finance appraisal based on AD. Next, in Section 4, we provide a numerical example that underlines the differences between the PD approach and the appraisal solutions described in Section 3. Section 5 provides proxies for the scale of NPV misevaluation when the PD methodology is applied. Section 6 concludes the paper.

2. Literature review and motivation

The fundamental conceptual difference between the AD and PD approaches entails important implications for their use in the valuation process. Vélez-Pareja and Magni (2009) advocate the use of the AD approach without distinguishing between corporate and project finance contexts. Application of the PD concept results in a different FCF pattern in comparison to the AD approach and, thus, offers different valuation results. The authors defend their reasoning with a comprehensive literature review of studies that both support (e.g. Benninga and Sarig, 1997; Brealey and Myers, 2010; Copeland *et al.*, 2010; Damodaran, 1999, 2005, 2006, 2008) and oppose (DeAngelo and DeAngelo, 2006, 2007; Fernández, 2002, 2007b; Tham and Vélez-Pareja, 2004; Vélez-Pareja, 1999a, b, 2004, 2005a, b) the application of the PD concept in valuation.

Our paper postulates that the AD method is the most appropriate approach to the valuation of project finance ventures, while the PD method can be justified for the evaluation of projects conducted within a standard corporate finance structure and in the process of fair value estimation. Like many other authors, we believe that FCFs obtained from projects realized within a corporate finance structure can be reinvested in other projects with a non-negative NPV. The reinvestment possibilities are reflected in the current valuation of a company, and the potential deviation from the reinvestment principle, as a rule, leads to a reaction by shareholders who then force a company to distribute or reinvest the FCF. Vélez-Pareja and Magni (2009) claim that investment in liquid assets is not a value driver. In fact, the authors prove that the stockpiling of cash destroys the value of the company. Accordingly, the company may be forced to distribute the excess cash to avoid value destruction (which is consistent with agency theory). The latter statement, however, implicitly supports the viability of the PD approach.

Vélez-Pareja and Magni (2009) argue that the concept of the potential FCF is logically inconsistent because it defines a stock rather than a flow. Moreover, according to these authors, only distributed cash flows create value for shareholders, while liquid assets in the entity's balance sheet cannot be included in value calculation. However, in the same paper, the authors recognize that the PD approach is viable if the distributable dividends are expected to be re-invested at the cost of equity capital, implying zero NPV of those investments for current shareholders. The equality of reinvestment and discount rates in valuation within the corporate finance context implies equivalence of the AD and PD approaches. However, the assumption that the reinvestment rate can be lower than the discount rate entails a conclusion that the management of the company is not fulfilling its fiduciary duty towards the shareholders. Value-destructive investment policy, according to the corporate finance theory, eventually results in a takeover or a management replacement.

If the company has a strong system of corporate governance, the shareholders should be treated as a sole proprietor in the sense that they are entitled to the entire distributable cash flow generated by the company and can force a dividend payout as soon as there is a concern regarding the sub-optimality of the investment policy implemented by management (Damodaran, 2006). Additionally, the assumption that the reinvestment rate can be lower than the discount rate, although realistic in the case of failure of corporate governance mechanisms, violates the principles of fair value estimation based on the International Valuation Standards and International Financial Reporting Standards 13. The mentioned standards rely on the concept of "highest and best use" (HBU), which postulates the use of assets by market participants in a way that maximizes the value of the asset. The HBU principle assumes the perfect symmetry of information between shareholders and management, and thereby effectively endows the owners with an efficient toolkit of corporate control, which precludes the eventuality of suboptimal investment policy implementation. We recognize that under particular circumstances, the HBU principle cannot be reasonably applied. This limitation concerns, for example, companies with flawed systems of corporate governance, or more generally, jurisdictions with poor law enforcement in the domain of shareholder rights protection. Similar problems may be encountered by minority shareholders of private companies with no liquid secondary equity market. The enumerated circumstances deprive the shareholders of possibilities to control the optimality of corporate investment and dividend policy, which may result in value impairment due to undertaking of negative NPV projects. The appropriate valuation techniques to permit accounting for the effects of suboptimal investment decisions should be either the modified net present value (MNPV) or the AD approach. MNPV directly incorporates varying reinvestment rates into the valuation model and facilitates quantification of the detrimental consequences of suboptimal investment policy, while the AD approach considers exclusively distributed cash flows without making any reinvestment assumptions. Special techniques help to make appropriate adjustments to the fair value estimate to account for inefficiencies in the current operating activities of the valued entity (Mielcarz and Wnuczak, 2011). However, the HBU principle clearly supports the use of the PD approach for fair value calculation and in the corporate finance context.

While the application of the AD concept is unjustified with regard to the fair value estimation, it appears to be best suited for the project finance analysis. The most important feature of a project executed in a classic project finance structure is, as we noted previously, its implementation within an economically and legally independent entity that is established to execute only one project. In such circumstances, there are no reinvestment opportunities, so the increase in cash in the accounts of an SPV cannot be treated, from the shareholders' perspective, as available ECF. Second, an SPV that is conducting a project repays liabilities only with the FCF generated by the project itself (Bis, 2009; Scannella, 2012), and the owners of the SPV do not provide any external collateral beyond the equity capital required to finance the SPV creation (John and John, 1991; Mielcarz and Mlinarič, 2014). As a result, an immanent attribute of a functioning SPV is the existence of credit covenants that often restrict payments to owners before the debt is reimbursed. Therefore, the generated FCFs cannot be treated as distributable in the sense that they are not available to owners at the moment of creation. Furthermore, even in the case of the absence of credit covenants, the transfer of FCF from the SPV requires time and adherence to formal procedures. Hence, the true moment of FCF transfer to equity holders differs from the moment of their creation, which justifies the use of an AD methodology. In this situation, no cash flows occur until the covenants expire, and changes are reflected only on the balance sheet of the entity under the "retained earnings" heading. Moreover, in most projects executed in a corporate finance structure, there is no additional direct payment from equity holders to finance the investment; usually, the cash available in companies' accounts is utilized for this purpose. However, project finance has some specific features. The structure of financing often requires owners to contribute all necessary resources to financing of the project at the moment that the SPV is formed or in tranches released in subsequent periods with an optional possibility of making additional equity investments. Because of this, a time gap exists between the moment when the expenditure is incurred by the investors and the moment when the expenditure is reflected in standard FCF calculations. The described specificities of project finance imply that the calculation of NPV and internal rate of return (IRR) that utilizes the PD approach for determining FCFs is incorrect for project finance ventures.

Analysis of the literature on project finance does not provide a clear answer to the question concerning the proper method of FCF estimation. Esty (1999), in his widely cited article, presented a formula that can be used in the valuation of project finance. The author claimed that the FCF discounted by the WACC and ECF methods should provide the same result. However, for practical reasons, Esty recommends, in the case of project finance evaluation, the approach based on ECF. To calculate the ECF, Esty proposed using the following equation:

$$ECF_{Esty} = \text{Cash available for debt service(CADS)} - \text{Principal payments}$$
$$- \text{Interest payments} - \text{Equity investments} \quad (1)$$

where CADS is equal to earnings before interest and taxes (EBIT) + Depreciation − Cash Taxes − Capital Expenditures − Increases in net working capital (NWC) − Funds for the debt service reserve account (DSRA).

Although Esty's approach resembles prima facie the AD concept, the application of this solution, contrary to Esty's statement, will not result in the same NPV as that obtained utilizing the standard methods presented by Fernández (2007a) and Ruback (1986, 2002). There are also a few ambiguities that may create a risk of NPV miscalculation. First, Equation (1) implies that the cash reserve should be deducted from the ECF. Furthermore, this approach does not provide clear guidance on the correct way in which the reduction of cash in debt service accounts should be treated in ECF calculations. Moreover, there is no information concerning the issue of how the potential financial incomes should be incorporated into ECF estimations. Finally, Equation (1) indicates that the capital expenditures should reduce the ECF twice: first, when the CADS is determined (− *Capital Expenditure*), and second, when the ECF ((−) *Equity Investment*) is finally calculated.

The method of calculating the ECF, as proposed by Esty, became popular and was commonly employed by both practitioners and theoreticians when assessing the financial viability of the project finance approach (Cooper and Nyborg, 2010; Weber *et al.*, 2011; Babusiaux and Pierru, 2009; Chiara *et al.*, 2007; Kokkaew *et al.*, 2011, 2012). Of course, there are more papers concerning the valuation of project finance, but their authors do not present the exact FCF calculation algorithms. For example, Scannella (2012) and Borgonovo *et al.* (2010) emphasize that equity investors receive cash distributions only after the debt service is paid, but they do not present any formal algorithms that meet the requirements of the correct project finance assessment.

To summarize, the literature on the appropriate FCF calculation for project finance is rather inconclusive. Some authors dealing with project finance issues consider ECF to be the best-suited method for project finance evaluation, but they do not give clear guidelines on how cash reserves should be treated in ECF calculations. Furthermore, they claim that different NPV calculation methods should result in the same NPV. However, a deduction of the cash reserves changes the FCF patterns, which excludes potential reconciliation of different NPV calculation methods. There is also no clear algorithm in the literature that indicates how to calculate the cash reserves in project finance structures that can induce miscalculations of NPV. Additionally, potential application of the PD concept in project finance structures should lead to a systematic misevaluation of such projects. The extent of the described ambiguities on the one hand, and the magnitude of the mistakes that can occur because of the application of PD methods on the other hand, create – in our opinion – the need for further development of a suitable methodology.

3. Project finance evaluation – a proposed approach

As we argued, when calculating the cash flow available to owners from project finance investments, we must consider their specific features. Namely, the calculation of FCF should consider only the expenditures actually incurred by investors (in the form of cash and in-kind contributions) and the withdrawals that directly benefit the owners. Therefore, the correct method of project finance venture appraisal is clearly based on the actual cash flow concept. We will utilize the abbreviation $\mathrm{ECF_{PF}}$ to denote the ECFs calculated for a project finance transaction.

The value of the $\mathrm{ECF_{PF}}$ for all periods (i), excluding the last year of financial projection, should be calculated according to the following equation:

$$\mathrm{ECF}_{\mathrm{PF},i} = P_F - P_I \tag{2}$$

where P_I is owners' payments in cash and in-kind contributions, P_F is transfers of cash to the owners.

The value of the $\mathrm{ECF_{PF}}$ for the last period of projection (R) is provided by the following equation:

$$\mathrm{ECF}_{\mathrm{PF},R} = P_F - P_I + C \tag{3}$$

where C is the value of the cash balance in the year of SPV liquidation.

It should be noted that the residual value (RV) should not be included in the project finance ECF calculation because the potential sale of the residual infrastructure is already included in the payments to owners ($\mathrm{P_F}$) or the liquidation of the cash balance (C).

Having determined $\mathrm{ECF_{PF}}$ and $\mathrm{ECF}_{\mathrm{PF},R}$, according to Equations (2) and (3), we can then use a traditional formula (6) for NPV calculation:

$$\mathrm{NPV_{PF}} = \sum_{i=0}^{n} \frac{\mathrm{ECF}_{\mathrm{PF},i}}{(1+r_e)^i} + \frac{\mathrm{ECF}_{\mathrm{PF},R}}{(1+r_e)^{n+1}} \tag{4}$$

where r_e is the rate of return expected by owners (cost of equity)[1] and $n+1$ constitutes the number of periods in which the project generates FCFs.

In contrast to the project finance $\mathrm{ECF_{PF}}$, the standard ECF is calculated as follows (Liu and Switzer, 2010):

$$ECF = PAT + A - WCI - I + D_N - D_R + RV_{ECF} \tag{5}$$

where PAT is the profit after tax, A is the amortization, WCI is the non-cash working capital investment (expenditures to increase NWC), I is capital investment, D_N is the new debt (inflows from contracted loans and borrowings), D_R is debt repayment (expenditures to repay principal installments on incurred loans and borrowings), and RV_{ECF} is the RV in the last year of analysis, which is calculated as the market value of non-cash assets minus the outstanding debt.

A detailed analysis of Equation (5) suggests that the standard ECF can be calculated in a simpler manner. Because the ECF represents the actual surplus for owners, it can be calculated as the difference between the value of capital invested by owners and the value of cash transferred to them, utilizing adjustments that reflect the changes of cash on the accounts of the company. The increase (decrease) of cash in a firm's accounts represents the money generated (spent) by the project that was not transferred to (taken from) the owners.

Therefore, the following equation presents a simplified method for calculation of the standard ECF:

$$\text{ECF} = P_F - P_I + C + \text{RV} \quad (6)$$

where ΔC is the change of cash on the company's accounts.

4. Project finance vs standard equity FCF – a numerical example

The purpose of this section is to illustrate the application of ECF_{PF} in the calculation of project finance NPV. Moreover, we intend to underline the misevaluation risk related to use of the PD approach.

We assume that an investor forms an SPV with initial capital at the level of 2,100 to conduct a property development project. The project involves construction of an apartment building. It is anticipated that the construction will take two years, and the apartment selling phase will require an additional two years. To start the project, the SPV obtains 1,500 of investment credit in year 1 and purchases the land (1,000) where the building is going to be constructed. The values of a partially built property in year 1 (the end of period balance of production in progress) and the finished building (finished products balance) in year 2 involve the value of land and construction expenditures as well as financial costs incurred in the development phase of the project. After all the apartments are sold, the project will end, and the SPV will be dissolved. The required rate of return by the investor is 15 percent. Detailed assumptions regarding revenues, costs, capital expenditures and working capital investments are provided in Table I.

Based on the assumptions presented in Table I, we have prepared the *pro forma* income and cash flow statements as well as the balance sheets. They are shown in Tables II-IV, respectively. Table V presents ECF estimations that were conducted utilizing the standard (Equations (5) and (6)) and project finance approaches (Equations (2) and (3)).

Table V shows that it makes no difference which of the standard ECF calculation methods is employed because the application of either Equations (5) or (6) leads to the same ECF values in all years. Additionally, the use of Equation (6) confirms that owners' payments (P_I) and withdrawals (P_F) do not affect the ECF values calculated in the standard manner because the payments and withdrawals are reflected in appropriate changes in the cash balance (ΔC). Contrary to standard ECF calculations based on the PD concept, the proposed project finance approach (Equations (2) and (3)) considers only payments to

Table I.
Assumptions of the numerical example

	Abbreviation/year	0	1	2	3	4
Equity capital in cash	P_I	2,100				
Dividends and other payments to shareholders	P_F				1,000	
Purchase of land			1,000			
Loans incurred	D_N		1,500			
Loan repayment	D_R				1,500	
Interest expenses	INT				150	0
Interest expenses allocated to production costs	INT		100	150		
Transfer of land to production in progress			1,000			
Construction expenditures			1,470	630		
End of period balance of production in progress			2,570			
Finished product balance				3,350	625	0
Planned revenues					4,800	1,100
Sales and administration costs			110	110	110	110
Cost of products sold					2,725	625
Effective tax rate (%)	T		0.0	0.0	16.7	19.0

and by owners as well as the cash balance at the end of the period being analyzed, i.e., the cash balance at the end of the period presented in the cash flow statement and balance sheet of the SPV (Tables III and IV, respectively). As a result, the sums of ECF in nominal terms are equal in both the standard and project finance approaches (1,588). However, what is important is that they are spread differently over time. This fact is crucial for the profitability assessment of a given project which utilizes the NPV and IRR measures.

	Abbreviation/year	0	1	2	3	4
Revenue					4,800	1,100
– Cost of sales					2,725	625
= Gross profit						
– Sales and administration expenses			110	110	110	110
= Operating profit (EBIT)			–110	–110	1,965	365
– Financial costs	INT				150	
= Profit before tax			–110	–110	1,815	365
– Tax expenses			0	0	303	69
= Profit After Tax	PAT		–110	–110	1,512	296

Table II. Projected income statement

	Abbreviation/year	0	1	2	3	4
Profit After Tax	PAT		–110	–110	1,512	296
+*Amortization*	*A*		0	0	0	0
+*Changes in inventories*			–2,570	–780	2,725	625
+*Changes in receivables*						
+*Change in accounts payable*						
Cash flows from operating activities			–2,680	–890	4,237	921
Cash flows from investing activities						
+*Proceeds from issue of share capital*	P_I	2,100				
+*Incurred loans and borrowings*	D_N		1,500			
+*Dividends paid*	P_F		0		–1,000	
+*Loan and borrowings repayment*	D_R		0		–1,500	
Cash flows from financing activities		2,100	1,500		–2,500	
Net cash flow in total	ΔC	2,100	–1,180	–890	1,737	921
Cash at the beginning of the period			2,100	920	30	1,767
Cash at the end of the period		2,100	920	30	1,767	2,688

Table III. Projected cash flow statement

Year	0	1	2	3	4
Fixed and intangible assets					
Non-operational fixed assets					
Current assets	2,100	3,490	3,380	2,392	2,688
Inventories	0	2,570	3,350	625	0
Receivables					
Cash and cash equivalents	2,100	920	30	1,767	2,688
Total assets	2,100	3,490	3,380	2,392	2,688
Equity	2,100	1,990	1,880	2,392	2,688
Long-term debt		1,500			
Short-term interest-bearing debt			1,500	0	
Accruals and provisions					
Accounts payable					
Total equity and liability	2,100	3,490	3,380	2,392	2,688

Table IV. Projected balance sheets

Table V.
Calculation of ECF according to the project finance and standard approaches

ECF	Project finance approach (Equations (2) and (3))					ECF	Standard approach (Equation (5))					ECF	Standard approach (Equation (6))				
Year	0	1	2	3	4	Year	0	1	2	3	4	Year	0	1	2	3	4
P_I	−2,100					P_I	2,100					PAT		−110	−110	1,512	296
P_F				1,000		P_F				1,000		A					
C					2,688	ΔC	2,100	−1 180	−890	1,737	921	WCI		−2,570	−780	2,725	625
						RV_{FCE}						I					
												D_N		1,500			
												D_R				−1,500	
												RV_{FCE}					
ECF_{PF}	−2,100	0	0	1 000	2,688	ECF	0	−1,180	−890	2,737	921	ECF	0	−1,180	−890	2,737	921
acum. ECF_{PF} in nominal terms	−2,100	−2,100	−2,100	−1,100	1,588	acum. ECF in nominal terms	0	−1,180	−2,070	667	1,588	acum. ECF in nominal terms	0	−1,180	−2,070	667	1,588
IRR_{PF} (%)			16.37			IRR			36.45			IRR			36.45		
NPV_{PF}			94.12			NPV			626.88			NPV			626.88		

The IRR calculated based on the standard approach gives a result of 36.45 percent, while the project finance IRR_{PF} equals only 16.37 percent. Furthermore, there are significant differences in the NPV calculated based on the standard ECF and ECF_{PF}. Considering that the required rate of return by the investor is 15 percent, the standard approach incorporating the PD provides an NPV of 626.88, while the project finance approach based on the AD approach results only in an NPV of 94.12. The difference in the results indicates the risk associated with miscalculations of the ECF generated by project finance. To illustrate the scale of the mistake, we have prepared Table VI, which presents the values of NPV for different discount rates, for both the standard ECF and the project finance ECF_{PF}.

To summarize, because of the differences between the actual cash flow for owners and their representation using the standard ECF method, application of the PD approach for project finance appraisal leads to a systematic misevaluation (overvaluation in the current case). The latter method assumes that the initial investment occurs later than it actually does and that the ECF will be available to owners sooner than it actually is. In contrast, the proposed ECF_{PF} project finance approach reflects the cash flows generated by a project finance venture correctly from the equity holders' perspective.

5. Analysis of the misevaluation effect

The aim of this section is to shed light on the scale of project finance NPV misevaluation stemming from application of the standard ECF approach instead of the ECF_{PF} method. To illustrate the scale of the problem, we conducted simulations for a project that requires 1,000 of initial investment and generates a constant ECF equal to 200 over ten consecutive years. The required rate of return by investors is 10 percent. We posit for the baseline calculation (Panel A in Table VII) that the moment of ECF creation is the same as the moment of ECF_{PF} payments by or to investors. Consequently, the standard NPV equals NPV_{PF} and amounts to 228.9. The results of the calculation are provided in Table VII.

Panel B presents how the credit covenant expiry date impacts the NPV. When the credit covenants restrict payment of the ECF to shareholders up to year 5, the accumulated cash balance amounts to 1,000. This delay in ECF_{PF} payments to investors results in a decline in the project finance NPV_{PF} to 14.6, which reduces its value by 93.6 percent compared to the NPV based on the PD approach. A potential extension of the covenant validity for years 6-9 even leads to negative NPV_{PF} values and, as a result, an increasing scale of overvaluation.

Panel C depicts the scale of overvaluation caused by modifications to the distribution of investment outlays. In the initial calculation (Panel A), we assumed that the entire investment occurred at time 0, which is consistent with the project finance ECF_{PF} approach. However, the potential distribution of investment outlays over a longer period would cause an increase in the NPV calculated based on the standard ECF. For example, division of the

Discount rate	NPV_{PF}	NPV	Overvaluation effect caused by using the standard approach
0%	1,587.5	1,587.5	0.0
4%	1,086.3	1,262.6	176.3
8%	669.3	993.7	324.5
12%	319.8	770.1	450.3
16%	25.0	583.2	558.3
20%	−225.2	426.5	651.7
24%	−438.8	294.4	733.2
28%	−622.0	182.9	804.9
32%	−780.0	88.5	868.5
36%	−916.9	8.3	925.2
IRR(%)	16.37	36.45	

Table VI. NPVs calculated based upon the project finance and standard approaches

Table VII.
Overvaluation effect of the standard ECF approach for project finance appraisal

Panel A. The baseline NPV calculation					
Number of years of ECF creation		10			
Discount rate		10%			
Investment at time 0		−1,000			
FCFE = DFCFE per year		200			
NPV_{PF} = NPV		228.9			
Panel B. The effect of covenants					
Expiration year of loan covenants	5	6	7	8	9
NPV_{PF}	14.6	−41.9	−103.5	−168.8	−236.6
NPV overvaluation	214.3	270.8	332.4	397.7	465.5
NPV overvaluation in (%)	93.6	118.3	145.2	173.7	203.4
Panel C. The effect of investment outlays					
Distribution of investment outlays in years	0-1	0-2	0-3	0-4	0-5
NPV	274.4	317.1	357.2	394.9	430.4
NPV overvaluation	45.5	88.2	128.3	166.0	201.5
NPV overvaluation in (%)	19.9	38.5	56.0	72.5	88.0
Panel D. Overvaluation effect for changing discount rates and scenarios from panels B and C					
	Discount rate impact on overvaluation (Panel B scenarios)				
Re/the expiry of the covenants (%)	5	6	7	8	
5	89.6%	105.9%	124.5%	145.2%	
7	91.2%	111.6%	134.4%	159.3%	
9	92.8%	116.3%	142.1%	169.7%	
10	93.6%	118.3%	145.2%	173.7%	
11	94.4%	120.1%	147.9%	177.1%	
13	95.9%	123.2%	152.2%	182.1%	
15	97.3%	125.6%	155.2%	185.2%	
	Discount rate impact on overvaluation (Panel C scenarios)				
Re/distribution of investment outlays (%)	0-1	0-2	0-3	0-4	
5	10.4%	20.5%	30.2%	39.7%	
7	14.3%	28.0%	41.0%	53.5%	
9	18.0%	35.1%	51.2%	66.4%	
10	19.9%	38.5%	56.0%	72.5%	
11	21.6%	41.9%	60.8%	78.4%	
13	25.1%	48.3%	69.8%	89.6%	
15	28.5%	54.5%	78.3%	100.0%	

investment into four equal installments in periods 0-3 results in an increase of the NPV calculated based on the standard ECF to the level of 357.2, and a 56 percent overvaluation of the project.

Panel D shows a proxy for the impact of discount rate changes on the overvaluation effects that are identified in panels B and C. Our simulations clearly indicate that application of the standard ECF instead of the project finance ECF_{PF} methodology leads to a more considerable overvaluation of projects as the discount rate rises.

6. Conclusions

The paper identifies several ambiguities present in the literature and concerns the proper valuation methods for investments realized within project finance structures. It argues that the PD approach, while perfectly suited for fair value estimation in the corporate finance context, is clearly inappropriate for the project finance approach. From the capital provider's point of view, debt covenants reduce cash flow availability, and the real timing of capital expenditures made by the SPV is irrelevant. Second, the character of project finance structures excludes the possibility of FCF reinvestment without previous payments of dividends. Therefore, we have tried to formulate a simple, coherent method of project finance appraisal. Our method is based on the AD concept, as it reflects the specificity of the timing of cash flows in a project finance venture and can produce accurate value estimates. Thanks to its simplicity, our method removes the ambiguities encountered in the literature. The NPV values that are calculated based on the ECF and ECF_{PF} do not differ only in unrealistic, alternative scenarios where the required rate of return is equal to zero or in which there are no debt covenants and capital expenditures by the SPV are made immediately after its creation. In other cases, as we have demonstrated, the NPV values obtained by employing the ECF and ECF_{PF} approaches differ significantly. More specifically, the PD approach leads to a systematic misevaluation (over- or undervaluation) of project finance ventures. The scale of this miscalculation is an increasing function of the debt covenants' duration, the required rate of return and the investment outlay dispersion over time.

Note

1. The cost of equity is intentionally assumed to remain constant to preserve the simplicity of the model and stress the distorting effect of the incorrect free cash flow estimation method on project appraisal by evaluating the influence of discount rate fluctuation on the project's NPV. Although often used in practice, this assumption may cause erroneous valuation results because the cost of equity varies as the leverage of the project changes, resulting in adjustment of the discount rate (Esty, 1999).

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