The Academia
(A Multidisciplinary Peer-Reviewed Research Journal)
Volume: 02, Issue: II, Pages: 25-33, Year: 2024

ISSN- 2583-8830

Evaluating the Impact of Cash Patterns on Project Evaluation

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Abstract

Public-private partnership projects are considered a successful mechanism for solving the problem of infrastructure development in a country. The successful implementation and application of this model require an accurate and efficient study of feasibility study however when it comes to the major partner of these project as appears from it name the private partners need to be assured of it investment and return therefore a need for financial modeling arises, which helps in a proper investment appraisal and the main component of a financial model is cash flow prediction, thus a proper and accurate cash flow prediction reduces the financial loss and helps in financial decision. Therefore, we have studied in this paper the impact of cash flow patterns on project evaluation. We have studied the inconsistency between two cash flow patterns: a mixed stream and an annuity, on mostly used financial matrices such as Net present value, internal rate of return, and payback period. The impact of cash flow patterns was studied on two dummy financial models using MS. Excel for data analysis. The finding suggested that the model with annuity cash inflows is the most predictive, feasible, and profitable compared to the model with a mixed stream cash flow pattern.

Keywords*:* Cash Flow Patterns, Investment Appraisal, Public-Private Partnership Projects, Project Evaluation.

1. Introduction

PPP stands for the public-private partnership projects. It is the collaboration between the private and government sectors(Krishnan, 2014). The main parties involved in these projects are the private sector and the government. A private party provides services or maintenance to the existing or new asset, and the government provides resources in the form of land, air, water, and holds the ownership of the resources. The partnership between the private and government is undertaken for mobilizing the resources, using private capacity, and faster the development ("PPPLRC," 2022). PPP facilitates partnerships between the government and private parties in numerous sectors, such as the service sector, infrastructure development, and other public service delivery. Investment in public infrastructure development has increased in the recent two decades(Ali et al., 2020),PPP model is being adopted in infrastructure development projects by a nation many countries around the globe (Verhoest et al., 2015). Infrastructure development is the backbone of a country. The better the infrastructure, the faster the economic growth of a country (Palei, 2015).The collaborative capacity of the private sector and government support can achieve this task. Private-public partnership helps in a nation's sustainable development by leveraging the private sector's capacity, resources, and expertise. PPP is underpinned by the Sustainable Development Goal #17 (Global Partnership Goal)(Nations, 2015), which further increases the importance of this model(Cheng et al., 2021).

Financial modeling is a mathematical method of predicting the future decisions of a particular company, projects, and assets. Financial modeling plays a vital role in the feasibility study of a project (Kurniawan et al., 2015). FM combines accounting, finance, and business knowledge using computing software to predict the outcome of a financial decision accurately. Net present value (NPV), internal rate of return (IRR), accounting rate of return (ARR), Payback period, Monte Carlo simulation, and S-curve are some of the investment appraisal

ISSN- 2583-8830

techniques that are used in financial modeling (Hossain, 2021).The fluctuating nature of the market and an unpredictable environment are some of the causes that complicate the investment decision, Various evaluation models are used to forecast the project valuation and feasibility, such as the DCF or discounting cash flow model, sensitivity analysis, and time value of money (Tarigan & Mawardi, 2024), (Topal, 2008).

The long project tenure, various parties involved, and high risks are the reasons that make investment decisions complicated in these projects (Rybnicek et al., 2020), especially for risk-averse investors (Investors who are unwilling to accept risky investments). The main concern of investors is the safety of principal capital invested and return on investment, Financial modeling provides answers to the profitability and feasibility of PPP projects. Parallel to the investor needs and volatility of the market, and the faster growth of technology, were some of the reasons that FM has shifted from old ways of computation and calculation to more advanced and accurate predictive models (Urefe et al., 2024). The best judgment of various cash inflow patterns in project evaluation could minimize project investment risk to a greater extent and could help in more effective and predictive financial decisions.

This paper studies a crucial but overlooked part of the financial modeling of PPP projects. We have studied in this paper the impact of different cash flow pattern son project evaluation. The impact of different cash flow patterns was analyzed on various investment appraisal techniques, such as NPV, IRR, and payback period, to find out the sensitivity of the topic. The result was significantly diversified when each cash flow pattern was analyzed.

The study aims to identify inconsistencies among various cash flow patterns, provide knowledge of how different cash flow patterns affect project evaluation, and ultimately provide a best practice model that could effectively predict financial decisions.

2. Methodology

This paper is a quantitative studythat highlights how different cash flow patterns affect project evaluation. We have used two dummy financial models based on an actual PPP project of an amusement park contracted under PPP regulation and used MS Excel, a tool for data analysis.

3. Data Summery

The following summary is drawn from a dummy financial model backed by an actual PPP project, The table represents each model's respective characteristics based on which the evaluation was conducted.

Criteria	Financial Model A	Financial Model B
1. The impact of different cash flow patterns on project evaluation.	Model with mixed stream cash inflow	Model with annuity cash flow
2. Project life	18 Years	18 Years
3. Discounting rate	10%	10%
4. Investment appraisal techniques	NPV IRR Payback period	NPV IRR Payback period

Table 1: Summary of financial models

1. Different Cash Flow pattern and their impact on project evaluation.

ISSN- 2583-8830

1.1. Patterns of cash flow

There are three cash flow patterns in general: a single amount cash flow, an annuity, and a mixed stream (*The Three Basic Patterns of Cash Flow*, n.d.).

a) A single amount cash flow is the one that occurs an amount at a single time; this pattern does not apply to our study, numerically presented as follow. e.g.

Year	Cash Flow	Remarks
0	-12000	Initial Investment
1	14500	

b) An annuity cash flow pattern: a fixed amount of cash inflow generated each period (quarterly, semi-annual, annually) throughout a project's life, mostly applicable to those projects that generate a fixed service fee either from user or government. Numerically presented as follow. e.g.

Year	Cash Flow	Remarks
0	-12000	Initial Investment
1	4000	
2	4000	
3	4000	

c) A mixed-stream cash flow pattern: the amount of cash inflow differs throughout the project's life; the cash flow of these projects isn't similar periodically, which shows more realistic cases. Numerically presented as follow. e.g.

Year	Cash Flow	Remarks
0	-12000	Initial Investment
1	3000	
2	4000	
3	5000	

The selected FMs have two distinct cash flow patterns, one with mixed stream cash flow pattern and the second with annuity cash flow, in this study we will examine how each cash flow pattern affects the project evaluation.

4. Data Analysis

We will study the impact of Cash flow patterns on the project evaluation, considering two cash flow patterns, annuity and mixed stream, the total inflow was equal in both models.

1. Model with mixed stream cash flow pattern (Table 2).

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Annual Cash Flow Estimation	Cash In		Cash Out										
	-		CAPEX			OPEX							
	Sales Income		Land & Liberalization Cost	Cost of Construction	Other Costs	Personnel	Insurance	Maintenance	Other	Taxes	Taxes	**Cash Flow**	**Cumulative Cash Flow**
2023	-		$(196,875)	$(751,750)	$(12,032)	-	-	-	-	-	-	$(960,657)	$ (960,657)
2024	$ 320,000		-	-	-	$(103,977)	$ (7,638)	$(25,000)	$(25,000)	$(12,800)	$ -	$ 145,585	$ (815,072)
2025	$ 331,200		-	-	-	$(107,616)	$ (7,905)	$(25,875)	$(25,875)	$(13,248)	$ -	$ 150,680	$ (664,392)
2026	$ 342,792		-	-	-	$(111,383)	$ (8,182)	$(26,781)	$(26,781)	$(13,712)	$ -	$ 155,954	$ (508,438)
2027	$ 354,790		-	-	-	$(115,281)	$ (8,468)	$(27,718)	$(27,718)	$(14,192)	$ -	$ 161,413	$ (347,025)
2028	$ 367,207		-	-	-	$(119,316)	$ (8,765)	$(28,688)	$(28,688)	$(14,688)	$ -	$ 167,062	$ (179,963)

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2029	$ 380,060		-	-	-	$(123,492)	$ (9,071)	$(29,692)	$(29,692)	$(15,202)	$ -	$ 172,909	$ (7,054)
2030	$ 393,362		-	-	-	$(127,815)	$ (9,389)	$(30,731)	$(30,731)	$(15,734)	$ -	$ 178,961	$ 171,907
2031	$ 407,129		-	-	-	$(132,288)	$ (9,717)	$(31,807)	$(31,807)	$(16,285)	$ -	$ 185,225	$ 357,132
2032	$ 421,379		-	-	-	$(136,918)	$(10,058)	$(32,920)	$(32,920)	$(16,855)	$ (7,336)	$ 184,371	$ 541,503
2033	$ 436,127		-	-	-	$(141,710)	$(10,410)	$(34,072)	$(34,072)	$(17,445)	$(26,219)	$ 172,198	$ 713,701
2034	$ 451,392		-	-	-	$(146,670)	$(10,774)	$(35,265)	$(35,265)	$(18,056)	$(27,137)	$ 178,225	$ 891,926
2035	$ 467,190		-	-	-	$(151,804)	$(11,151)	$(36,499)	$(36,499)	$(18,688)	$(28,087)	$ 184,463	$ 1,076,389
2036	$ 483,542		-	-	-	$(157,117)	$(11,541)	$(37,777)	$(37,777)	$(19,342)	$(29,070)	$ 190,919	$ 1,267,308

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2037	$ 500,466		-	-	-	$(162,616)	$(11,945)	$(39,099)	$(39,099)	$(20,019)	$(30,087)	$ 197,601	$ 1,464,910
2038	$ 517,982		-	-	-	$(168,307)	$(12,363)	$(40,467)	$(40,467)	$(20,719)	$(31,140)	$ 204,517	$ 1,669,427
2039	$ 536,112		-	-	-	$(174,198)	$(12,796)	$(41,884)	$(41,884)	$(21,444)	$(32,230)	$ 211,675	$ 1,881,102
2040	$ 332,925		-	-	-	$(108,177)	$ (7,946)	$(26,010)	$(26,010)	$(13,317)	$(20,015)	$ 131,450	$ 2,012,553

Table 2: Model with mixed stream cash flow pattern/ Source: Author analysis

INVESTMENT APPRAISAL

PAYBACK PERIOD	**7.04**
IRR	**16%**
NPV (DR: 10%)	**$ 397,412.82**

Table 3: Investment Appraisal for Model Mixed Steam Cash Inflow

2. Model with annuity cash flow pattern.

We have divided the total cash inflow of $ 7,043,655 by the total number of project years to find the annuity amount of $ 391,314, so the annuity amount was considered as cash inflow for the entire project life, and all other values remain the same. The results are shown in Table 4.

INVESTMENT APPRAISAL

PAYBACK PERIOD	**5.68**
IRR	**18%**
NPV (DR: 10%)	**$ 405,217**

Table 4: Investment Appraisal for Model with annuity

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5. Discussion and Conclusion

A model with mixed stream cash flow with a payback period of 7.04 years. IRR is 16%, which is higher than the discounting rate, suggesting the project is acceptable. NPV at the discounting rate of 10% is estimated at $ 397,413. The NPV is positive, which means the project is profitable. After deducting all the expenses from the 18 years of project cash inflow and discounting by 10%, the project profit is estimated at $ 397,413.Another way to explain all the future cash inflows in today's terms (2023) is $ 397,413 net. The overall finding of the investment evaluation for this model suggests the project is feasible and profitable.

The model with an annuity cash flow pattern shows the recovery of the initial investment during the sixth year. The IRR is 18%, which is higher than the discounting rate of 10%. The IRR suggests the project is acceptable. The project NPV is $405,217. The NPV is positive, so the project is profitable. Overall, investment appraisal findings suggest the project is feasible and profitable.

So far, the total cash inflow of both models was equal; the only difference is in the cash flow pattern, the model with a mixed team cash flow pattern and the model with the annuity. the total cash flows were equal in both models, the same discount rate of 10% applied, and the total life of the projects (18 years) is also the same, yet the data analysis reveals there was a significant impact of the cash flow pattern on project evaluation. The difference in the payback period is 1.34 years, which means the model with annuity cash flow quickly recovers the initial investment by 1.34 years than the model with a mixed stream cash flow pattern reason behind this is simple to find: the initial six years of cash inflow for model with mixed stream and annuity is respectively ($ 2,096,049 & $ 2,347,885), it appears that model with annuity total is slightly more, the difference of $ 251,836 cause the model to faster recover initial investment. Simultaneously, the model with the mixed stream cash flow has an IRR of 16%, and the model with annuity has an IRR of 18%. IRRs greater than the discounting rate are considered favorable. It appears that the model with annuity has an IRR 2% higher; the figure suggests that the model with annuity is more feasible than the model with mixed stream cash flow. Finally, the model with a mixed stream cash flow and the model with annuity have an NPV of $ 397,413, $ 405,217, model with annuity apparently has a higher NPV, higher the NPV means higher profitable. The difference is 7,804,which makes the model with annuity more profitable by this amount than the other. Now, here a question arises: How do both model makes different profits if they have the same total cash inflow and outflow? The answer is simple, a model with a mixed stream cash flow has different cash inflows each year, and a model with annuity has the same amount of cash inflow each year, and where the discounting factor is fixed for each year, therefore, despite the amount of cash inflow in that year the discounting factor will apply the same, so if the cash flow was higher in a particular year it will discounted amount will be more and alternatively if the cash flow was less the discounted amount will be less, that is the reason that model annuity has more profit over the model with mixed stream cash inflow.

The findings of this paper indicate that the model with annuity has an advantage over the model with a mixed stream cash flow pattern. Finally, we can argue based on the above scenario model that an annuity cash inflow pattern is more feasible, profitable, and quickly recovers the initial investment as compared to the model with a mixed stream cash inflow.

6. Limitations and Implications

This research has some limitations. We have applied the study to a single project's data of an infrastructure project, limited the analysis scope, and secondly, we have studied only the impact of cash flow patterns and excluded other aspects of cash flow, and finally, we have include the investment appraisal techniques such as: NPV, IRR, and Payback period. We suggest that further research needs to be conducted to include other sectors, include other aspect such as the impact of cash flow streams on project evaluation and include investment appraisal techniques other than applied to this study.

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The study provides a significant and wider scope of implementation, which could provide a handful of support to decision makers and practitioners, and also helps the students and researchers in the same field.

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