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EL FAKIR, Adil <http://orcid.org/0000-0002-0922-7274> and TKIOUAT, Mohamed

Published version

EL FAKIR, Adil and TKIOUAT, Mohamed (2018). PLS ratios negotiability: A repeated game incentive mechanism approach. Corporate Board: role, duties and composition, 14 (3), 7-14.

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PLS RATIOS NEGOTIABILITY: A REPEATED GAME INCENTIVE MECHANISM APPROACH

Adil EL Fakir *, Mohamed Tkiouat **

* *Corresponding author*, Sheffield Hallam University, Sheffield Business School, UK;
Contact details: City Campus, Howard Street, Sheffield, S1 1WB, UK
** Laboratory of Research in Applied Mathematics (LERMA, IFE-LAB) Ecole Mohammadia d'Ingenieurs, Morocco

How to cite this paper: EL Fakir, A., & Tkiouat, M. (2018). PLS ratios negotiability: A repeated game incentive mechanism approach. *Corporate Board: Role, Duties and Composition, 14(3), 7-14.* http://doi.org/10.22495/cbv14i3art1

ISSN Online: 2312-2722
ISSN Print: 1810-8601

Received: 23.07.2018
Accepted: 24.09.2018

JEL Classification: C74, C44, G02, G21, G24
DOI: 10.22495/cbv14i3art1

Abstract

PLS contracts in Islamic finance are fair economic practices as they focus on sharing profits and loss between the project's participants. Despite its ethical dimension, moral hazards and adverse selection are the paramount risks in this type of contracts. In this paper we seek reducing moral hazards in the form of the entrepreneur's effort shirking and if a project optimum lifetime can be identified. To answer these questions, we use a game theory approach in one stage and in a repeated framework. Under each scenario, the participants either fix the capital contributions or negotiate over the sharing ratio or vice-versa. We found theoretical evidence that cooperation can be sustained over a one period game. Cooperation can be sustained in a repeated game only if an appropriate monetary incentive is introduced. However, this incentive can only be given for a specific period before the project's NPV starts to drop. Indeed, we managed to find that period, called duration, for which the financier NPV is maximized. This duration can be proposed to be used as the optimum lifetime of the contract.

Keywords: Moral Hazard, Musharakah, Profit and Loss Contracts, Duration, Repeated Game, Social Value

1. INTRODUCTION

Islamic finance has shown resilience in a challenging international financial environment. It focuses on the principles of economic prosperity and social and economic justice (Setiawan, 2006). This resulted in a massive shift from conventional to Islamic banking ($2 trillion of total assets (Economist, 2014) with an annual growth of 19.7% a year to 2018) (Al-Deehani et al., 2015).

One example of the shift from conventional banking to Islamic banking is manifested in the adoption of Sukuk vs conventional bonds. Sukuk are the Islamic version of bonds and they are based on profit and loss sharing rather than providing a fixed income to its holders. It is shown that *sukuk* issuers have better performance than their matched bond issuers, but that *sukuk* contributes to reducing the gap in performance over time (Klein et al., 2018).

One example of equity financing in the Islamic jargon is profit and loss sharing contracts known as Musharakah (where all parties contribute with capital) or Mudaraba (where the financier is the only provider of capital).

Profit and loss sharing contracts in Islamic finance are partnership contracts between financier(s) and an entrepreneur(s) characterized by two main distinctive features. First profits are shared on a pre-agreed ratio (Obaidullah, 2005). Second losses are born according to each one's ratio of the project's capital. Parties must enter into the contract with their full consent (Usmani & Ansari, 2010). Each of the parties involved contributes with capital and one or some of the members are designated as managers (Ward, 2010). Partners can as well agree to give extra remuneration to another party (Obaidullah, 2005).

In Musharakah contract, no one part can demand guarantees against losses. Recourse to a guarantee can be made only in case of managerial mismanagement.

Musharakah offers the parties the right to gradually transfer ownership to the other parties through a process called diminishing Musharakah (Musharakah mutanaqisah) (Ward, 2010).

Islamic market indices (Abidi, 2009) and Islamic windows have been set to show the Importance of Musharakh products. It is reported that in the global Islamic financial services industry stood at US$2.293 trillion by the end of 2016 (Dubai Islamic Bank, 2017).

As it will be apparent in the literature review, PLS contracts in Islamic finance, suffer from asymmetric information more than conventional

equity contracts. The motivation is then to reduce asymmetric information, specifically moral hazards in the form of an entrepreneur's low effort. Because of this behavioural aspect manifested in these contracts, we found it suitable to apply game theory techniques as opposed to traditional techniques. This type of contracts raises the relational issue between holders of funds and entrepreneurs. These issues can be addressed from the perspective of agency theory (principal-agent relations).

Nabi (2013) in his work tries to reduce moral hazard by combatting the shirking behaviour of the financed entrepreneur. We extended his work by applying a repeated incentive mechanism model. We strive to sustain cooperation between the financier and the entrepreneur over a certain period using a specific incentive mechanism. We also try to find the optimum period, called duration, over which the project can be undertaken.

2. LITERATURE REVIEW

Many conventional contracts have tackled the asymmetric information case. However, some of these are not acceptable from an Islamic point of view. For example, in a conventional setting, collateral is used by managers to signal their efficient type (Berger et al., 2011). This is not allowed in Islamic finance as no guarantee is to be provided against losses.

Another method, used in a conventional equity contract, is the willingness of entrepreneurs to sign for a low job protection to signal their efficient type Subramanian (Subramanian et al., 2002). This is again not allowed in Islamic finance as signing for a low job protection is seen as a guarantee against losses.

This raises a major issue in terms of the safety of the capital provided to the entrepreneur. Without capital guarantees, Islamic banking might not extend mudharaba or musharakah to entrepreneurs. The safety of the capital has to be ensured in any investment made. Without any capital guarantee, Islamic banking usually will not want to offer Mudaraba or Musharakah contract to clients. The non-provision of capital guarantee is in line with the Islamic Jurisprudence (Janor, Yakob, Hashim, Zanariah & Wei, 2016).

The non-provision of capital guarantee is very attractive to clients especially if they are at the early growth stage of their business. This is because clients with the long track in business are confident in their business standing and therefore do not favour sharing profits with other financiers. On the other side, clients with low expertise level, do not want t risk the totality of their capital and therefore prefer sharing losses in the event of adverse market conditions. This is a major challenge to Islamic banks. If the demand for Musharakah and Mudaraba financing is made by big corporations that have a solid business track record, more of such financings could be offered. However, the demand from the high-risk small and medium companies is not a valid reason for Islamic banks to refuse to provide Musharakah financing; and thus, eliminate the spirit of Islamic banks of being fair to all.

Another major challenge in Islamic banking contracts is the selection of the right partner (entrepreneur) for whom financing is to be provided. Islamic financial institutions are not charitable institutions and the selection of the right partner should equally be likely on the basis of social as well as monetary grounds. Islamic banks can still offer Mudaraba and Musharakah financings to small companies as long as the partners or the companies are able to convince them through the planning and operation of the business that they have the potential to be jointly developed.

Profit and loss sharing contracts such as Modaraba and Musharakah are classified as a high-risk investment. This is due to their high probability of failure. Many factors contribute to such high risk. One of such factors is the lack of the entrepreneurial expertise. This put the Islamic bank in a high risky position as, not only that, it has to protect the funds of depositors but also insure them a steady and competitive rate of return. If losses occur, the Islamic bank has to replace the funds used. So, a cautious treatment of application files has to be taken into consideration. Many points must be considered before considering the financing through profit and loss sharing contracts: production costs, demand, market competition, industry conditions. These methods can greatly reduce the risk of asymmetric information between the entrepreneur and the Islamic bank.

Like any other form of equity financing, profit and loss sharing contracts suffer from contractual disputes. Preliminary findings indicate that businessmen often fail to plan exchange relationships completely, and seldom use legal sanctions to adjust these relationships or to settle disputes (Macaulay, 1963). Despite these facts, it is claimed that the preferred financial instrument is currently the profit-participating loan (Hornuf, Klohn & Schilling, 2018) such as profit and loss sharing contracts.

Regraded as forms of equity financing, PLS contracts, named Musharakah in Islamic finance, are different from traditional conventional equity financing in many aspects. Two of the main differences are the sharing of profits and the sharing of losses. In Islamic finance, the sharing of losses must be determined according to a predetermined ratio before the start of the financed project. This is different from the conventional framework where sharing can be dictated according to the financier outlook of the project. In a conventional setting, changing the profit-sharing ratio can also be dictated by the financier in case of adverse market conditions.

From another angle, in Islamic finance, losses must be born according to each participant's capital contribution. This is different from conventional equity contracts were the financier might dictate a maximum loss leaving the entrepreneur to bear the rest. Also, in Islamic finance, the entrepreneur is not to provide guarantees against losses while in a conventional system this can be allowed.

From the two points above, it is clear that profit and loss contracts in Islamic finance are subject to more restrictions compared to their conventional counterpart. They are, however, ethical forms of financing as participants share profits and bear losses collaboratively.

Because of the many restrictions manifested on the PLS contracts, this makes them more subject to asymmetric information compared to their conventional counterparts. In fact, many gaps are still to be covered in the literature regarding Musharakh product which is a form of equity financing. Some of these gaps include capital

structure and treatment of asymmetric information in Musharakah (Chatti & Yousfi, 2010).

Profit and loss sharing contracts are considered as fair economic contracts as they entail the sharing of profit as well as the sharing of losses. This in contradiction, for example, to a model provided by (Mitra, 2018) where local middleman earn excessive extra profits compared to other agents.

Credit bureaus use information sharing to tackle the issue of information asymmetry between financiers and entrepreneurs. This is because it has been reported that such methods increase borrowers' effort in managing projects (Padilla & Pagano, 1997). This method as well helps in loosening competition between banks (Gehrig & Stenbacka, 2007). The intensity of information is higher when the mobility of the borrower increases (Pagaon & Jappelli, 1993) and the likelihood of asymmetric information increases (Brown & Zehnder, 2010). It has been shown empirically that information sharing is correlated with higher access to credit (Pagaon & Jappelli, 1993), and in countries with lower creditors rights (Djankov et al., 2007; Hertzberg et al., 2011). Banking relationships are however destroyed from information sharing (Padilla & Pagano, 1997) resulting in a weaker banking competition.

Musharakah contracts suffer from the moral hazard problem of misreporting profits compared to standard conventional loans. Therefore, more due diligence is required (Al-Suwailem, 2006). It is also argued that providing collateral and a capital contribution by the entrepreneur can reduce this problem (Karim, 2002). Providing collateral against performance is not permissible in Islamic finance.

Some of the issues resulting in moral hazards, in conventional contracts, relate to the unfair distribution of profits among participants (Shaikh, 2011). For example, the financier in a conventional contract may demand a higher return to compensate for the risk undertaken. This can lead to a less entrepreneurial motivation to run projects. So, to deal with such issue, one research suggested different incentives in line with the project's risks (Jaffar, 2010) and the application of two sharing ratios for each partner (Maheran, 2010).

Nabi (2013), in his work, tries to reduce moral hazard by combatting the shirking behaviour of the financed entrepreneur. He proposes that to reduce moral hazards, it is necessary that the entrepreneur provides a minimum financial contribution and that a minimum profit-sharing ration is determined in advance. Our paper differs in that it proposes flexibility in terms of either negotiating on the capital contribution or the profit-sharing ratio.

The benefits of profit and loss sharing contracts have been shown through an investigating experiment. This experiment investigates the impact of Revenue-Sharing and Cost-Sharing offered by a retailer on a manufacturer's carbon emission abatement efforts and the two firms' profitability in a linear demand setting when consumer environmental awareness and carbon tax arise it was found that both *Revenue sharing and cost Sharing* can improve system efficiency and manufacturer's incentive for abatement (Yang, 2018).

In a previous paper (EL Fakir & Tkiouat, 2015a) of ours, we have proposed an incentive mechanism to reduce asymmetric information. This mechanism results in higher social value and more entrepreneurial negotiation power in terms of the profit-sharing ratio. The model, however, does not provide for two contracts type as the current model does.

In order to assess the viability PLS contracts versus other modes of financing such as ROSCA and debt-finance, we have proposed in a previous paper a new model called ROMCA (EL Fakir & Tkiouat, 2016). Our Simulation results show that our rotating Musharakah model, ROMCA, prevails against debt finance when it comes to employment generation, wealth creation, and consumption. It becomes even dominant under cases of adverse random shocks with low market conditions and prevailed in cases of moral hazards (EL Fakir & Tkiouat, 2016).

In dealing with adverse selection and moral hazards, some series of publications use two contracts. The purpose is to allow for agents type separation. In the first paper, we suggested using two types of contracts: one is effort based and the second is output based. Theoretical evidence showed that an effort-based contract can give higher compensation to the agent as this contract offers a lower sharing ratio to the financier (EL Fakir & Tkiouat, 2015b). This result emphasises two important Islamic concepts. First, it emphasizes the sentiment of altruism which the financier shows by taking a smaller profit-sharing ratio. Second, it emphasizes the sentiment of positive reciprocity which the agent exhibits by providing high effort.

In the second paper, we tried to reduce the adverse selection with respect to Mudaraba using a model of two contracts combined with adverse selection index for each contract. We have managed to develop three types of indices that can help financial institutions in their agent selection process (EL Fakir & Tkiouat, 2016a). These indices can be useful in separating efficient entrepreneurs from inefficient ones.

In the third paper, we tried to use a two-contract concept in a game theoretical approach under incomplete information. We wanted to test whether menu contracting (where the entrepreneur has the choice between high risk and low risk projects, is better than single contracting (where the entrepreneur is Offred one kind of projects). Menu contracting was found not to be always the optimal option for moral hazard reduction (EL Fakir & Tkiouat, 2016b).

3. THE MODEL

We try to extend the model of Lone & Quadir (2017). We aim at reducing moral hazard in a profit and loss sharing agreement involving a financier and an entrepreneur. Both parties are risk neutral. The entrepreneur wants to finance of a project that costs F. The entrepreneur is to contribute with an amount "f". The entrepreneur's effort is a key to the success of the project. The project is expected to yield an output R where the share of the entrepreneur is R_e and the share of the financier is R_f such that $R = R_e + R_f$. This output can take upper and lower values depending on the effort being taken. In fact, the output can be $\overline{R}$ with probability θ_h, in case of high effort, or low output value $\underline{R}$ with probability θ_l, in case of low effort. Such that $\theta_h > \theta_l$ regardless of the entrepreneurial effort the project, however, can still yield a zero income in both high effort and low effort resulting in the total investment loss *F*. The project is expected to yield an upper and lower *NPV* depending on effort level as:

$$\overline{NPV} = \theta_h R - F > 0 \quad (1)$$

$$\underline{NPV} = \theta_l R - F + S < 0 \quad (2)$$

Assumption 1: We assume that under equation 2 the *NPV* is negative even if the entrepreneur enjoys some private benefits S when he performs a low effort.

3.1. One stage game

We start by a one stage contract. The sharing contract is formulated as (x; F, α, β=x) such that $\alpha(\beta)$ is financier profit share (loss share) and X represents the financier capital contribution ratio as described by Nabi (2013).

For the entrepreneur to perform a high effort we must have:

$$\theta_h(1-\alpha)(R-F) - (1-\beta)(1-\theta_h)F \geq \theta_l(1-\alpha)(R-F) - (1-\beta)(1-\theta_l)F + S \quad (3)$$

3.1.1. Case 1: Fixing β and negotiating on α

Since the financier gets $R_e = \alpha . R$ we can figure out the maximum share α that the financier can get to induce the entrepreneur to perform a high effort. This means that given a specified capital share contribution β provided by the financier, we get:

$$\alpha \leq 1 - \frac{\frac{S}{\Delta\theta} - (1-\beta)F}{R-F} \quad (4)$$

This maximum α must ensure that the financier is at least breaking even i.e.:

$$\theta_h \alpha . R - \beta(1-\theta h).F \geq 0 \quad (5)$$

Rearranging for α we get:

$$\alpha \geq \frac{\beta(1-\theta h)F}{\theta h(R-F)} \quad (6)$$

So, for a given β and remembering the fact that $0 \leq \alpha \leq 1$ we can deduce upper and lower values for α to be incentive compatible for both the entrepreneur and the financier:

$$Max\,[0; \frac{\beta(1-\theta h)F}{\theta h(R-F)}] \leq \alpha \leq Min[1;\ 1 - \frac{\frac{S}{\Delta\theta} - (1-\beta)F}{R-F}] \quad (7)$$

3.1.2. Case 2: Fixing α and negotiating on β

Also, if we fix α we can infer automatically the maximum capital share contribution β of the financier to motivate the entrepreneur to perform a higher effort by rearranging the right-hand side of (7). i.e.:

$$\beta \leq 1 - \frac{\frac{S}{\Delta\theta} - (1-\alpha)(R-F)}{F} \quad (8)$$

Consequently, we can determine the minimum β that will allow the financier to break even by rearranging the left-hand side of (7) i.e.:

$$\beta \leq \frac{\alpha\theta h(R-F)}{(1-\theta h)F} \quad (9)$$

We conclude from (8) and (9) and from the fact that: $0 \leq \beta \leq 1$, that for the capital share to be compatible for both, the entrepreneur and the financier, under the fixing of α we must have:

$$0 \leq \beta \leq Min\,[1;\ \frac{\alpha\theta h(R-F)}{(1-\theta h)F}; 1 - \frac{\frac{S}{\Delta\theta} - (1-\alpha)(R-F)}{F}] \quad (10)$$

3.2. Repeated game

We extend the previous analysis into a repeated game by considering the two cases above.

3.2.1. Case 1: Fixing β and negotiating on α

Under this case, we fix the capital contribution ratio β at the beginning of the period and deduce α as in (7). Then we gradually reduce the financier's capital contribution ratio by an increment $d\beta$ at each round as long as the agent is cooperating by providing a high effort. The reduction of the financier capital share β represents an incentive for the entrepreneur to sustain cooperation as he holds more capital gradually. Using an appropriate discount factor δ, the returns to the financier and the entrepreneur from sustaining cooperation over an *N* period can be given respectively as:

$$R_{fN} = R_f \frac{\delta^{N+1} - \delta}{\delta - 1} - d\beta . F \frac{\frac{\delta^2 - \delta^{N+1}}{1-\delta} - (N-1)\delta^{N+1}}{1-\delta} \tag{11}$$

$$R_{eN} = R_e \frac{\delta^{N+1} - \delta}{\delta - 1} + d\beta . F \frac{\frac{\delta^2 - \delta^{N+1}}{1-\delta} - (N-1)\delta^{N+1}}{1-\delta} \tag{12}$$

Where we can name *INC* the incentive over the period *N* to sustain cooperation:

$$\text{INC} = d\beta . F \frac{\frac{\delta^2 - \delta^{N+1}}{1-\delta} - (N-1)\delta^{N+1}}{1-\delta} \tag{13}$$

We should remark from (11) and (12) that the incentive, *INC*, is taken off the financier payoff and transferred to the entrepreneur over the *N* period.

3.2.2. Case 2: Fixing α and Negotiating on β

Under this case, we fix the profit-sharing ratio α at the beginning of the period and deduce β as in (10). Then we reduce the profit-sharing ratio by an increment $d\alpha$ at each round as long as the agent is cooperating. The reduction of the financier profit share α represents an incentive for the entrepreneur to sustain cooperation. Using an appropriate discount factor δ, we can deduce the return the financier and the entrepreneur respectively from sustaining cooperation over an *N* period as:

$$R_{fN} = R_f \frac{\delta^{N+1} - \delta}{\delta - 1} - d\alpha\,(R - F). \frac{\frac{\delta^2 - \delta^{N+1}}{1-\delta} - (N-1)\delta^{N+1}}{1-\delta} \tag{14}$$

$$R_{eN} = R_e \frac{\delta^{N+1} - \delta}{\delta - 1} + d\alpha\,(R - F). \frac{\frac{\delta^2 - \delta^{N+1}}{1-\delta} - (N-1)\delta^{N+1}}{1-\delta} \tag{15}$$

Where we can name *INC* the incentive over the period *N* to sustain cooperation:

$$\text{INC} = d\alpha\,(R - F). \frac{\frac{\delta^2 - \delta^{N+1}}{1-\delta} - (N-1)\delta^{N+1}}{1-\delta} \tag{16}$$

Similarly to the first case, we should remark from (14) and (15) that the incentive, *INC*, is taken off the financier payoff and transferred to the entrepreneur over the *N* period.

4. DISCUSSION AND NUMERICAL SIMULATION

4.1. The duration problem

Using the above cases, we have managed to decide under each case on the appropriate incentive to sustain cooperation from the part of the entrepreneur. The problem that is left is what the optimum period to end the project is. What we mean by optimum period is that period that enables the financier to maximize its *NPV*. Mathematically, the duration, *D*, is that period under which:

$$\frac{d(NPV)}{dt} = 0 \tag{17}$$

And

$$\frac{d^2(NPV)}{d^2t} < 0 \tag{18}$$

We provide a numerical simulation of our analysis for each of the two cases above. The following table provides the initial values for our simulation. We should note however that these parameters should ensure that under low effort a negative *NPV* of the project is realized.

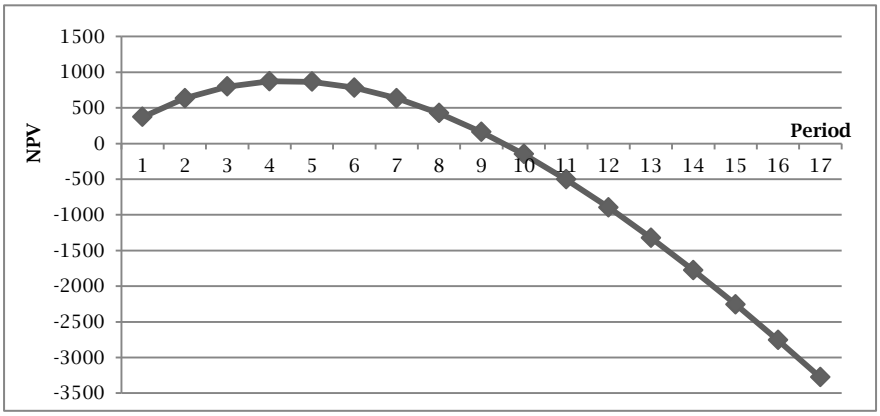
Table 1. The simulation initial parameters

F	500
R	1000
θ_h	80%
θ_l	30%
B	50%
A	50%
δ	5%
$d\beta$	10%
$d\alpha$	10%

4.1.1. Case 1: Fixing β and negotiating on α

The following table and graph show the result of the simulation. The *NPV* of the financier increases up to a certain duration period and then start to decrease. It is easy to approximate the graph function using a polynomial equation as shown on the graph. We can then calculate the duration and ultimately the corresponding incentive to sustain cooperation.

Figure 1. NPV under different project life and Case 1 (Fixing β and negotiating on α)



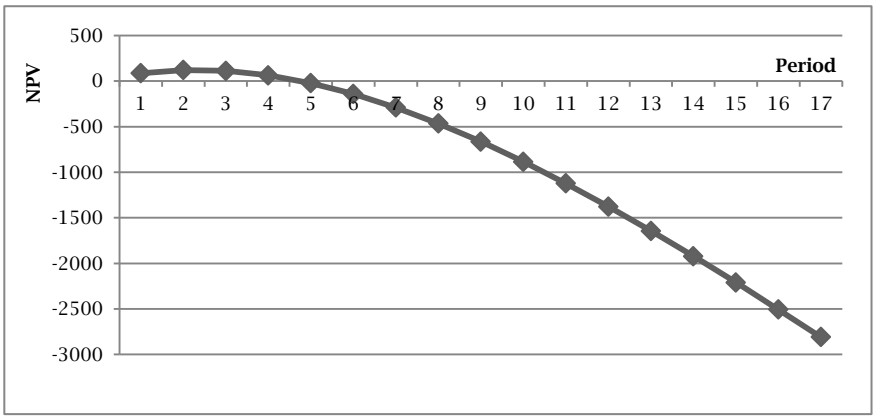
NPV	*Period*
371.838	1
633.852	2
797.88	3
872.244	*4*
864.858	5
783.228	6
634.452	7
425.22	8
161.814	9
-149.892	10
-504.432	11
-896.748	12
-1322.19	13
-1776.516	14
-2255.892	15
-2756.892	16
-3276.498	17

In this case, the duration is 4 years representing the period at which the *NPV* is maximized for the financier. On the other hand, the corresponding incentive to sustain high effort provision from the entrepreneur, to this period by applying equation 13 is 90.70.

4.1.2. Case 2: Fixing α and Negotiating on β

Similarly, to Case 1, The *NPV* of the financier increases up to a certain duration period and then start to decrease. We can then calculate the duration and ultimately the corresponding incentive to sustain cooperation.

Figure 2. NPV under different project life and Case 1 (Fixing α and negotiating on β)



NPV	*Period*
85.874	1
121.624	*2*
112.914	3
63.704	4
-22.238	5
-141.336	6
-290.206	7
-465.656	8
-664.686	9
-884.488	10
-1122.446	11
-1376.136	12
-1643.326	13
-1921.976	14
-2210.238	15
-2506.456	16
-2809.166	17

In this case, the duration is 2 years representing the period at which the *NPV* is maximized for the financier. On the other hand, the corresponding incentive to sustain high effort provision from the entrepreneur, to this period by applying equation 16 is 90.70.

From the above two cases, we can see the implications of our model in terms of four concepts. First, the model allows for the flexibility in terms of negotiability. The parties can agree on fixing the contribution of each party in the equity and negotiating accordingly the profit-sharing ratio. Or alternatively, fix the profit-sharing ratio and negotiate on the capital contribution of each party.

Second, the model depending on each case allows for gradually transferring project ownership to the entrepreneur (in case of the initial fixing of the capital contribution) and increasing the entrepreneur profit as an incentive to sustain cooperation (in the case of the initial fixing of the profit-sharing ratio).

Third, the model allows for the calculation of the monetary incentive that can help in sustain cooperation (high entrepreneurial effort provision) over a certain period.

Fourth, the model allows for the calculation of duration as the optimum life of the projects.

5. CONCLUSION

We have tried to reduce the effort shirking of an entrepreneur by applying a specific incentive mechanism using game theory in a repeated framework. We started by establishing a one stage game under which a specific profit-sharing ratio is negotiated based on a given entrepreneur's capital contribution. We reversed the case by negotiating the entrepreneurial capital contribution and fixing the profit-sharing ratio. The negotiation, in this case, was done in such a way that both participants are better off in a cooperation setting than in a defection setting. This mechanism was then extended to repeated framework were an incentive mechanism was the introduced to sustain cooperation. We found theoretical evidence that the introduction of such an incentive can induce

cooperation from the part of the entrepreneur. However, this incentive can only be given for a specific period before the financier's *NPV* starts to drop. Indeed, we managed to find that period, called duration, for which the financier *NPV* is maximized. This duration can be proposed to be used as the optimum lifetime of the contract.

This model can be extended using a double-sided moral hazard where the effort of the financier and the entrepreneur are analysed to sustain cooperation.

Since the model represents a repeated game, we propose extending an agent-based model to facilitate numerical analysis.

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