

Optimizing R&D Resource Allocation for Enterprise Innovation Team's in Ethiopia

Ashenafi Hailemichael Mesfin

School of Economics and Management, Chongqing University of Posts and Telecommunications, Chongqing 400065, China

Abstract: This paper examines the optimal strategies for distributing limited R&D resources, considering the impact of governmental incentives and intra-enterprise competition teams in Ethiopia. We investigate that Success probabilities are increasing likelihood of innovation success with enhanced resource and effort inputs, but with diminishing returns. Equilibrium analysis and optimization problems, solved via MATLAB simulations, illustrate how resource allocation can significantly enhance innovation efficiency. We find while focusing resources on a single team may maximize outputs under specific conditions, distributing resources across multiple teams can promote beneficial competition and exploit diverse capabilities, thus optimizing the overall innovation within enterprises. This paper contributes valuable insights to strategic management in Ethiopia by outlining mathematical methods through which Ethiopian enterprises can maximize their innovation potential in the midst of resource constraints and competitive dynamics.

Keywords: R&D, Resource Allocation, Game Theory, Ethiopian Enterprises.

1. Introduction

Effective allocation of R&D resources is essential for enterprises aiming to optimize innovation outcomes and sustain long-term growth. However, in many developing countries, including Ethiopia, R&D resource allocation remain suboptimal due to financial constraints, limited infrastructure, and inefficient distribution strategies. Ethiopia, with its growing economy and expanding industrial sectors, recognizes the significance of innovation in driving economic transformation. Despite various government-led initiatives to support R&D, enterprises in Ethiopia face challenges in efficiently allocating their R&D resources. [1] found that while R&D investments significantly impact innovation and long-term financial performance, Ethiopian companies face constraints due to resource limitations and restricted access to credit, affecting their R&D capacity.

Ethiopian innovation is mainly influenced by factors like R&D involvement, training programs, and digital infrastructure. [2] highlighted that innovation depends significantly on R&D activities, information access, and employee training. These elements are crucial for enhancing innovation capacity across firms of all sizes. Websites and digital platforms help enterprises interact with stakeholders and access valuable information that fosters innovation. Additionally, enterprises investing in on-the-job training enhance their employees' skills, bolstering their innovation potential.

Industrial development strategy in Ethiopia's, particularly in the apparel sector, emphasizes export led and labor-intensive industrialization. Despite these strategic goals, apparel sector exports remain insignificant due to inefficient resource utilization. These challenges reflect a broader trend in Ethiopian enterprises, where resource allocation is critical, especially within innovation teams striving for efficiency and competitiveness [3]. The Ethiopian government supports innovation and enterprise development through various initiatives, including tax exemptions and duty-free import privileges under Investment Incentives Regulation No. 517-2022. These measures ease financial burdens by allowing

duty-free import of capital goods, construction materials, and vehicles. The Development Bank of Ethiopia (DBE) provides soft loans for strategic projects in key sectors like manufacturing and agriculture, with repayment terms of up to 20 years and grace periods of up to five years. Additionally, domestic investors in industrial parks can access startup loans covering up to 85% of required capital.

Furthermore, the government has launched the Next Ethiopian Startup (NEST) initiative, a collaborative effort between the Ministry of Innovation and Technology and the Ministry of Labor and Skills, which focuses on organizing innovation competitions, developing support networks, and fostering a vibrant startup ecosystem (Shega, 2023). According to the governmental incentives in Ethiopia, the aim of this paper is to optimize R&D resource allocation for enterprise innovation teams in Ethiopia, using a mathematical model that considers competition, resource constraints, and governmental incentives. The model will guide decision-makers in enterprises on how to best allocate limited R&D resources to maximize innovation success across competing teams.

2. Literature Review

2.1. Probability of Innovation Success

The probability of innovation success is influenced by various factors, including collaboration mechanisms, predictive modeling, strategic orientation, and financial structuring. [4] present a differential game model highlighting how multi-agent collaboration, supported by knowledge sharing, can significantly enhance innovation success under uncertainty, particularly by reducing development time and aligning incentives through optimized contracts. Another dimension involves predictive methodologies, as explored by [5], who compares logistic regression and maximum likelihood classification (MLC) for predicting success in Android applications, showing that MLC achieves superior accuracy.

2.2. Optimizing R&D Resource Allocation

In the context of optimizing R&D resource allocation, several foundational theories and models are critical for understanding how enterprises can best utilize their limited resources. RBV is one such theory that emphasizes a firm's internal resources such as technology, human capital, and financial assets as the basis for competitive advantage and innovation[9]. According to RBV, efficient resource allocation in R&D allows firms to leverage these internal resources to create and sustain a differentiated position in the market. This theory supports the notion that strategic resource allocation in R&D can help firms capitalize on their unique capabilities and foster long-term innovation.

2.3. Game Theory

Game theory serves as a mathematical framework for analyzing conflicts and strategies, pivotal in disciplines such as economics, philosophy, and political science. [16] explores the versatility of game theory in modeling scenarios of competition, from economic markets to nuclear strategies, emphasizing its value in understanding conflict resolution and strategic decision-making. [17] highlights its philosophical applications, including the analysis of Hume's conventions through correlated equilibria and the exploration of morality using bargaining games. These examples underscore game theory's theoretical robustness in examining ethical and collective decision-making

2.4. R&D Resource Allocation

In the Ethiopian context, [2] offer empirical evidence of the importance of structured R&D activities that integrate technological advancements with traditional practices. Their study identifies critical drivers of innovation within Ethiopian enterprises, such as R&D engagement and skills development. This emphasizes the need for multifaceted strategies to enhance innovation. Similarly, [23] explore the interplay between R&D team structures and breakthrough innovation, proposing a framework that highlights the importance of diverse knowledge and team configurations. This research is particularly relevant for Ethiopian enterprises, which aim to achieve breakthrough innovations through effective team structures and knowledge management. Ferreira, [25] analyze the optimal R&D investment strategy in competitive markets, emphasizing the Cournot competition model. This model depicts duopolistic competition, where firms invest strategically in R&D to gain a competitive edge by lowering production costs, enabling them to offer competitive pricing.

China's experience underscores the critical impact of resource allocation on technological innovation. [26] reveal that China's approach to land resource allocation, involving large-scale industrial land transfers and restricted commercial and residential land transfers, significantly influences technological innovation. Their research emphasizes the importance of aligning land resources efficiently to optimize R&D outcomes.

Lastly, [37] shed light on the unique challenges faced by Ethiopian firms due to their dependence on foreign R&D and limited local innovation inputs. They emphasize that while innovations positively impact productivity, the direct influence of R&D is inconsistent across different methods. This highlights the need for frameworks specifically addressing the interplay between competitive dynamics and sectoral dependencies in Ethiopia. My study aims to bridge the gap by developing a mathematical model that to optimize

the allocation of R&D resources among innovation teams within enterprises team in Ethiopia, aiming to maximize the overall success probabilities of the teams.

3. Methodology

3.1. Abbreviation and Parameters

R&D	Resource and development
RBV	Resource-Based View
BI	Backward induction
s.t	Subject constraints
B	Total Budget
γ	Profit Share
α	Competition Intensity
I_v	Governmental incentive
b_i	Resource
x_i	Effort
y_i	Failure Probability
$p(b_i, x_i, I_v)$	success Probability
λ	Scaling factor
m	Number of Innovating
n	Total Teams

3.2. Research Approach and Design

In this study we developed a mathematical model for optimizing R&D resource allocation within enterprise innovation teams in Ethiopia which consists of two stages. The enterprise has a finite number of R&D resources with capacity $B > 0$ that can be allocated to two teams indexed by $i = 1, 2$. These resources complemented by Innovation Incentives I_v , which are government provided support to promote innovation. During the resource allocation stage, the enterprise chooses a resource (b_1, b_2) and an incentive I_v subject to the budget constraint $b_1 + b_2 + I_v \leq B$, where $b_i, I_v \geq 0$.

In the innovation stage, given the resource (b_1, b_2, I_v) the two teams simultaneously choose their effort levels (x_1, x_2) . For team i exerting effort comes with the cost donated as x_i , where, $(x_i \geq 0)$. For each team, the outcome of innovation is binary: either success or failure.

$$p(b_i, x_i, I_v) = 1 - e^{-(b_i + I_v)x_i} \quad (1)$$

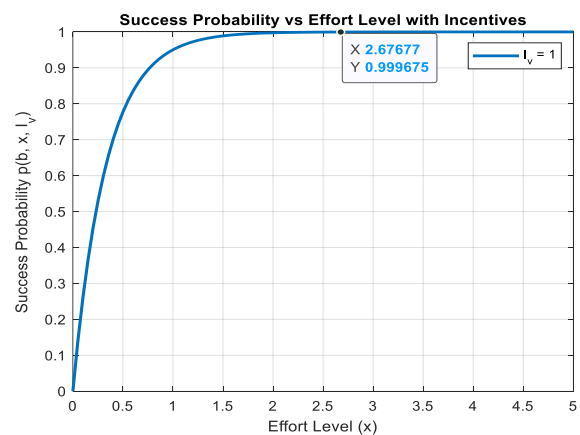


Figure 1. success probability Vs Effort level with incentive at $I_v=1$

When a team successfully innovates, it introduces a new product into the market. The profit from the market is shared

between the enterprise and the team. The team receives a fraction $\gamma \in (0, 1)$ of the profit, while the remaining $1 - \gamma$ is retained by the enterprise. The team's total payoff is the expected profit minus its effort cost. If both teams succeed, two competing products are launched. The profit of each product is normalized to 1 in a market without competition. However, if both products coexist, their profits are affected by a competition parameter $\alpha \in [0, 1]$. When $\alpha=1$, the two products target separate consumer groups and do not compete. Conversely, when $\alpha < 1$, the products are substitutes and compete for the same group of consumers. The parameter α measures the intensity of competition and the degree of product substitutability in the market.

3.3. Equilibrium Analysis for Innovation Stage

The equilibrium analysis is conducted via backward induction. The enterprise decides how to allocate resources and governmental incentives, anticipating the teams' effort

$$x_i^*(b_i + I_v) = \begin{cases} 0, & \text{if } \gamma(b_i + I_v) \leq 1 \\ \frac{\ln(\gamma(b_i + I_v))}{b_i + I_v}, & \text{if } \gamma(b_i + I_v) > 1 \end{cases} \quad (2)$$

The equilibrium success rate in b_i and I_v

$$p_i(b_i, x_i^*(b_i), I_v) = 1 - e^{-(b_i + I_v)x_i^*} \quad (3)$$

Case 2: Both teams Receiving Resources

Suppose the enterprise allocates resources to both teams, $b_1 > 0$, $b_2 > 0$ and $I_v > 0$, the equilibrium effort levels $(x_1^*(b_1, b_2, I_v), x_2^*(b_1, b_2, I_v))$ are determined by a static game (the analysis by considering a single stage of decision-making where resource allocation by the enterprise and effort levels chosen by the teams are determined simultaneously) between two teams. Let $y_i = 1 - p(b_i, x_i, I_v) = e^{-(b_i + I_v)x_i}$ denote the failure rate; then, $x_i = -\frac{\ln y_i}{b_i + I_v}$. Because there is a one-to-one

$$Y(b_i, I_v, y_{-i}) = \arg \max_{0 < y_i \leq 1} \{ \gamma(1 - y_i)[\alpha + y_{-i}] + \frac{\ln y_i}{b_i + I_v} \} \quad (4)$$

For γ

$$Y(b_i, I_v, y_{-i}) = \arg \max_{0 < y_i \leq 1} \left\{ (1 - y_i) + \frac{\ln y_i}{\gamma(b_i + I_v)[\alpha(1 - y_{-i} + y_{-i})]} \right\}$$

We consider scenarios where all innovation teams are motivated to exerting positive effort.

Lemma 1 outlines the conditions that ensure all teams actively engage in innovation activities, accounting for both allocated resources b_i and external governmental intensive I_v , which collectively influence their willingness to exert effort which is positive. $0 < y_1^* \leq y_2^* < 1$ is

$$\gamma(b_2 + I_v) > 1, \quad \text{and}$$

levels and outcomes. We analyze two scenarios:

Case 1: One team Receiving Resources

We assume the enterprise decides to allocate resources only to one innovation team, denoted as team i , with a resource amount $b > 1$. According to the innovation success function $p(b_i, x_i, I_v)$, the other team that receives no resources will have a zero probability of success $p(b_i, x_i, I_v) = 0$. If team i succeeds in its innovation, it will generate a profit share γ from the resulting product in the market.

Suppose the Enterprise allocates all resources to a single team i $b_i > 0$ while the other team j receives no resources $b_j = 0$, $p_j = 0$. The effort level of team i is determined by maximizing their payoff:

$$U_i = \gamma(1 - e^{-(b_i + I_v)x_i}) - x_i$$

The first-order condition (FOC) and solving for x_i .

correspondence between x_i and y_i , it is equivalent to considering the team choosing y_i instead of x_i . This transformation simplifies the algebra in the equilibrium analysis.

We restrict $y_i > 0$ because achieving a zero-failure rate $y_i = 0$ requires an infinitely large effort. The boundary condition, $y_i = 1$, indicates that a team exerts zero effort and thus has zero probability of success. Without loss of generality, let $b_1 \geq b_2$.

Given resources b_i combined with governmental incentive and the other team's failure rate y_{-i} , team i 's best response is determined by solving the following problem: payoff function becomes

$$1 \leq \frac{b_1 + I_v}{b_2 + I_v} < 1 + \alpha(\gamma(b_1 + I_v) - 1). \quad (5)$$

Under these conditions, the failure probabilities y_1^* and y_2^* for the innovation teams are uniquely determined. For both teams to actively engage in innovation activities, the total resources available to each team comprising internal allocations (b_i) and governmental incentive (I_v) must be sufficiently large. Specifically, the condition $\gamma(b_2 + I_v) > 1$ ensures that the combined resources exceed the minimum

threshold required to justify the effort. In addition to being adequate, the allocation of resources must be balanced between the teams. This requires that the ratio of resources satisfies $1 \leq \frac{b_1 + I_v}{b_2 + I_v} < 1 + \alpha(\gamma(b_1 + I_v) - 1)$. where α

accounts for the intensity of competition.

When these conditions are satisfied, the equilibrium failure probabilities y_1^* and y_2^* can be derived from the first-order conditions equation (5) (FOC) of the model. This equation balance resource allocation, competition effects, and team incentives, providing a unique equilibrium where all teams are motivated to participate.

The equilibrium failure probabilities y_1^* and y_2^* are determined by

$$\frac{1}{\gamma(b_1 + I_v)} = \alpha(1 - y_2^*)y_1^* + y_1^*y_2^* \quad \text{and}$$

$$\frac{1}{\gamma(b_2 + I_v)} = \alpha(1 - y_1^*)y_2^* + y_1^*y_2^*. \quad (6)$$

$$\Pi(\bar{B}, I_v) := \max_{b_1 \geq 0, b_2 \geq 0} \{ (1 - \gamma)[2\alpha(1 - y_1^*)(1 - y_2^*) + (1 - y_1^*)y_2^* + (1 - y_2^*)y_1^*] - \lambda I_v \} \quad (7)$$

s.t

$$b_1 + b_2 + I_v \leq \bar{B} \quad , \quad \text{and} \quad y_1^* = Y(b_1, I_v, y_2^*) \quad ,$$

$$y_2^* = Y(b_2, I_v, y_1^*)$$

The term $2\alpha(1 - y_1^*)(1 - y_2^*)$ is the total expected profit when both agents successfully innovate. This total profit decreases in α .

where:

$$y_1^* = Y(b_1, I_v, y_2) \quad , \quad \text{Failure probability for team 1,}$$

$$\max_{b_2 \in [0, B]} \Pi(B - b_2, b_2, I_v) := (1 - \gamma)[2\alpha(1 - y_1^*)(1 - y_2^*) + (1 - y_1^*)y_2^* + (1 - y_2^*)y_1^*] - \lambda I_v$$

Where;

$$y_1^* = Y(B - b_2 + I_v, y_2^*) \quad , \quad y_2^* = Y(b_2 + I_v, y_1^*).$$

Here

b_2 serves as the enterprise choice variable and b_1 determined $b_1 = B - b_2$

Proposition 1: The optimal resource allocation strategy either allocates resources to Team 1 ($(b_2^* = 0, b_1 = B)$) or Team 2 ($(b_2^* = B, b_1 = 0)$), leaving the other team to rely entirely on governmental incentives I_v or splits resources between the two teams ($0 < b_2^* < B$) to balance innovation benefits while minimizing competition costs and the penalty associated with I_v .

3.4.1. Resource allocated in one team

Building on Proposition 1, we evaluate and compare the enterprise's profits under two strategies: allocating all resources to one team versus distributing them across both

Lemma 2: Under the conditions specified in equation five, the failure probabilities y_1^* and y_2^* for an innovation team decreases when its allocated resources ($b_i + I_v$) increase.

However, in cases where resources are distributed among multiple teams, increasing the allocation for one team ($b_{-i} + I_v$) intensifies competition. This reduces the other team's incentive to exert effort, as the competitive pressure in the market diminishes its expected benefits

3.4. Optimal Resource Allocation for Enterprise Innovation Teams Strategy

Given a total resource budget B , and the additional support provided by governmental incentives I_v , the challenge is to determine how to allocate resources b_1 and b_2 between innovation teams to maximize their success probability. The principal optimization problem is formulated as:

adjusted for b_1 And I_v incorporating to the other team failure probability y_2^*

$y_2^* = Y(b_2, I_v, y_1)$, failure probability for team 2, similarly adjusted.

With out loss the generality, suppose b_2 is the variable the choice of enterprise then the enterprise optimization problem is rewritten as

teams. When the enterprise invests all internal resources into one team, creating a monopoly in the product market, the profit is represented as $\Pi_m(B, I_v)$.

$$\Pi_m(B, I_v) = \begin{cases} 0, & \text{if } \gamma(B + I_v) \leq 1 \\ (1 - \gamma)\left(1 - \frac{1}{\gamma(B + I_v)}\right), & \text{if } \gamma(B + I_v) > 1 \end{cases} \quad (8)$$

The subscript m indicates that the resource allocation strategy results in a monopoly in the market. Since $\Pi_m(B, I_v)$ increases with B when $\gamma(B + I_v) > 1$, the enterprise will fully utilize its available resources $(b_1 + b_2) = B$ to maximize profits.

Propulsion 2. When the enterprise invests all resources in one team, the allocation is $(b_1, b_2) = (B, 0)$ Accordingly, the enterprise's expected payoff when investing in one team is $\Pi_m(B, I_v)$, and the expected payoff of the team receiving the investment is:

$$u_m(B, I_v) = \begin{cases} 0, & \text{if } \gamma(B+I_v) \leq 1 \\ \gamma(B+I_v) - (1 + \ln \frac{\gamma(B+I_v)}{(B+I_v)}), & \text{if } \gamma(B+I_v) > 1 \end{cases} \quad (9)$$

$u_m(B, I_v)$ is also non-decreasing in B . Thus, both the enterprise and the team receiving the investment achieve higher payoffs with larger resource endowments, particularly when governmental incentives.

3.4.2. Resource allocated to two team's

Given $B \leq \bar{B}$ and from Proposition 1, the resource allocation is equal for the two teams, such that $b_1 = b_2 = \frac{B}{2}$.

By Lemma 1, when $\gamma(B+I_v) > 2$, both teams exert positive effort. Using the equilibrium conditions, the failure probability for each team is:

$$y_1^* = y_2^* = y^* := \frac{4}{\alpha(B+I_v)\gamma + \sqrt{(B+I_v)\gamma\sqrt{8-8\alpha + \alpha^2(B+I_v)\gamma}}} \quad (10)$$

y^* decreases as $(B+I_v)$ increases, meaning that

allocating more resources to the teams reduces their failure probability. The equilibrium effort level, given by:

$$x^*\left(\frac{B}{2} + \frac{I_v}{2}\right) = -\ln \frac{y^*}{\frac{B}{2} + \frac{I_v}{2}}$$

$$y_1^* = y_2^* = y^* := \frac{4}{\alpha(B+I_v)\gamma + \sqrt{(B+I_v)\gamma\sqrt{8-8\alpha + \alpha^2(B+I_v)\gamma}}}$$

$$\Pi_d(B, I_v) = \begin{cases} 0, & \text{if } \gamma(B+I_v) \leq 2 \\ (1-\gamma)\left[\alpha - \frac{4}{\gamma(B+I_v)} + \sqrt{\frac{\alpha^2(B+I_v)^2 - 8\alpha + 8}{\gamma(B+I_v)}}\right], & \text{if } \gamma(B+I_v) > 2 \end{cases} \quad (11)$$

The expected payoff of each team is given by:

And the profit,

$$u_d(B, I_v) = \gamma(1-y^*)[\alpha(1-y^*) + y^*] + \ln \frac{y^*}{\frac{B}{2} + \frac{I_v}{2}}$$

$$\Pi_d(B, I_v) = \begin{cases} 0, & \text{if } \gamma(B+I_v) \leq 2 \\ \frac{1}{2(B+I_v)} \left[\alpha((B+I_v)\gamma + \sqrt{(B+I_v)\gamma\sqrt{8-8\alpha + \alpha^2(B+I_v)\gamma}}) + 4 \ln \frac{4}{\alpha(B+I_v)\gamma - 4} \right], & \text{if } \gamma(B+I_v) > 2 \end{cases} \quad (12)$$

4. Result AND Discussion

Case 1: One team Receiving Resources

$$x_i^*(b_i + I_v) = \begin{cases} 0, & \text{if } \gamma(b_i + I_v) \leq 1 \\ \frac{\ln(\gamma(b_i + I_v))}{b_i + I_v}, & \text{if } \gamma(b_i + I_v) > 1 \end{cases}$$

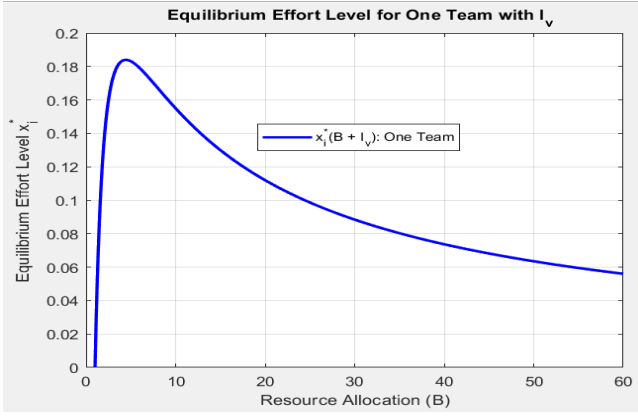


Figure 2. Equilibrium effort level for one team

Table 1. Equilibrium Effort Level for Varying Resource Allocations and Governmental Incentives

Resource Allocation (B)	Government Incentives	Equilibrium Effort Level
1	1	0.2884
5	1	0.4007
10	1	0.4355
20	1	0.4477
30	1	0.4480
40	1	0.4482
50	1	0.4482
60	1	0.4482

Where: profit sharing is 0.5

At lower levels of B resource, additional resources governmental incentive significantly enhances the effort level as teams gain more capacity to innovate. However, beyond a certain point, the marginal utility of resources decreases due to factors such as saturation or diminishing returns, where the team has sufficient resources. When B becomes too large, effort levels begin to decline as excessive resources may lead to inefficiency or over-reliance on the resources rather than sustained effort. This analysis offers a valuable framework for determining the optimal allocation of resources B required to maximize effort and innovation output. By incorporating incentives, the model addresses the practical realities of the Ethiopian, where government support serves as a critical factor in fostering innovation and driving competitive advantage.

For decision-makers, the plot serves as a valuable guide in optimizing resource allocation. Allocating resources just beyond the peak of the curve (optimal B) ensures that innovation teams exert maximum effort without unnecessary wastage. This approach strikes a balance between sufficient investment and resource efficiency. However, over-allocating resources beyond the optimal point may lead to diminishing returns and inefficiency. This is particularly critical in resource-scarce enterprise in Ethiopia, where the effective use of limited resources is crucial to maximizing the impact of R&D initiatives and fostering sustainable innovation.

Case 2: two team Receiving Resources

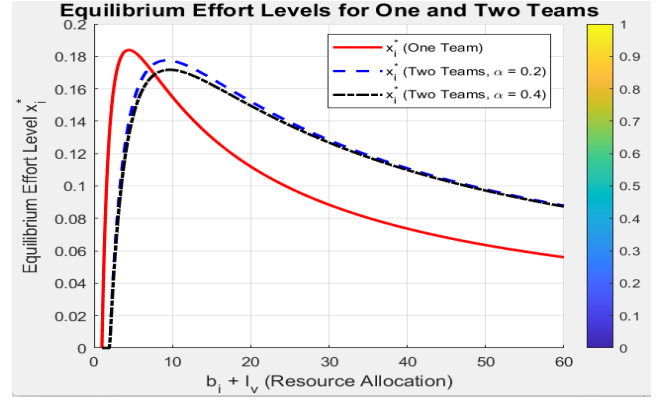


Figure 3. Team's Equilibrium Effort level with $\gamma = 0.5, \alpha = 0.2, \alpha = 0.4$

Table 2. Equilibrium Effort Levels for One and Two Teams with Varying Competition Intensities

Resource Allocation (B)	Equilibrium Effort (One Team)	Equilibrium Effort (Two Teams, $\alpha=0.2$)	Equilibrium Effort (Two Teams, $\alpha=0.4$)
1	0.2884	0.2244	0.2054
5	0.4007	0.3471	0.3257
10	0.4355	0.3944	0.3702
20	0.4477	0.4119	0.3859
30	0.4480	0.4146	0.3892
40	0.4482	0.4166	0.3912
50	0.4482	0.4173	0.3922
60	0.4482	0.4177	0.3928

The red curve represents the effort when resources are allocated solely to a single team. Initially, as resource allocation increases, the effort level rises steeply, reflecting the team's efficient utilization of resources. However, beyond a certain point optimal resource allocation the effort level declines due to diminishing marginal returns, where additional resources have a progressively smaller impact on effort, and the governmental incentive becomes less effective. In contrast blue dashed line represents the equilibrium effort level for two competing teams with a competition intensity of $\alpha=0.2$. As resources are shared between the two teams, the overall effort level is lower compared to the red curve, reflecting the reduced incentives for individual teams due to the higher competition. The division of resources and the intensified competition diminish the teams' ability to fully leverage the available resources.

The black dash-dot line depicts the equilibrium effort level for two competing teams with a lower competition intensity of ($\alpha=0.4$). Compared to the blue dashed line, the effort level is slightly higher, as reduced competition intensity ($\alpha=0.4$) minimizes overlap and rivalry, enabling the teams to exert greater effort. Together, these curves highlight the interplay between resource allocation and competition intensity, showcasing how these factors influence the equilibrium effort levels of innovation teams.

Proposition 1: The optimal resource allocation strategy either allocates resources to Team 1 ($(b_2^* = 0, b_1 = B)$) or Team 2 ($(b_2^* = B, b_1 = 0)$), leaving the other team to rely entirely on governmental incentives I_v , or splits resources between the two teams ($0 < b_2^* < B$) to balance innovation benefits while minimizing competition costs and the penalty

associated with I_v .

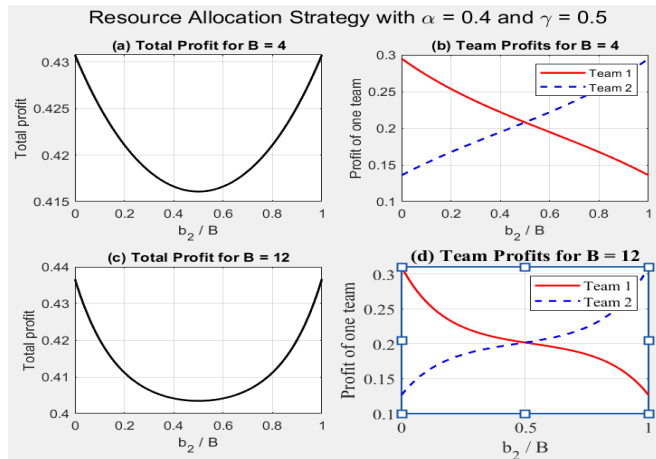


Figure 4. Illustrate of proposition 1

Resource allocation affects total profit and individual team profits under different resource capacities $B=4$ and $B=12$ competition $\alpha=0.4$ intensities. Total profit is maximized when all resources are allocated to a single team, while splitting resources equally between the teams leads to the lowest total profit due to inefficiencies caused by competition. As for individual team profits, each team's profit increases as it receives more resources, peaking when it controls the entire allocation (B for Team 1 or Team 2). However, when resources are divided equally, neither team achieves its full profit potential. The impact of resource capacity shows that a higher allocation increases both total and individual team profits, but the overall trend remains the same, with the allocation strategy still playing a crucial role in determining the profit outcomes.

5. Conclusions

5.1. Summery of Conclusion

This study provides key insights into the strategic distribution of resources to maximize innovation outcomes. The analysis demonstrates that resource allocation significantly influences the effort levels of innovation teams, with governmental incentives playing a crucial role in enhancing performance. For a single innovation team, the results indicate that increasing resource allocation initially leads to higher effort levels. However, beyond a certain threshold, diminishing marginal returns emerge, causing inefficiencies. This highlights the importance of identifying the optimal resource level to sustain innovation without unnecessary expenditure.

In the case of multiple competing teams, the study reveals that competition intensity affects effort distribution. Allocating resources evenly among teams leads to reduced effort due to competition, while concentrating resources on a single team maximizes innovation output. A balanced allocation strategy, where resources are split while minimizing competition costs, provides an optimal approach.

The findings suggest that decision-makers in Ethiopian enterprises should adopt a strategic resource allocation model that optimally allocate R&D resource while leveraging governmental incentives. By carefully managing competition effects and resource saturation, enterprises can enhance their innovation capabilities and drive sustainable growth in Ethiopia's innovation ecosystem.

5.2. Acknowledgment

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