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OPTIMIZING MARKETING EXPENDITURES AND MAXIMIZING RETURN ON INVESTMENT IN SMALL ENTERPRISES

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Abstract: Small enterprises often allocate limited marketing budgets under uncertain demand and incomplete information about channel effectiveness. This study develops an economic–mathematical framework for optimizing marketing expenditures and maximizing marketing return on investment. The framework combines nonlinear response functions, constrained optimization, and marginal analysis to represent diminishing returns, customer acquisition costs, and channel interactions. Marketing expenditure is allocated across channels subject to budget and operational constraints, with incremental contribution profit serving as the objective function. Sensitivity analysis examines how optimal allocations respond to changes in conversion rates, contribution margins, and response parameters. Empirical application requires firm-level expenditure, sales, and cost data, alongside credible estimation of incremental marketing effects. The proposed framework provides a transparent basis for comparing allocation strategies and identifying conditions under which additional marketing investment remains economically justified.

Keywords: marketing expenditure; marketing return on investment; small enterprises; nonlinear optimization; budget allocation; marginal analysis; diminishing returns; incremental profit.

I. Indroduction.

Small enterprises face a persistent challenge: how to allocate limited marketing resources while maintaining profitability and sustaining competitive growth. Unlike larger firms, they often operate with narrow financial reserves, limited analytical capabilities, and incomplete information about customer responses. Consequently, marketing expenditure represents both an opportunity to generate additional revenue and a financial commitment whose returns remain uncertain. Effective allocation therefore requires an economic assessment of how each investment contributes to incremental profit.

Marketing decisions become particularly complex when enterprises use multiple channels with different costs, conversion rates, and response patterns. Increasing expenditure does not necessarily produce proportional increases in sales. Diminishing marginal returns, audience saturation, and interactions between channels can alter the effectiveness of additional investment. Moreover, revenue growth alone provides an incomplete measure of performance because it overlooks contribution margins and the costs incurred in generating that growth. A financially meaningful evaluation must distinguish sales associated with marketing activity from sales that would have occurred without it.

Economic–mathematical modelling offers a structured approach to these allocation problems. Nonlinear response functions can describe relationships between expenditure and incremental demand, while constrained optimization identifies allocations that maximize contribution profit within an available budget. Marginal analysis further clarifies whether an additional unit of expenditure generates sufficient economic value. However, maximizing a return ratio and maximizing total profit are distinct objectives: a highly efficient but small investment may yield less total profit than a larger, lower-ratio allocation.

This study develops a framework for optimizing marketing expenditures in small enterprises by integrating channel response, contribution margins, and budget constraints. It examines how allocation decisions change under alternative assumptions about conversion efficiency and diminishing returns. The contribution lies in connecting marketing performance measurement with financially consistent optimization, providing a basis for investment decisions while explicitly recognizing the uncertainty surrounding estimated marketing effects and their practical application.

II. Methods

The study adopts a quantitative modelling approach based on constrained nonlinear optimization. Channel-specific marketing expenditure is treated as the decision variable, while incremental contribution profit constitutes the objective function. Concave response functions represent diminishing marginal returns, subject to an overall budget constraint and non-negativity conditions. Marketing return on investment is calculated as incremental contribution profit net of marketing expenditure divided by that expenditure. Model parameters require estimation from firm-level expenditure, sales, and contribution-margin data, with incremental effects identified through controlled experiments where feasible. Sensitivity analysis evaluates allocation stability under alternative response parameters, margins, and budgets. Optimized allocations are compared with equal-budget and existing allocation benchmarks.

III. Results

The following results are analytical implications of the proposed model. No firm-level observations or estimated effects are reported.

Assuming additive channel effects and diminishing returns, incremental contribution before marketing costs is represented as:

$$C_i(x_i)=a_i\left(1-e^{-b_i x_i}\right), \qquad a_i>0, \quad b_i>0. \qquad (1)$$

Here, x_i denotes expenditure on channel i, a_i is the maximum attainable incremental contribution, and b_i measures expenditure responsiveness. Net incremental profit is maximized subject to the available budget:

$$\max_{\mathbf{x}} \Pi(\mathbf{x})=\sum_{i=1}^{n}\left[a_i\left(1-e^{-b_i x_i}\right)-x_i\right]. \qquad (2)$$

$$\sum_{i=1}^{n} x_i \le B, \qquad x_i \ge 0.$$

The second derivative establishes diminishing marginal profitability:

$$\frac{\partial^2 \Pi}{\partial x_i^2}=-a_i b_i^2 e^{-b_i x_i}<0. \qquad (3)$$

Consequently, the objective is strictly concave and has a unique optimum for a finite budget. Applying the Karush–Kuhn–Tucker conditions gives the optimal allocation:

$$x_i^* =\max\left\{0, \frac{1}{b_i}\ln\left(\frac{a_i b_i}{1+\lambda}\right)\right\}. \qquad (4)$$

The budget multiplier satisfies the feasibility and complementary slackness conditions:

$$\lambda \ge 0, \qquad B-\sum_{i=1}^{n} x_i^* \ge 0. \qquad (5a)$$

$$\lambda\left(B-\sum_{i=1}^{n} x_i^*\right)=0. \qquad (5b)$$

For funded channels, marginal contribution equals $1+\lambda$. Channels with initial marginal contribution $a_i b_i \le 1+\lambda$ receive no expenditure. Allocation therefore depends on marginal economic productivity rather than equal budget shares.

When the budget is nonbinding, $\lambda=0$, and investment stops where marginal contribution equals marginal cost. Additional available funds remain unspent once profitable investment opportunities are exhausted. Marketing return on investment at the profit-maximizing allocation is:

$$MROI^* = \frac{\sum_{i=1}^{n} a_i\left(1-e^{-b_i x_i^*}\right)-\sum_{i=1}^{n} x_i^*}{\sum_{i=1}^{n} x_i^*}\times 100\%. \qquad (6)$$

This ratio is defined only when total expenditure is positive. If all channels satisfy $a_i b_i \le 1$, zero expenditure is optimal and MROI is undefined.

Under the assumed response functions, the optimized allocation yields profit at least as high as any feasible equal-budget allocation. This is a mathematical implication, not an observed percentage improvement. Its empirical magnitude requires reliable estimates of channel response parameters. Maximizing total profit does not necessarily maximize the MROI ratio; both indicators should therefore be evaluated when assessing marketing performance.

IV. CONCLUSION

This study establishes an economic–mathematical framework for allocating marketing expenditure in small enterprises under budget constraints. The analytical results show that profit-maximizing allocation equalizes marginal contribution across funded channels while accounting for diminishing returns. Expenditure should stop when additional investment no longer generates sufficient contribution to cover its cost. The framework also distinguishes total profit maximization from marketing return on investment maximization, supporting a more balanced assessment of performance. These conclusions depend on the assumed response functions and require empirical validation. Future research should estimate channel effects using firm-level data and incorporate uncertainty, customer retention, and interactions between marketing channels.

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