

# Dynamically Allocating the Marketing Budget

## HOW TO LEVERAGE PROFITS ACROSS MARKETS, PRODUCTS AND MARKETING ACTIVITIES

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Marketing budget decisions are critical and should be fact based rather than intuitive. Profit can be improved by better allocating a fixed budget across products or regions. The Excel-based decision support model presented in this article makes it possible to determine near-optimal marketing budgets and represents an innovative and feasible solution to the dynamic marketing allocation budget problem for multi-product, multi-country firms. The model accounts for marketing dynamics and a product's growth potential as well as for trade-offs with respect to marketing effectiveness and profit contribution. It was successfully implemented at Bayer, one of the world's largest firms in the pharmaceuticals and chemicals business. The profit improvement potential in this company was more than 50 % and worth nearly EUR 500 million in incremental discounted cash flows.

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### Rule of Thumb Marketing Budgeting is Common

Determining the marketing budget has been of paramount importance to marketers for many decades. Global players such as Procter & Gamble spend billions of dollars on advertising per year. Nevertheless, marketing practitioners frequently use rules of thumb when it comes to determining marketing budgets. By far the most often used budget rules across regions and industries are the "percentage-of-sales", "objective-and-task", and "affordability" method. In addition, budget decisions are often based on gut instinct and the negotiations skills of individual managers. Consequently, politics and individual opinions tend to shape the decision process instead of fact-based discussions. Obviously, these rules and practices bear the risk of results far away from the optimal profit-maximizing budget.

### Challenges of Optimal Budget Allocation

The global annual marketing budget of a company is usually set in the previous year, i.e., it is fixed. If companies offer a broad product portfolio to customers from various countries and use a variety of communication channels they need to break down the fixed annual

budget into expenditures across countries, products and communication activities. For many firms this task requires determining individual budgets for hundreds of allocation units. As a result, firms face a complex decision problem: they need to allocate a fixed budget across a multitude of allocation units by evaluating the impact of these investment decisions on future cash flows. Since marketing expenditure is immediately recognized as cost on the income statement but its total impact on sales often only unfolds fully in future periods, it needs to be evaluated in terms of an investment decision and based on the principle of marginal returns. Technically speaking, management needs to solve a dynamic optimization problem for an investment portfolio under a budget constraint. This management challenge recurs on a regular basis as marketing budgets are set annually.

Consequently, a new allocation approach was developed. In a first step, a theoretical solution is presented that provides important insights into how individual budgets should be set so that they account for differences in profit contribution, marketing effectiveness, and growth

**BOX 1:**  
Constrained Dynamic Profit  
Maximization Problem

$$\sum_{\text{Time } t} \text{Discount factor}_t \left[ \sum_{\text{Countries } k} \sum_{\text{Products } i} \text{Profit contribution}_{kit} \times \text{Unit sales}_{kit} - \sum_k \sum_i \sum_n \text{Marketing expense}_{kint} \right] \rightarrow \text{Max!}$$


**Discounted net value of product portfolio**

where Unit sales = f (life cycle, marketing expense, etc.)

**Restrictions**

- (1)  $\sum_k \sum_i \sum_n \text{Marketing expense}_{kint} = \text{Total Budget}_t$
- (2) Marketing effects decay at a constant rate over time
- (3) Boundary conditions (e.g., positive marketing budgets)

**BOX 2:**  
Optimal Solution

$$\text{Optimal budget}_{kint} = \frac{\text{Optimal allocation weight}}{\sum_{\text{Countries } k} \sum_{\text{Products } i} \sum_{\text{Activities } n} \text{Optimal allocation weight}_{kint}} \times \text{Total budget}_t$$


$$\text{Optimal allocation weight}_{kint} = \frac{\text{Profit contribution}_{kit} \times \text{Optimal unit sales}_{kit} \times \left[ \text{Optimal mktg elasticity}_{kint} + \text{Optimal growth elasticity}_{kit} \right]}{1 + \text{Discount rate} - \text{Marketing carryover}_{kin}}$$

**BOX 3:**  
Heuristic Allocation Weight

<p>Last period's marketing elasticity</p> <hr style="width: 50%; margin: 0 auto;"/> <p>1 + Discount rate – Marketing carryover</p> <div style="border: 1px solid gray; width: 80%; margin: 10px auto; height: 40px; position: relative;"> <div style="position: absolute; top: -10px; left: 50%; transform: translate(-50%, -100%); font-weight: bold; font-size: 24px;">1</div> </div> <p>(Discounted) long-term marketing effectiveness</p>	×	<p>Profit contribution margin (%) × Last periods' revenue</p> <div style="border: 1px solid gray; width: 80%; margin: 10px auto; height: 40px; position: relative;"> <div style="position: absolute; top: -10px; left: 50%; transform: translate(-50%, -100%); font-weight: bold; font-size: 24px;">2</div> </div> <p>Size of profit contribution</p>	×	<p>Expected revenues in T periods</p> <hr style="width: 50%; margin: 0 auto;"/> <p>Last period's revenues</p> <div style="border: 1px solid gray; width: 80%; margin: 10px auto; height: 40px; position: relative;"> <div style="position: absolute; top: -10px; left: 50%; transform: translate(-50%, -100%); font-weight: bold; font-size: 24px;">3</div> </div> <p>Growth potential (T = Planning horizon)</p>
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potential. In a second step, a near-optimal allocation rule is derived from that solution which addresses the demand for simple allocation rules by practitioners. It can be used with a spreadsheet. While easy to understand and implement, the heuristic goes beyond widespread budgeting rules such as the “percentage-of sales”.

### Developing a Dynamic Budget Allocation Approach

According to previous findings the profit improvement potential from a better allocation of a total marketing budget is much higher than from optimizing the total budget. Therefore the approach does not tackle how to determine the overall budget but how to allocate a fixed budget that is constant over the planning horizon. The model provides a solution for an international firm that offers a broad portfolio of products to customers from different countries, using different marketing tools or activities to promote its products (e.g., classical advertising, below-the-line activities, personal selling, etc.). The portfolio is composed of products that differ in their life-cycle stage and the firm wishes to maximize the discounted total profits of its portfolio.

Specifically, the model integrates and trades off information about

- > the size of the business,
- > the profit contribution margin,
- > the (short-term) effectiveness of marketing investments,
- > the carryover-effect of marketing investments,
- > the growth potential,
- > and the time value of money.

In the model, sales are represented by a general growth function (a product life cycle) and the response of marketing investments. The growth function describes the evolution of new product sales over time and is assumed to be influenced by marketing investments. The effect of marketing investments is determined by a marketing stock that arises from previous investments and depreciates over time (decay factor) plus the marketing investments in the current period. Based on these specifications, the discounted net value of the product portfolio is maximized. Box 1 shows the formulation of the maximization problem and its restrictions in mathematical terms.

The optimal solution considers dynamics in two different ways. First, it incorporates the dynamic effects of building and leveraging the marketing stock, which is

reflected in the marketing carryover coefficient. Second, it accounts for the growth potential of a product that is related to marketing investments as reflected in the growth elasticity.

The growth elasticity measures the power of marketing to shape the life cycle. Hence, based on prior evidence it is assumed that the growth process is not predetermined but can be influenced by the level of marketing expenditure in different phases of the life of a product. In particular, marketing investments in the growth potential of a new product have a strong impact on future cumulative sales and discounted cash flows. On the basis of a parametric growth model, it can be demonstrated in the subsequent case study how the optimal solution favors shifting marketing resources to young products so that they can leverage their endogenous growth potential. The optimal solution is based on the principle of relative attractiveness of an allocation unit to get a share of the total marketing budget. The idea is to calculate the optimal allocation weight for a product, as an example, and relate this weight to all allocation weights of the portfolio. This share is proportional to the profit contribution margin, current sales, marketing budget elasticity and growth multiplier. Box 2 explains how the optimal allocation weights for individual countries, products and marketing activities can be determined in detail.

» The profit improvement potential from a better allocation of a total marketing budget is much higher than from optimizing the total budget. «



### Implications for Budget Allocation

The optimal solution (Box 2) provides a number of intuitive insights into the allocation problem.

- > The optimal budget for a product relative to other products increases with its contribution margin and its sales base.
- > Similarly, the larger a product's long-term marketing effectiveness for a certain activity, the higher its optimal budget.
- > The long-term marketing effectiveness is composed of the short-term sales elasticity, the discount rate, and the marketing carryover. Consequently, if long-term marketing effectiveness is larger across all activities of a product compared to other products, the total budget for that product increases.
- > Finally, the sales growth elasticity varies over the life cycle. It is largest at the beginning when most of the sales are yet to come. Hence, the potential impact of marketing expenditure on future cash flows is greatest at this stage, which is why young products get a higher allocation weight and thus a larger share of the total budget.



» The effectiveness of detailing and other marketing activities varies substantially across the different therapeutic areas. «

Because of the growth potential of a new product the optimal marketing budget might even be higher than revenues at the beginning of its life. Therefore the solution may suggest spending money on products that involve a temporary loss in such a case.

### Adapting the Approach for Practical Application

For managers it is more transparent and easier to use an allocation rule instead of a numerical solution of such a model. Therefore, an allocation heuristic is derived directly from the theoretical solution that produces near-optimal budgets, is easy to understand for managers and can be implemented in a simple spreadsheet. Basically, the proposed heuristic is a simple proportional rule that integrates relevant information from three areas:

- > the long-term effectiveness of marketing investments in the focal product,
- > the profit contribution of the focal product,
- > and the focal product's growth expectations.

Box 3 shows how the allocation weights are determined using the simplified decision rule. Data for the carryover coefficient, sales elasticity, and the growth multiplier are not readily available but must be estimated.

Current values of revenues are available from last year and the contribution margin is a target figure decided by management. The growth potential is calculated as a multiplier that divides expected revenues in 5 years (planning horizon) by the current revenue level. By this, products get a greater share of the total budget as long as they are expected to grow. In contrast, when they are expected to turn into their decline stage their budget is reduced.

By definition, the heuristic solution is likely to differ from the optimal solution, but it should not deviate too much to be useful. The performance of the heuristic was tested in an experimental simulation study and found to provide very good results which even improve after several planning cycles and in some cases converge to the optimum if applied consecutively.

Although the tool was applied to prescription drugs (see below), it is suitable for many other industries, such as consumer durables, consumer packaged goods, etc. In all these markets, rich information is available at the aggregate product level that allows the calibration of market response models.

## PRACTICAL APPLICATION IN THE PHARMACEUTICAL INDUSTRY: THE BAYER CASE

### Company Background and Challenge

Bayer is one of the world's leading companies in the pharmaceuticals and chemicals business sector. As of 2008, the company had EUR 32.9 billion sales and around 108,600 employees (Bayer 2009). The company invests substantial resources in marketing and sales activities. Total marketing and selling expenditures were EUR 7.6 billion (~23.1 % of total sales) in 2008. Bayer consists of three major business areas, Healthcare being the largest area in terms of sales (contributing almost 50 %). Within Healthcare, the Primary Care Unit (EUR 3.1 billion) is the largest within the prescription drug business (EUR 10.7 billion). The unit operates in four separate competitive market environments or therapeutic areas, respectively: *diabetes, hypertension, infectious diseases and erectile dysfunction*.

The challenge for the management was to find a balance in the allocation of marketing resources that trades off the size of the business, the growth expectations, and eventually the effectiveness of marketing expenditure. The main objective was to improve the process and results of annual budget allocation in order to maximize discounted profits from the product portfolio over a planning horizon of five years. The implementation of the allocation tool was targeted at the five main European countries which contribute the largest share to total sales. The application was developed in the period 2005-2006 and budget recommendations for 2007 were derived.

At that point in time the three therapeutic areas *diabetes, hypertension* and *infectious diseases* represented established areas which are in their saturation stage. Due to the aging of the population in industrialized societies and innovative new product introductions they are, however, expected to continue to grow at moderate rates in the future. The biggest challenge for Bayer in these areas is to keep its market position. Existing and new drugs by other global players are the main competitors for the Bayer drugs.

In contrast, the market for the treatment of erectile dysfunction is a new category that was pioneered by Pfizer with its Viagra brand in 1998. Bayer and Eli Lilly followed in 2003 with the introduction of their brands Levitra and Cialis. This market is still growing and does not face generic competitors yet.

» A product with high marketing effectiveness but a low profit contribution level could get a lower budget than a product with a high level of profit contribution but lower marketing effectiveness. «



### Data and Model Estimation

To obtain relevant input information such as sales elasticities and growth parameters, the authors estimated a market response model for each product market. Quarterly marketing and sales figures at product level of the previous 10 years (1996-2006) were available. The market response model is a mathematical representation of how sales evolve over time and react to marketing and other investments. Estimating the parameters of this model from the observed sales time-series provides the data input to compute marketing elasticity and other input data, which are not observed. Bayer management helped to identify the relevant subcategories and competitors within each therapeutic area by country. Subcategories range from 12 for Anti-infectives to one for Erectile Dysfunction. Products range from 15 for the Erectile Dysfunction area and 306 for the Hypertension area. Table 1 gives an overview of the key input variables used to calibrate the heuristic allocation tool (see Table 1).

Method	Antidiabetes		Hypertension		Erectile dysfunction		Antiinfectives	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Unit sales in thousand standard units	16,319	20,674	11,891	16,649	1,008	649	5,291	8,004
Elapsed time since launch in years	14.50	12.69	10.00	7.42	2.75	1.91	12.25	10.45
Order of entry (Median)	3		4		2		3	
Price in EUR per standard unit	.16	.26	.50	2.96	7.00	.48	2.01	1.97
<i>Marketing stock variables</i>								
Detailing at general practitioners in thousand EUR	22,519	36,566	64,595	87,134	55,026	30,326	44,259	34,930
Detailing at specialists in thousand EUR	2,081	4,068	8,803	13,701	14,498	12,771	10,380	11,353
Detailing at pharmacies in thousand EUR	588	1,453	1,930	3,039			1,766	2,598
Professional journal advertising in thousand EUR	149	341			458	502	165	295
Meeting invitations in thousand EUR	730	2,030	1,361	3,062	3,884	2,481	471	837
Other marketing expenditures in thousand EUR			2,558	9,278	3,912	4,404		
# of countries	5		5		5		5	
# of subcategories	6		10		1		12	
# of products	104		306		15		100	
# of observations	2,398		7,908		233		2,916	

Notes: All units and EUR figures are on a quarterly basis.

**TABLE 1:**  
Overview of Input Variables  
for the Heuristic Allocation  
Tool for Bayer

Each therapeutic area is specified as a double-log sales response function that accommodates nonlinear and interaction effects. Marketing mix data in each area was reflected by including marketing stocks (a combination of all marketing expenditure types) for Bayer and its competitors (in total), own and competitive prices and brand/quality effects. A double-log market response model was used to ensure diminishing marginal returns and get estimated parameter values associated with marketing-mix variables that correspond to elasticities, which indicate the effectiveness of the specific activities. An elasticity is a dimensionless measure of the relative change of a dependent variable, such as sales, divided by the relative change of an independent variable, such as the marketing budget. Thus, if sales increase by 5 % when the marketing budget is increased by 20 %, the elasticity is  $5\%/20\% = 0.25$ . It can be compared across products, countries and marketing instruments. Further, the model incorporates a number of control variables that have been shown to impact sales of pharmaceuticals, like order of entry, country or seasonal effects and asymmetric life cycle functions. In-sample model fit and predictive validity were very good across all four therapeutic areas.

The effectiveness of detailing and other marketing activities varies substantially across the different therapeutic areas. In general, they worked best in the Erectile Dysfunction category, which is not surprising as this category was the youngest category and still in its growth phase. In detailing, visiting general practitioners appears to work better than detailing at specialists and pharmacists. However, considering that specialists only account for a share of approximately 20 % in Diabetes and around 27 % in Hypertension, segment-specific specialist detailing effectiveness is 4 – 5 times higher. These findings are consistent with findings from other pharmaceutical studies. Own price effects were significant, but price changes did not have strong effects. The impact of competitive marketing expenditure was negative across all therapeutic areas although it was not always statistically significant. An earlier market entry was favorable, as expected. Seasonal effects were only relevant to Anti-infectives, which experience a high season in autumn and winter.

### The Bayer Implementation

To ensure that management can easily use the allocation formula in everyday business life, the authors developed an Excel-based Decision Support Tool. The tool provides budget scenarios and their implications for the development of market shares and profits over five years and produces a recommendation for the allocation of the total marketing budget. It uses input data at the quarterly level.

The heuristic rule requires an allocation weight for each marketing spending category and each drug to be computed. Input data have been obtained either from econometric analysis or internal records. The plausibility of input data, especially the estimated sales elasticities, has been extensively discussed with different groups of managers in several workshops (global marketing, market research, product management, sales management, controlling, etc.).

Following the needs of management, the tool was extended in two ways. First, a threshold for product budgets was included because of internal setup costs that are fixed at the product and marketing-activity level. Second, manual adjustments to budgets recommended by the heuristic were made possible. By this feature, management could account for exogenous restrictions to budget setting, e.g., to counter competitive attacks in a predetermined way. In addition, it enabled management to investigate the effects of budget scenarios on market share and profit as well as on the recommended budgets for other products and marketing activities. The tool is easy to use and flexible enough to adapt to varying conditions of decision making. The effort to develop and implement the budget allocation tool had significant impact on managerial decision making.

### Impact on Managerial Decision Making

#### > *Providing Structure to the Allocation Problem*

Obviously it is a challenging task to allocate a total budget across six spending categories for 36 drugs that are marketed in different countries and therapeutic areas. The suggested allocation heuristic gives structure to this complex decision problem. It specifies that information and data from three fields are necessary (data on the long-term effectiveness of marketing, information on a product's contribution to profit and growth potential of the product).

#### > *Providing Solutions to the Problem*

The allocation rule suggests that these three fields of information are to be combined in a multiplicative fashion so that the budgets are proportional to these three information pieces. Implications from this rule are straightforward.

(1) Products that generate more incremental sales with the same budget should get a larger slice of the total budget. Of course, relative incremental sales tend to decline as sales and budgets increase due to saturation effects.

(2) Products with a higher level of profit contribution generate more financial resources to cover their own marketing expenditure and contribute more to overall profits.

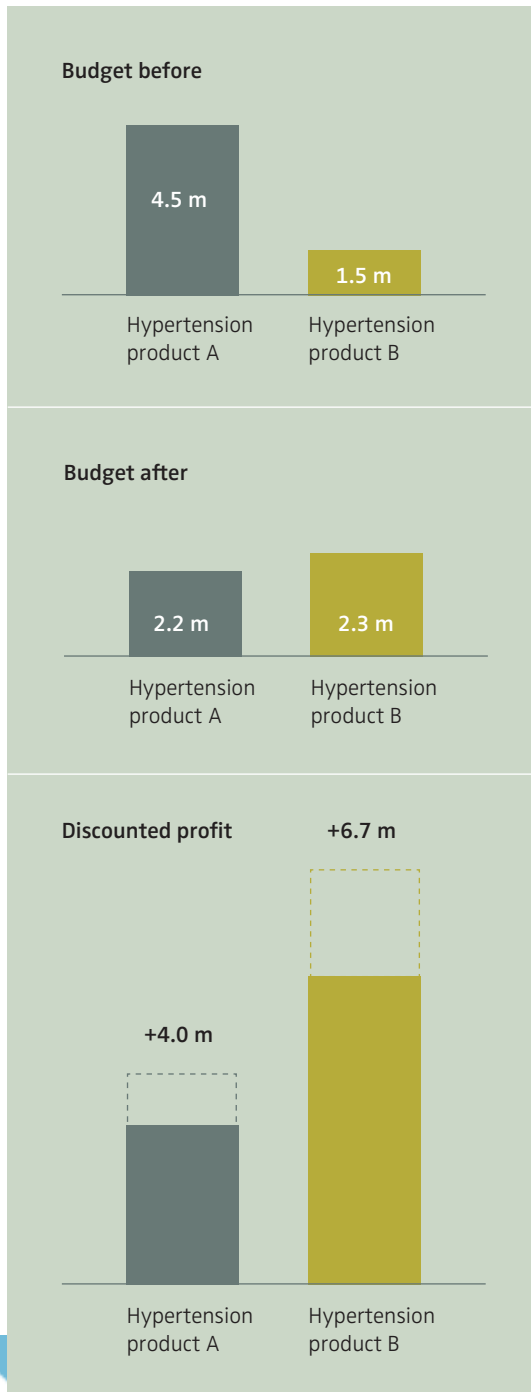
(3) Marketing should support growing and not declining products and shift resources over the life cycle.

The rule also teaches that the drivers of a product's near-optimal budget share interact with each other, i.e., synergies exist between them. Finally, it makes the trade-offs in budget allocation transparent. For example, a product with high marketing effectiveness but a low profit contribution level could get a lower budget than a product with a high level of profit contribution but lower marketing effectiveness. Even though that product's spending is less effective it may still contribute more to overall profit because of its larger sales base.

» The allocation tool adds an independent perspective and its recommendations are fully fact based. «



FIGURE 1:  
Example of Budget Re-Allocation Across Products in EUR



> **Understanding the Limitations of Separate ROI Analysis.**

Profit calculations with the allocation tool quickly revealed the limitations of comparing incremental ROIs that result from raising/decreasing marketing expenditure for individual products and marketing activities. First, separate ROI analyses for individual marketing activities do not consider synergies between marketing activities nor do they consider the trade-offs that exist with respect to potential profit improvements by other products and activities. Further they do not inform about the optimal magnitude of budget changes for products and activities, given a fixed total budget. All three requirements are met by the allocation heuristic in one step.

> **Organizational Impact**

Although the allocation tool is not the only source used by Bayer to generate budget options, it has significantly improved the efficiency and quality of the decision process. Because of its transparency and top down perspective, the allocation tool ameliorates the decision process that often appears emotional and inefficient. Since it is strictly based on a range of verifiable input information it adds an independent perspective and its recommendations are fully fact based. The budgeting-project contributed substantially to an organizational transformation that eventually resulted into the creation of a completely new marketing intelligence unit called Global Business Support. This unit supports global marketing management and sales including the global management board with tools, results, and recommendations for a more efficient and effective use of marketing resources.

> **Last and Most Important: Financial Impact**

The tool enables its users to simulate the financial impact of different budget allocation options. By analyzing the simulation results, it provides transparency about the impact of different assumptions on financial results. Figure 1 shows an example of the budget-shift recommendations of the model in the hypertension market. A budget shift between the two products implying an overall budget reduction can cause increased profits for both products.



Based on the year 2007, the simulation suggested an increase in discounted profits of 55 % over the next five years due to an optimized allocation. This is worth EUR 493 million. In contrast, changing the overall budget by 20 % promised a profit impact of less than 5 %. Even if only a small portion of this increase can be realized, the additional profit for a business unit, such as Primary Care with EUR 3 billion worldwide sales, is substantial. Actual profit improvements are hard to evaluate. First, management did not completely follow the suggested reallocation by the tool for several reasons (e.g., varying personal experiences, concerns about errors in some data from third party data providers). Second, activities by competitors and exogenous influences on market dynamics impact profit results. Nevertheless, the business area Bayer HealthCare reports an increase in EBIT of 12 % (EUR 273 million) compared to a 4 % revenue increase for 2008 (Bayer 2009). Although there is no validation from a field test, these results are consistent with prior observations that reallocation really focuses on the bottom line.

### Conclusion

The innovative budgeting allocation approach provides a simple but comprehensive heuristic that accounts for dynamics in marketing effects and product growth. Allocating a budget proportionally to the size of the business (sales and profit contribution margin), the effectiveness of the marketing activities (short-term elasticity and carryover coefficient), and the growth potential of the product (growth multiplier accounting for time discounting) revealed substantial profit improvement potential compared to a simple allocation dominated by rules of thumbs, separate ROI analysis for different products or subjective evaluations. It is suitable for many other industries, including consumer durables and consumer packaged goods, provided that rich information is available at the aggregate product level. •

## FURTHER READING

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### KEYWORDS:

Marketing Budget, Optimization, Resources, Allocation, Case Study

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