The Contribution Margin due to a Limiting Factor in the Presence of Several Sales Options: Actuality Is Not Always As It Appears at the Beginning of the Analysis

Maria Silvia Avi

Ca' Foscari University of Venice, Venice, Italy

The analysis of company data useful for economic decisions, if not interpreted in an overall view of the company situation, can lead to wrong conclusions. This is the case when a company has to choose between several sales options for one or more products in the presence of a limiting factor. The continuation of the investigation often denies the initial analysis. Not everything is as it appears, therefore, at the beginning of the deepening of the data useful for economic decisions. As it is well known, the choices of profitability concerning the planning of the sale of company products take place, at least in the majority of cases, through the determination of the contribution margin, i.e. the profitability margin connected to the individual goods/services sold by the companies (selling price net of variable costs). The contribution margin can be determined with four objectives: (1) Determination of the yield of the single product, net of variable costs only. In this case, the margin defines unitary, from net product yield to unitary contribution margin. (2) Determination of the return on total sales of an individual product, net of variable costs. In this hypothesis, reference is made to the first level (or gross) contribution margin. (3) Determination of the ability of the individual product to contribute to the coverage of fixed costs common to the company. This margin is determined net of special product variable and fixed costs. This aggregate is defined as a Level II (or semi-gross) margin. (4) Determination of the useful value in the planning choices in case of presence of scarce productive factors. In this case, it must identify the so-called unitary margin for low factor. Here we will only deal with the problem of the use of the contribution margin in the presence of rare factors. To complete the analysis, below are some very brief considerations regarding, respectively, the unitary, level I, and level II contribution margin in order to better understand where the problem of the most convenient choice of income is located in the event of the presence of rare production factors, especially in an environment characterized by a plurality of sales options.

Keywords: contribution margin, unit contribution margin, first level contribution margin, second level contribution margin, Unit Scarce factor contribution margin**,** Unit Scarce factor contribution margin in the presence of a plurality of sales options, profit

Maria Silvia Avi, Ph.D., full professor, Management Department, Ca' Foscari University of Venice, Venice, Italy.

Unit Contribution Margin: From Net Unit Return to Product-Specific Contribution Margin[1]

It is obvious that, from an income point of view, the product to be favoured is the one with the highest yield. The circumstance that needs to be clarified is what is to be understood, in this specific context, by "product yield".

In the previous pages, the concept of full cost has been illustrated in detail, i.e. the notion of product cost, including any negative component of company income (excluding specific costs in relation to which it is not appropriate to make reversals on goods/services).

Based on what has been explained so far, it would seem obvious that the product yield is determined by the contrast between the unit selling price and the full cost (i.e. the unit cost including each company's cost, obviously for the part referring to the single good. For the distribution of common costs, it is necessary to identify appropriate distribution parameters. The cost that derives from the summation of the variable and fixed costs, referred to a product, can be determined according to traditional criteria that is based on the identification of the cost centers or through more innovative methodologies such as, for example, the Activity Based Costing. Independently from the methodology used, the full cost is characterized by the presence of part of the fixed costs. It is to be noticed that, in general, if it is operated in base to the centers of cost, the full cost contains only costs connected to the business characteristic management. If, instead, the ABC is used, the full cost deriving from the use of the activities like basic element in the distribution of the fixed costs, contains all the business costs, that are the costs of the characteristic management and the costs of not typical nature.

The difference between price and full cost gives rise to the so-called net unit return.

Before continuing our discussion on the concept of product performance, it is worth remembering that if the information needs of manager's concern the economic and income side of business management, income always becomes an aggregate on which the attention of directors is polarized. In the context of the flow of information intended for managers, this value assumes, in fact, a primary importance since it expresses, in a synthetic way, the wealth produced or destroyed as a result of the performance of a specific business activity or part of it.

In this regard, however, it should be stressed that the notion of income—understood as a synthetic aggregate deriving from the contrast between revenues and costs—is not univocal.

If all the company's costs and all the revenues obtained in a financial year are the object of interest, the value deriving from the algebraic sum of these accounting elements is represented by the income for the financial year. It would be misleading, however, to consider this notion of income as the only one relevant for decision-making purposes. Just think, for example, of the hypothesis in which the need to know concerns the ability of the company to make profits in the context of the typical activity carried out by the company.

Even in this case, the contrast between the negative and positive components of income linked to the performance of such management gives rise to the determination of a particular configuration of income: the operating income of the distinctive management.

This value, if completed by the consideration of costs and revenues which, although not part of the typical business activity, derive from active asset and financial management, is transformed from the operating income of the typical administration to a tout-court operating income.

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[1] To facilitate reading, I have decided not to include in the text, except in exceptional cases, the names of the scholars who have dealt with the subject under analysis. I have opted not to indicate all the terms of the scholars in the text because this would have meant a continuous interruption of the reading of the complete sentence in which I express my thought. References are placed at the end of the article.

If, on the other hand, the interest of those who determine these values is focused on the business-environment relationship, it is highly probable that the choice of income configuration will be further different. In this case, the added value of the company will undoubtedly represent the cognitive element aimed at those who wish to obtain useful information from the accounts.

From these brief considerations, it is easy to understand how the concept of income and, consequently, of economic performance, is characterized by different facets and differentiations that form the basis of its being of the diverse types of revenues and costs that, hypothetically, can be added algebraically.

Product performance can also take on various connotations depending on the information needs to be satisfied.

The net unit return represents a notion of income that can be traced back to the single product which, while, on the one hand, is useful for the understanding of the economy of the different products, on the other hand, cannot be used to identify the "most profitable" goods that it is appropriate to push on the market in order to maximize the company's profits.

The reasons for this statement will be discussed in the following pages when some of the concepts that are essential for the reader to understand the true informative significance of the net unit return have been illustrated.

In order to demonstrate what has already been expressed, it is necessary to proceed step by step by illustration of some general theoretical considerations.

First of all, in order to facilitate the understanding of some terms that will be subsequently used, it is opportune to highlight how a need for information of considerable interest concerns the ability of the activity carried out to contribute to the coverage of fixed company costs.

For example, imagine that a given company has a fixed, special, and common cost of 100 million euro. The primary objective of this company is to cover fixed costs. The company can, of course, cover these costs with the amount that remains after deducting all variable costs from the income. For this reason, it can be said that the difference between revenues and variable costs represents the amount that contributes to covering fixed costs.

Since the difference between full revenues and full variable costs contributes to covering fixed business costs, whether they are special or common, a contribution margin is defined.

The contribution margin, understood as the difference between revenues and variable costs, represents a useful element of knowledge, or rather indispensable, so that many business decisions can be taken in full awareness of the income implications of the alternatives subject to option.

The phrase used to identify the "sum-value" object of our interest, containing within it the term "contribution" makes explicit, also from a terminological point of view, the information function assigned to this cognitive vector which, therefore, can be unequivocally identified in the deepening of the capacity of the activity under analysis, to contribute to the coverage of fixed costs. From these brief observations, it is easy to understand how the effectiveness of the determination of the margin is drastically reduced if this differential value is determined concerning the complete company. The contrast between all revenues and all variable business costs leads to a deepening of the ability of the whole company to cover all fixed costs. This information can be deduced, however, in a clear and obvious way without the need to divide the costs into fixed and variable, from the budget not reclassified. In fact, if in this document, a profit for the year is recorded, the company has been able, on the one hand, to cover all fixed costs and, on the other hand, to produce new wealth for a value equal to the income highlighted. If, at the same time, the company has incurred a loss, the mere consideration of this value leads to the assertion that the activity carried out has contributed to the coverage of fixed costs but has not been able to

absorb the entire amount of these negative components. Finally, an ideally balanced budget with no income shows how the company could cover faultlessly the fixed costs, failing at the same time to produce new wealth.

The reclassification of the company's profit and loss account as a "contribution margin" can therefore, only have the purpose of deepening the company's cost structure. This information, as we will see in the following pages, is certainly very useful to fully understand the different impact of business decisions on the overall economy of the company. In such a context, however, the determination of the company's global contribution margin loses much of its effectiveness as an accounting tool for economic decisions.

In order to maximize the usefulness of margin calculations, this value must be identified by reference to partial business combinations. The interest of those who determine these margins must therefore be focused not on the company as a whole, but on the distinctive products offered on the market, the product ranges, the individual business departments, etc. This means that the company—at the accounting level—is divided into areas relevant for decision-making and management purposes in reference to which the differential values are determined arising from the contrast between revenues and variable costs relating to these "sections" of activity. This makes it possible to understand the ability of the different products and/or business sectors to contribute to the coverage of fixed business costs. Among the diverse alternatives analyzed, the choice of managers will, of course, fall on the options that most contribute to the coverage of fixed business costs.

As it can be better understood in the following pages, there are various types of contribution margins depending on the object of reference. If the focus is on a specific product, the margin is defined as a unitary margin.

If, for example, Sweet Kangaroo had the possibility of marketing the Alfa or Beta product, the costs/revenues associated with these alternatives were as follows:

Table 1

Example of Unit Contribution Margin

	Alfa	Beta
Unit selling price	1,000	300,000
Material a	(400)	(130,000)
Material b	(20)	(7,000)
Direct labour costs	(300)	(30,000)
Other variable costs	(30)	(24,000)
Unit contribution margin	250	109,000

If the sales volumes of the two products are the same or if the market has the unlimited potential, it would clearly be better for the management to opt for the Beta product. It should be noted that this decision can be taken independently of the knowledge of the amount of fixed business costs, since both in the case of fixed costs below the total margin and in the case of the opposite scenario, alternative B would be accepted by the company, since in the first case, it would maximize profit, while in the second case it would minimize loss.

However, as can be easily understood, the basic assumptions set out above (infinite market or perfect coincidence of sales volumes of A and B) are, at operational level, unactualistic assumptions. It is for this reason that the managerial decisions that are the subject of our interest must be taken in the light, not of the unitary margin, but of the total contribution margin, i.e. the value deriving from the product of the unitary margin for the sales volume.

The unitary contribution margin cannot therefore be used for decision-making purposes precisely because it does not show, at a global level, the ability of the product to cover fixed costs. In actuality, there are three "exceptional" hypotheses, which allow the use of the contribution margin for decision-making purposes. The unitary margin can, in fact, be used for decision-making purposes in the following three cases:

(1) in the hypothesis of a negative unitary contribution margin: in this case, actually, unless strategic needs require it, the sale of the product is not economically convenient because it creates a loss. In the presence of negative unitary contribution margins, in actuality, the more one sells, the greater is the loss that the company achieves at a company level;

(2) if the company is a single-product company: in this case, the unitary contribution margin of the only product placed on the market is significant for the economic convenience of the product itself;

(3) if the company were to decide to sell between several goods marked by the identical sales quantities, clearly in this case, for the same quantities sold, the discriminating element is represented, in practice, by the unitary contribution margin.

Apart from the three hypotheses mentioned above, the unitary contribution margin cannot be used for decision-making purposes. Therefore, in order for the decisions taken to be the most economically advantageous, it is necessary to move on to another concept of margin: a global margin that takes into account the quantities sold. This margin is referred to as the first-level contribution margin.

From what has been explained above regarding the need for the decision regarding the products to be pushed onto the market to be dictated by the awareness of the unchangeability of fixed costs and the need for management to act in such a way as to ensure that (fixed) costs are covered in the best possible way, it is clear that the net unit return cannot have decision-making purposes but must be "relegated" to meet information needs that are not useful, directly, to the identification of the products that are "most profitable" and therefore "most convenient" for the company.

The First-Level Contribution Margin

As we have already pointed out on the previous page, apart from the three hypotheses specifically identified, the unitary contribution margin cannot be used for decision-making purposes. In order for management decisions to maximize the overall profitability of the company, it is necessary to introduce the concept of first-level margin, i.e. full margin in relation to sales quantities.

Level 1 full contribution margin is the product at the unit contribution margin and the sales quantity. It should be noted that the quantities to be calculated should, of course, be those of sale and not those of manufacture as fixed costs are covered not if the company produces goods, but if it sells its products/services. The first-level contribution margin is used to make short-term decisions. In this context, the word "short" has a double meaning:

(1) The term "short term" refers to decisions that do not impact on the company structure. Production capacity is considered to be given, and these decisions are not intended to make structural changes to the company, such as the closure of departments, the sale of business units, etc.;

(2) The word "short" also has another meaning: in this context, it becomes synonymous with "immediate". We intend to refer here to the period between the time when the information is known and the time when the decision has to be made. As far as the decisional aspect of the first-level margin is concerned, it can be said that this period is practically nil. In other words, when the manager becomes aware of the information, he can, automatically and immediately, make the decision and make it economically more convenient. We will see later

that there is also a second-level contribution margin where the decision is not immediate but time-consuming. This is not the case for the first-level margin where, we repeat, the decision can be taken at the same time as the determination of the margin itself.

In the margin of first level it serves to take, in particular, four very important decisions:

(A) accept or not accept an order: in this case, regardless of strategic decisions that may subvert the logic of maximizing income in the short term, the acceptance of a job order depends on whether the margin is favorable or negative. Clearly in the presence of a first-level advantageous contribution margin, it will still be useful to accept the order, even if the amount is reduced, for that same amount of the fixed costs will be covered. It should be noted that it is not necessary for the margin to cover fixed costs because, in any case, if the margin is positive, the choice to accept the order involves either maximizing the profit or minimizing the loss, options which both guarantee that the most useful decision will be taken;

(B) choice between some orders: naturally in this case, the choice between several orders will fall on the order with the highest level of first margin. In this case, in fact, the maximum coverage of fixed company costs is guaranteed with consequent maximization of profit;

(C) choice between decisions to sell elevated quantities at low prices or limited quantities at high prices: every company, in general, has to make a significant decision when manufacturing its annual planning. In this case, we are referring to the predominantly economic hypothesis of goods with flexible demand. That is, regarding goods that have the characteristic of seeing demand increase when the price decreases and, on the contrary, seeing demand reduce when there are increases in sales prices when there are such goods, each company must ask itself whether it is appropriate to sell high quantities while keeping sales prices relatively low or whether it is more profitable to limit the quantities sold by raising the price at which the goods must be sold. In general terms, there is no "best" solution. It all depends on the first-tier margins that the two alternatives allow the company to achieve. To decide, therefore, it is necessary to make the various hypotheses of sales quantities/prices and then determines the first-tier contribution margins corresponding to each option. The most cost-effective alternative will be the one that will, of course, allow the company to achieve the highest tier one margins.

(D) identification of the favorable sales mixes: this decision is taken at the planning stage when the quantities and sales prices of the various products that the company chooses to place on the market have to be decided. If, as it happens in the majority of cases, the company is a multi-product company, in the planning stage, inevitably, you will have to identify the favorable sales mixer, because, hypothetically, you can sell different quantities of individual goods at unusual prices. The identification of the quantities of the single goods and of the more convenient prices happens to determine for every hypothesis the margin of contribution total of first level. It is evident that the optimal mix is represented by the one that guarantees, in a programmed way, the margin of contribution of first level higher. The planning of sales cannot therefore disregard the identification of the values object of our interest because, not always, to sell finer quantities of product means to obtain better economic performances. If, in fact, the finer sale of a given product is obtained by sacrificing the placement on the market of other products with higher margins, the policy implemented leads to a reduction in the overall result of the company. The identification, during the planning phase, of the most economically useful mix and the exact perception of the differentiation of the capacity of the various products to contribute to the coverage of fixed company costs represents two informative elements whose knowledge can play a fundamental role in avoiding the assumption of apparently convenient decisions from the income point of view which, on the contrary, undermine the stability and the economic equilibrium of the company.

From what has been stated above, clearly most business decisions must be made based on consideration of the first-tier contribution margin. The maximization of such value involves, in fact, the consequent maximization of the characteristic income because, in front of the total direct labourifiability of the variable costs, there is a "crystallization" of the fixed costs (always within the so-called relevant range, that is to say, at given productive conditions).

This consideration can be usefully shown with a simple equation whose relevance is not connected to a particular demonstration effectiveness but depends on its ability, on the one hand, to highlight the impact of the change in the volume of activity carried out on the profitability of the company and, on the other hand, to highlight the income consequences of the different cost structures (variable and fixed) potentially present in the diverse business entities.

As highlighted in the previous pages, the first-level margin derives from the contrast between revenues and variable costs. If, from the first-level margin, all the fixed costs of the typical management are removed, the operating income of the characteristic activity is determined. From this simple consideration, it can be easily deduced how the variability of the operating income of the characteristic management depends on the type of structure and proportion existing between the total margin, and the characteristic fixed costs. Because of the variability of the costs inserted in the margin and the fixity of the other typical costs, it is evident how the operating result of the characteristic management is direct labourified in a more than a proportional way with respect to the volume of the activity carried out. This leads to the definition of this multiplicative impact as an "operational leverage effect".

To understand what is the global income consequence of a change in business activity in the face of various structures and cost compositions (variable and fixed), consider this simple example:

Selling price 50,

Variable unit cost 40,

Fixed costs typical management 10,000,

Sales volume/production 1,000 units.

Based on these basic data, suppose a 20% increase in sales.

The following table shows the income consequences of the increase in activity:

Table 2

Sales, Cost, GOP

	Basic assumption	Assumed 20% increase in sales/production	Percentage increases assuming a 20% increase in sales
Sales volume/production	1,000	1,200	+20%
Total sales revenues	50,000	60,000	+20%
Total variable costs	40,000	48,000	+20%
First-level margin	10,000	12,000	+20%
Characteristic fixed costs	8,000	8,000	Percentage 0
Gross operating profit (GOP)	2,000	4,000	+100%

From the above example, a 20% increase in sales/production corresponds to an equal increase in the margin caused by the proportional development of sales revenues and total variable costs.

For the principles described above, the gross operating profit (GOP), i.e. the income deriving from the devolution of the core business, varies more than proportionally with the increase in sales and margins due to the

lack of variation in fixed costs, which, precisely because they cannot be direct labourified, remain constant in both hypotheses. In fact, the percentage increase in the ordinary operating income is equal to 100%.

This greater "consolidation" of characteristic profitability is due to the operating leverage which, in essence, expresses the change in GOP caused by a corresponding change in sales/production volume (within the relevant range).

If we indicate with ∆GOP (the change in the operating income from characteristic operations) and with ∆Q (the increase in the quantity sold/produced), the operating leverage effect can be summarized as follows:

$$\text{Degree of operationa legerage} = \frac{\frac{\Delta GOP}{GOP}}{\frac{\Delta Q}{Q}} = \frac{\Delta GOP}{GOP} \cdot \frac{Q}{\Delta Q} = \frac{\Delta Q \cdot (\text{price} - \text{cvun}) \cdot Q}{Q \cdot (p - \text{cvun}) - CF} \cdot \frac{Q}{\Delta Q}$$

where:

p = unit sell price

c. var. u. = unit variable cost

CF = fixed costs

GOP = Gross operating profit

That is:

$$\text{Degree of operating leverage} = \frac{\text{First} - \text{level contribution margin}}{GOP}$$

From the above, it can be understood that the greater the degree of operational leverage (i.e. the ratio of contribution margin to GOP), the higher the multiplier effect of the operational leverage on the operating income of typical performances.

Since the interconnection between the first-level margin and the GOP depends on the cost structure and the ratio of variable costs to fixed costs, it is clear that the operational leverage effect depends, directly, on the type of cost structure of the company under analysis, i.e. on the ratio between fixed company costs and variable product costs.

To understand the effect of the corporate cost structure on the trend of the operating income of the typical management, it is probable to express the formula of the operating leverage above also in function, respectively, of the variable costs and the fixed costs.

Leaving aside the mathematical steps that lead to the final formulas, it can expose the degree of operational leverage in the following ways:

$$\text{Degree of operational leverage expressed as a function of fixed costs} = 1 + \frac{CF}{GOP}$$

$$\text{Degree of operational leverage expressed as function of variable costs}$$
$$= \frac{\text{total sales}}{GOP} - \frac{\text{unit variable cost}}{GOP}$$

In order to understand the above arguments in quantitative terms, the results of two different cost structures should be compared: company A, characterized by the cost values shown in the previous example (high variable costs and low fixed costs), and company B, characterized by an opposite structure (high fixed costs and low variable costs):

Table 3

Sales, Costs, GOP With 20% Increase in Sales

	Company A	Assumed 20% increase in sales/production	Percentage increases assuming a 20% increase in sales	Company B	Assumed 20% increase in sales/production	Percentage increases assuming a 20% increase in sales
Unit selling price	50	50		50	50	
Unit variable cost	40	40		5	5	
Sales volume/production	1,000	1,200	+20%	1,000	1,200	+20%
Total revenues	50,000	60,000	+20%	50,000	60,000	+20%
Total variable costs	40,000	48,000	+20%	5,000	6,000	+20%
First-level contribution margin	10,000	12,000	+20%	45,000	54,000	+20%
Fixed costs	8,000	8,000	Unaltered	43,000	43,000	Unaltered
GOP	2,000	4,000	+100%	2,000	11,000	+450%

$$\text{Degree of operational leverage Company A} = \frac{10.000}{2.000} = 5$$

The same result is obtained by determining the operating leverage as a function of variable costs:

$$\text{Degree of operational leverage Company A} = \frac{50.000}{2.000} - \frac{40 \times 1.000}{2.000} = 5$$

or according to fixed costs:

$$\text{Degree of operational leverage Company A} = 1 + 8.000/2.000 = 5$$

$$\text{Degree of operational leverage Company B} = \frac{45.000}{2.000} = 22.5$$

Or according to fixed costs:

$$\text{Degree of operational leverage Company B} = \frac{50.000}{2.0} - \frac{5 \times 1.000}{2.000} = 22.5$$

Or according to fixed costs:

$$\text{Degree of operational leverage Company B} = 1 + 43.000/2.000 = 22.5$$

From the above example, clearly the higher the degree of operational leverage, the greater the increase in typical operating income in the face of a certain increase in sales. And, given the definition of operating leverage, it can be understood that the intensity of the increase in GOP against an increase in sales/production depends on the identifiable proportion between variable costs and fixed costs. Focusing the attention of the formulas of the operating lever expressed in terms, respectively, of fixed costs and variable costs, it is easy to understand how, in the presence of an extremely rigid structure (absurdly, characterized by variable costs = 0 and presence of fixed costs only), the operating lever would be directly proportional to the ratio between total turnover and GOP while, on the contrary, if the structure was completely flexible (presence of variable costs only and absence of fixed costs), the operating lever would be equal to 1.

Second-Level Contribution Margin

If, for example, the need for information regarding two products is not so much aimed at the choice of "pushing" one or the other alternative but has as its primary objective the determination of useful information in order to understand the ability to contribute individual products or significant aggregations of products to cover

common fixed costs—i.e. not particularly related to a precise business sector or product offered on the market—it is necessary to move from the determination of the contribution margin of level I to the contribution margin of level II, the determination of which presupposes the algebraic sum of revenues, variable costs, and fixed costs specific to that particular product or business sector.

The second-level contribution margin is an accounting tool for medium to long term decision making, unlike the Level 1 margin which is characterized by the fact that the decisions that can be taken are only short-term decisions.

The medium-long term locution, concerning the level two contribution margin, has two specific meanings:

(1) the use of the medium-long term presupposes that the decision to be taken has or can have a structural impact on the company. Different from the first-level margin, in relation to which the decisions did not affect the company structure, in the hypothesis in which the decision-making aspect involves the second-level margins it is possible to assist, for example, the closure of departments, elimination of products, etc. Clearly such decisions cannot be qualified as short-term decisions but, rather, refer to decisions that, necessarily, must be taken in the medium to long term;

(2) to speak of the medium-long term also assumes a temporal meaning with regard to the period of time within which the decision is to be taken. It has been pointed out in the previous pages that, with regard to decisions involving the first-level margins, the identification of the most convenient choice is contextual to the information concerning the first level margin. It is for this reason that, with regard to such margin, the knowledge of the information can be considered contextual at the moment of the assumption of the decision (if, for example, three orders arrive to me at the same time and I can satisfy only one of them; the choice will fall in the job order that presents the highest margin of first level. Clearly the decision is instant and does not need an extensive period of time to be taken, unless, of course, there are elements of a strategic nature to keep in mind, which, on the contrary, may take a long time before making the most strategically correct decisions). As far as the second-level margins are concerned, clearly the decision cannot be prompt. If, for example, in an exercise, at a programmed level or at a final level, a product appears to be marked by an adverse second-level margin, it is unthinkable that, immediately, the top management eliminates that product. It will take time to see if that adverse value also characterizes subsequent years or even if, a change in company policy, can transform that second-level margin, marked by a negative sign, in a positive margin that contributes to the coverage of fixed costs common to the company. It is therefore, understandable that the medium-long term, in this context also means that the decision is not immediate and contextual to obtaining the information of the amount of the second-level margin.

The above observations could lead to the conclusion that, where a product or a business sector provides a relatively low margin, it is economically viable to eliminate or otherwise drastically reduce the manufacture of such a service in favor of end products or departments which, on the contrary, have a high margin. In order for business decisions to maximize business effectiveness and efficiency, however, it is necessary to always keep in mind that the company, as a system, is characterized internally by strongly interrelated elements: any decision must therefore be taken only after the impact of that decision has been carefully assessed on all the various sub-systems that make up the company.

In the company actuality, it can happen, for example, that the presence of a department or product characterized by an extremely low margin represents a polarizing element of customers who allow another product to contribute in a very high way to the coverage of fixed costs.

In such cases, it is important to understand whether the product with an adverse level II contribution margin is a driving product or not. If so, clearly the elimination of the apparently unprofitable product would have extremely adverse economic consequences in terms of business profitability. In this sense, it is therefore, clear that it is possible to accept, over time, the presence of negative second-level contribution margins precisely because these margins actually allow the achievement, in other departments, of positive first- and second-level contribution margins that allow, overall, maximizing business profits.

In this case, the elimination or drastic reduction of an apparently unprofitable activity would lead to a significant reduction in the volume of activity carried out by the company with consequences that can easily be guessed at in terms of the company's income and financial situation.

These considerations, therefore, suggest a prudent attitude if economic choices are made based on the values described above. When taking a decision, it is essential to take account of the possible influence that one aggregate has on the other aggregates. The underestimation of this element can, in fact, lead to incorrect decisions whose diseconomy does not depend on the limits of the accounting instrument used but derives from the failure to take into account all the implications—economic and strategic—connected with the decision in question.

In the context of this problem, it should also be borne in mind that, in companies, there are numerous joint products in reference to which it is impossible to envisage a split in the production/sale of a good separately from the production/sale of other products. The existence of such links makes it impossible to assume, for example, the elimination of a particular product, even though it is characterized by unsatisfactory profitability. Such a decision could have negative consequences for other products. All this shows that the elimination of activities and/or the remixing of activities is not a decision directly linked to the determination of unsatisfactory margins. It is certain, however, that the quantitative determinations we are discussing are indispensable for every decision to be taken in full awareness of the income and financial impact related to these choices.

Unit Scarce Factor Contribution Margin in the Presence of a Plurality of Sales Options

The presence in the company of scarce—i.e. limited—production factors, the use of which plays a fundamental role in the manufacture and sale of the product offered on the market, requires the definition of a unitary contribution margin determined taking into account the quantity of limited factors absorbed by the product itself. In this case, it is referred to as a contribution margin due to a low factor. If there are such bottlenecks in the hotel business, the preference between various alternatives must be for the one which allows for a higher unit margin per restricted factor.

A typical critical factor that could be available on the farm in restricted quantities is the volume of trained labour. Think, for instance, of the case in which it is possible to offer two products that require a different quantity of trained labour provided by a limited number of people that cannot be increased for reasons of the company's recruitment policy or for reasons of the unavailability on the labour market of a workforce characterized by specific characteristics (e.g. particularly high professional skills) that make it a "rare factor" in the company.

In the presence of such constraints, the choice of "pushing" one product rather than another depends, to a predominant extent, on the unitary contribution due to a rare factor (hours of skilled labour) that each of the two alternatives presents.

Another classic example of a low factor is, for instance, the volume of manufactured goods if the warehouse is particularly small and storage is not an easy problem to solve.

In the presence of a limited factor, the company must "sacrifice" the production and, consequently, the sale of a good in favor of another profitable element. Obviously, from an economic point of view, the good whose production must be sacrificed must, necessarily, identify the less convenient goods.

At this point, the technical and theoretical problem is the identification of the income asset that is less convenient, i.e. the product whose sale has the least impact on the overall amount of net income.

In general terms, the convenience of pushing a product is identified by the amount of the first level contribution margin of that good.

On other occasions we have pointed out that the contrast between the selling price and the full cost of the product, i.e. the determination of the net unit return, does not represent an element of knowledge useful for the decisional purposes of selling the products.

The distribution of fixed costs, often common, among the various company assets represents in fact an accounting "spreading" operation that divides what, in actuality, is unitary. Think, for example, of the attempt to subdivide the cost of depreciation or indirect labour. It is clear that the unit share of this cost represents an accounting operation that aims to spread a negative income component that, in actuality, in the income statement, will influence the determination of the final income for the total amount.

The net unit return cannot, therefore, be taken into consideration when it is necessary to decide which products to push or the sales mix to identify in order to definitively determine the sales budget and, consequently, the production cost budget.

The concept of income useful for these purposes is the contribution margin, which derives from the contrast between revenues and variable costs. In this work, we leave out the analysis of the problems concerning the determination of this value to focus attention on the reasons that lead to the use of this concept of income.

The contribution margin must, of course, be related to the sales quantities. If these values are not taken into account, the company, of course, risks focusing its energies on products with high unit margins but with few sales opportunities.

The value of making short-term decisions about decisions of:

(a) accepting or not accepting an order in progress;

(b) choosing between several products (ex-ante or on the way);

(c) identifying, ex-ante, the optimal sales mix;

(d) selling high quantities at low prices or low quantities at high prices (in tenure or ex-ante);

is, therefore, the first level contribution margin, i.e., both the unit margin and the sales quantity ratio.

It is particularly interesting to investigate, from a theoretical-operational point of view, the hypothesis in which a company has to choose between two price/quantity hypotheses and, at the same time, has to manage a scarce factor.

When these two contextual situations occur, decisions will have to be made based on the margins of contributions, which will have to be differentiated, however, in consideration of the decision to be taken.
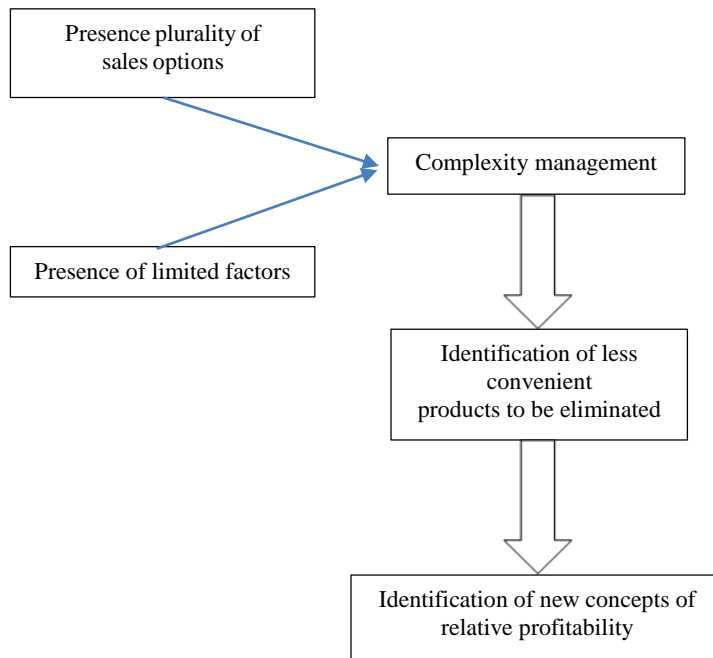
Figure 1. Contribution margin due to a limiting factor.

It should be stressed that the most effective and efficient decision making must also take into account the life cycle of the product. The temporal positioning of the product within its natural life cycle requires decisions that vary according to the temporal positioning considered. This problem would, however, open the way for a dissertation that would lead this in-depth study to an objective different from the one we set ourselves in addressing the issue of the unitary contribution margin due to a scarce factor in the presence of a plurality of sales options. For this reason, the matter of the timing of the product cycle will be set aside so as not to pollute the specific topic of interest with other discourses that may not make clear the subsequent exposure.

To fully understand the complexity of this management issue, we believe it is appropriate to develop a case in which we will proceed to the practical solution of the issue and the theoretical exposure of the problems and solutions.

Suppose that the company Miluegi sells five products: A, B, C, D, and E, a bottleneck characterized the company: it had 120,000 hours of unincreasable skilled direct labour at its disposal.

The 1/1 and 12/31 inventories were as follows:

Table 4

Inventories

Product/Raw material	1/1 inventories	12/31 inventories
A	1,500	500
B	1,000	800
C	600	400
D	2,000	1,800
E	5,000	2,000
Raw material 1 (kg)	1,000	1,100
Raw material 2 (kg)	700	900
Raw material 3 (kg)	1,500	800

The programmed variable costs were as follows.

Table 5

Quantity Factor Per Unit Produced and Unit Selling Price

Product	Quantity factor per unit produced	Unit selling price
A		
Raw material 1	5 kg	2 €/kg
Raw material 2	8 kg	5 €/kg
Raw material 3	12.5 kg	3 €/kg
Direct labour	0.5 h	40 €/h
B		
Raw material 1	6 kg	2 €/kg
Raw material 2	7.5 kg	5 €/kg
Raw material 3	10 kg	3 €/kg
Direct labour	0.7 h	30 €/h
C		
Raw material 1	8 kg	2 €/kg
Raw material 2	13 kg	5 €/kg
Raw material 3	15 kg	3 €/kg
Direct labour	1.3 h	40 €/h
D		
Raw material 1	3.5 kg	2 €/kg
Raw material 2	11 kg	5 €/kg
Raw material 3	4 kg	3 €/kg
Direct labour	1.5 h	40 €/h
E		
Raw material 1	7.2 kg	2 €/kg
Raw material 2	14 kg	5 €/kg
Raw material 3	18.3 kg	3 €/kg
Direct labour	1 h	50 €/h

The preparation of the sales values of the products led to the identification of the following sales hypotheses.

Table 6

Product D: Problem of Two Sales Alternatives

Products	Sales quantity	Unit selling price	Sold quantity	Unit selling price
A	20,000	150		
B	17,000	180		
C	15,000	220		
D	22,000	200	35,000	180
E	45,000	300		

As can be seen, two sales alternatives have been identified for product D.

The first step in the planning process to be implemented to identify the optimal mix is to identify the best alternative for product D. This decision must be taken by determining, for each choice, the first-level contribution margin.

Step 1: Alternative Determination More Convenient for the Product D: Identification of the First-Level Contribution Margin of the Two Sales Hypotheses

Table 7

Variable Unit Cost of Product D

Raw material 1	3.5 kg	2 €/kg	€7.00
Raw material 2	11 kg	5 €/kg	€55.00
Raw material 3	4 kg	3 €/kg	€12.00
Direct labour	1.5 h	40 €/h	€60.00
			€134.00

Table 8

Alternative First Level Contribution Margin 1

Product	Var. unit cost	Unit selling price	Unit contribution margin	Sales quantity	First-level contribution
D	134	200	66	22,000	1,452,000

Table 9

Alternative First Level Contribution Margin for Product D

Product	Var. unit cost	Unit selling price	Unit contribution margin	Sales quantity	First-level contribution
D	134	180	46	35,000	1,610,000

Based on the above income data, it can be said that option 2 is the best one.

The sales planning can be said, for the moment, concluded with the following results.

Step 2: Determination of the Company's Sales Budget (Temporary)

Table 10

Sales Budget

Products	Sales quantity	Unit selling price	Partial budget
A	20,000	€150.00	€3,000,000
B	17,000	€180.00	€3,060,000
C	15,000	€220.00	€3,300,000
D	35,000	€180.00	€6,300,000
E	45,000	€300.00	€13,500,000
Budget aggregate		€29,160,000	

After the sales budget has been determined, the document in which the quantities to be produced are identified can be identified.

Table 11

Temporary Production Programme

Product	1/1 inventories	12/31 inventories	Sales quantity	Product quantity
A	1,500	500	20,000	19,000
B	1,000	800	17,000	16,800
C	600	400	15,000	14,800
D	2,000	1,800	35,000	34,800
E	5,000	2,000	45,000	42,000

Step 3: Determination of the (Temporary) Production Schedule

After having determined the production quantities useful in the achievement of the planned sales and indicated in the sales budget mentioned above, it is needed to assess whether the scarce factor (Direct Labour) is enough to face the production identified above. If the hours of Direct Labour were not satisfactory to produce the quantities indicated on the production schedule, a cut in production would be needed and, consequently, a reduction in the sales quantities shown in the sales budget.

Table 12

Total Hours to Products A, B, C, D, and E

Products	Direct labour for one product	Product quantity	Hours to products A, B, C, D, and E	Available hours	Excess hours
A	0.5	19,000	9,500	120,000	14,700
B	0.7	16,800	11,760		
C	1.3	14,800	19,240		
D	1.5	34,800	52,200		
E	1	42,000	42,000		
	Total hours		134,700		

Step 4: Determination of the Amount of Scarce Factor Needed for the Purpose of Production as Indicated in the (Temporary) Production Schedule

As can be seen, the DIRECT LABOUR hours needed in the production of the goods indicated in the production program are not sufficient. In particular, since only 120,000 hours are available, it is necessary to eliminate the output of one or more products to bring the hours used within this limit.

Since the elimination of the production and sale of a product must occur on an income basis, clearly the least suitable product must be sacrificed. In the previous pages, it has been shown how its contribution margin measures the profitability of an asset. The maximization of the margin, in fact, always involves the contextual maximization of the typical profit and, to parity of conditions, not characteristics, of the net income.

To identify the least advantageous element, it is, therefore, necessary to calculate the unitary product margin.

Step 5: Determination of the Unitary Contribution Margin for Each Product in Order to Identify the Good to Be Sacrificed in Production and Sales

Based on one contribution margins, it could be wrongly assumed that, since product A has the smallest one contribution margin, it is also the least advantageous product and, consequently, identifies the good as the relation to which it is appropriate to sacrifice part of the production and sale.

However, such a choice would be conceptually wrong because the elimination of a certain quantity of production and sale of a good must be made assuming its "relative" convenience measured based on the participation, in its production, of the scarce factor present in the company. The fact that a product absorbs minimal factor influences, in significant direct labour, it is relative convenience. For each unit of limited factors present in the company, it will, therefore, be necessary to calculate the profitability of the goods produced. Only in this direct labour will it be possible to have a complete picture of the actual profitability of the products measured in the light of the presence of bottlenecks on the farm.

The economic viability of a product in the presence of a low factor should, therefore, not be measured by the unit margin but by a particular unit margin determined to take into account the quantity of the scarce element

present in the various products. The expression identifies this value: one margin for limited factor and its determination provides for the contrast between one margin and quantity of scarce factor present in the product.

Table 13

Unit Variable Cost

Unit variable cost Prodotti	C.V.U
A	€107.50
B	€100.50
C	€178.00
D	€134.00
E	€189.30

Table 14

Unit Contribution Margin

Products	Unit selling price	Unit variable cost	Quantity of variable labour	Unit contribution margin
A	€150.00	€107.50	0.5	€42.50
B	€180.00	€100.50	0.7	€79.50
C	€220.00	€178.00	1.3	€42.00
D	€180.00	€134.00	1.5	€46.00
E	€300.00	€189.30	1	€110.70

Step 6: Determination of the Low Unitary Contribution Margin for Each Product in Order to Identify the Good to Be Sacrificed in Production and Sales

Table 15

Unit Contribution Margin for Scarce Factor

Products	Unit selling price	Unit variabile cost	Direct labour for one product	Unit contribution margin	Unit contribution margin for scarce factor (direct labour)
A	€150.00	€107.50	0.5	€42.50	€85.00
B	€180.00	€100.50	0.7	€79.50	€113.57
C	€220.00	€178.00	1.3	€42.00	€32.31
D	€180.00	€134.00	1.5	€46.00	€30.67
E	€300.00	€189.30	1	€110.70	€110.70

As can be seen from the table above, the least advantageous asset in terms of margin by low factor is not A, but D. Product D will, therefore, be sacrificed in terms of production and sales.

To determine the quantity of the product to be eliminated from production and sale, it is necessary to consider the amount of the scarce factor present in the good.

Table 16

Direct Labour (h) for Product D

Excess hours	Direct labour (h) for one product D	Number of pieces to reduce	Production option 1	New production
14,700	1.5	9,800	34,800	25,000

Step 7: Identification of the Quantity of Product D to Be Sacrificed in Terms of Production and Sales

On the basis of this information, the production and sales quantities identified in the above tables should be amended as follows:

Table 17

New Production in New Perspective

Product	1/1 inventories	12/31 inventories	Production	Sales
A	1,500	500	19,000	20,000
B	1,000	800	16,800	17,000
C	600	400	14,800	15,000
D	2,000	1,800	25,000	25,200
E	5,000	2,000	42,000	45,000

Step 8: Recalculation of the Production and Sales Quantities of the Various Products

Based on these data, it can be stated that the first level margin related to the management choices described above amounts to:

Table 18

First-Level Margin Contribution

First-level contribution margin			
Products	Unit contribution margin	Sales	First-level contribution margin
A	€42.50	20,000	€850,000
B	€79.50	17,000	€1,351,500
C	€42.00	15,000	€630,000
D	€46.00	25,200	€1,159,200
E	€110.70	45,000	€4,981,500
	M.d.C.I °total		€8,972,200

Step 9: Calculation of the First Level Contribution Margin Connected With the Management Choices Made Following the Elimination of Part of the Production of the Asset With a Unitary Margin due to a Limited Scarce Factor and the Initial Choice to Opt for Alternative 2

To an unobservant reader, it might seem that the issue we are interested in has been completed. In actuality, this does not correspond to actuality because any income calculation developed so far depends on the initial choice that led to the implementation of alternative 2 for product D.

At this point, however, it is needed to ask whether the first-level margin indicated in the last table (8,972,200) represents the highest margin obtainable in the company.

At this point, all that remains is to keep in mind that all the data reported are based on the assumption that the choice of alternative 2 for product D was the best. Based on the initial data, indeed, the first-level margin of this alternative was higher than the margin withdrawable from alternative No. 1.

However, following the decay of production and sales of D, due to the limited presence of DIRECT LABOUR, it is necessary to monitor whether what has been claimed so far is still valid. The comparison between alternatives 1 and 2 in respect of product D was made by analyzing the sales quantities in tune, i.e. without any reduction caused by external elements, such as the presence of bottlenecks.

The sales quantities that lead to the achievement of the margin of 8,972,200, compared to those indicated in the provisional sales budget, show, in fact, differences. At this point, it is necessary to take a step back to see if the alternative 2 direct labour due to the presence of a scarce factor is better than alternative 1.

At this point, all that remains is to draw up a new sales budget with the quantities of product D indicated in alternative 1.

Step 10: Recalculation of the Sales Budget With Quantities Related to Alternative No. 1 of the Product D

Table 19

New Sales Budget

Sales budget alternative 1			
Product	Unit sales	Unit selling price	Sales
A	20,000	€150.00	€3,000,000
B	17,000	€180.00	€3,060,000
C	15,000	€220.00	€3,300,000
D	22,000	€200.00	€4,400,000
E	45,000	€300.00	€13,500,000
Sale budget		€27,260,000	

Subsequently, it is necessary to recalculate the production schedule and assess whether the scarce factor is sufficient to meet the production quantity required by alternative 1.

Step 11: Recalculation of the Production Programme and Total Direct Labour Hours Required by That Programme

Table 20

New Production Programme and Total Labour Hours

Production programme				
Product	1/1 inventories	12/31 inventories	Sales quantity	Product quantity
A	1,500	500	20,000	19,000
B	1,000	800	17,000	16,800
C	600	400	15,000	14,800
D	2,000	1,800	22,000	21,800
E	5,000	2,000	45,000	42,000

Table 21

Total Working Hours Requires to Prepare the Alternative 1

Product	Direct labour for one product	Production	Hours for product	Available hours	Excess hours
A	0.5	19,000	9,500	120,000	-4,800
B	0.7	16,800	11,760		
C	1.3	14,800	19,240		
D	1.5	21,800	32,700		
E	1	42,000	42,000		
			115,200		

As can be seen, the available DIRECT LABOUR hours are more than the quantity of the factor necessary for the products indicated in the table above to be implemented. Since this alternative does not pose problems of exceeding the use of a limiting factor concerning the quantity present in the company, it is possible to proceed with the preparation of the sales budget and, consequently, to determine the first level margin corresponding to this management hypothesis.

Step 12: Preparation of Sales Budget and Determination of the First-Level Contribution Margin Corresponding to This Management Hypothesis

Table 22

First Level Contribution Margin

Products	Unit selling price	Unit variable cost	Unit contribution margine	Sales	First-level contribution margin
A	€150.00	€107.50	€42.50	20,000	€850,000
B	€180.00	€100.50	€79.50	17,000	€1,351,500
C	€220.00	€178.00	€42.00	15,000	€630,000
D	€200.00	€134.00	€66.00	22,000	€1,452,000
E	€300.00	€189.30	€110.70	45,000	€4,981,500
		M.d.C.I °total		€9,265,000	

As can be seen, the tier one margin of this alternative is higher than the margin related to alternative 2 modified due to the presence of a low factor. This means that the alternative that initially seemed the most profitable actually was identified the least convenient choice.

Step 13: Final Choice of the Put Option in the Light of the Total Direct Labourified Top-Level Margins due to the Presence of Any Limited Factors in the Company

In the presence of a plurality of sales options and a multiplicity of scarce factors, the procedure to be followed is, therefore, a process of successive approximations.

It is, therefore, necessary to evaluate the choices of production/sale in the light of the results of the other options because if only one element changes, the initially less convenient choice can become the option that maximizes the company's income.

In conclusion, of this brief analysis, it can accordingly be stated that the choice between some sales options in the presence of rare factors must, necessarily, be made by calculating the unit margin for limited elements. However, if there are some sales options, a further step in the analysis is needed. It is necessary to verify whether the choice made through the value of the contribution margin for low factor is, actually, the most convenient option compared to what was discarded at the beginning because it is considered not profitably advantageous. The double evaluation prevents from making wrong income choices and represents, therefore, the necessary way for the company to maximize the effectiveness and efficiency of the company's income, considered in its entirety.

And, in conclusion, we can therefore say that, continuing with the analysis, not everything appears as it may seem at the beginning of the investigation of corporate data.

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