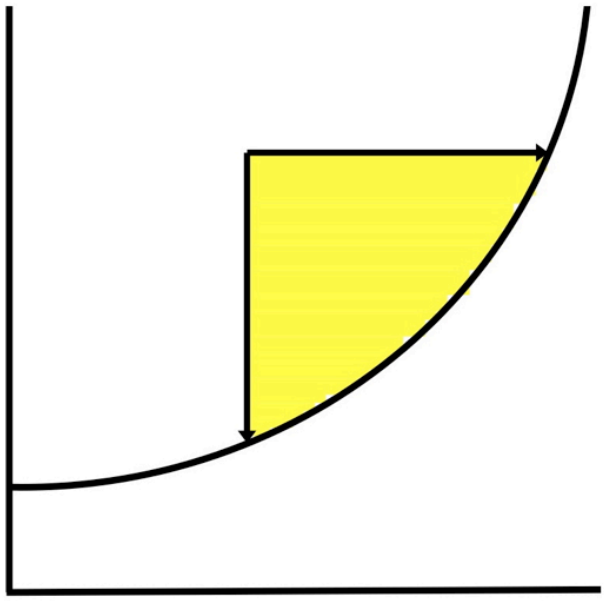
Using GMROI to Evaluate Purchasing Quantity Price Breaks



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An Inventory Curve Management Guide

Two of the basic questions in any inventory system are when to order and how much to order. This discussion centers on an approach to the question, how much to Order?

Organizations use a variety of methods to determine order lot sizes for products including: lot of lot, period order quantity, economic order quantity, lowest unit cost and quantities based on standard package quantities such as case, pallet or container. Many times, guidelines and order policy variables in systems are specified such as order "X" weeks supply for "A" items, "Y" weeks supply for "B" items and "Z" weeks of supply for "C" items. Yet, when actual inventory performance is reviewed, the performance does not match the specified guideline.

One possible reason may be a conflict between achieving inventory turnover objectives, as outlined by the organization's strategy and implemented by the order policy variables such as lot-for-lot, minimum order sizes, order size multiples and min/max; versus an ***ongoing*** culture to achieve the lowest purchase price.

In inventory theory and purchasing literature, it is rare to see discussions specifically on inventory turnover as it relates to volume pricing for varying lot sizes and, to the best of my knowledge, there has been no discussion of the impact of lot sizes on item profitability. This document will explore incorporating a technique known as GMROI, Gross Margin Return on Inventory Investment.

To study this, I ask two questions:

- Can a model be constructed that calculates GMROI based on the purchase price for an item, particularly when quantity discounts and price breaks apply?
- Can such a model provide meaningful insight and direction related to purchasing the item?

I believe the answer is "Yes" for both questions with interesting results that will be useful to the development of both purchasing and inventory strategy.

GMROI

GMROI is a turn-and-earn technique that measures inventory performance based on gross margin and inventory turnover. It is widely used in retail and also in wholesale/distribution. I have used it successfully in manufacturing under certain circumstances.

GMROI seeks to answer the question, for every dollar invested in inventory, how much is earned in gross profit?

The formula is Gross Profit % (GP%) divided by Cost of Goods Sold % (CGS%) times inventory turnover (ITO) or

$$\frac{GP\ \%}{CGS\ \%}\ x\ ITO = GMROI$$

GMROI can be calculated at the enterprise level, for operating subdivisions and product lines, at the item level or for any group where you can identify gross profit and associated inventory turnover. It is a useful tool to make comparisons between internal segments or as an external benchmarking tool.

The question frequently asked is, what is a good number? Generally, higher is better. Keep in mind that GMROI's can vary dramatically between industries and companies. To determine a number that is suitable for you, start by computing the GMROI for your own organization based on your total company financial statements. You can then use the results as a baseline for comparison with internal segments and other companies in your industry.

As an example, the following table shows the GMROI calculations for select public companies in the US based on their most recent annual financial statements.*

Sales, CGS and Inventory in $ millions

	$ Sales	$ CGS	$ Avg Inv	GP %	CGS %	ITO	GMROI
Apple	156,508	87,846	783.5	43.9	56.1	112.1	$87.72
Best Buy	45,085	34,435	6,151	23.9	76.1	5.6	$1.76
Costco	97,062	86,823	6,867	10.5	89.5	12.6	$1.48
Dell	44,744	36,683	1,393	18.0	82.0	26.3	$5.77
Sysco	44,411	36,544	2,288	17.7	82.3	16.0	$3.44
W.W. Granger	8,950	5,034	1,285.5	43.8	56.2	3.9	$3.04

Table 1

As you can see, there is a wide range of Gross Profit Margins and Inventory Turnover between these companies. The GMROI indicates the profitability of the inventory investment. In the case of Apple, $87.72 in Gross Profit is earned for every dollar carried in inventory.

For more information on GMROI, see http://www.inventorycurve.com/GMROI.html

* Latest 10K reports as of August 28, 2013. Average Inventory calculated as average of ending inventory for the year and ending inventory for the prior year.

The Basic Model

We can apply and extend the GMROI logic at the individual item level to calculate the impact of purchase price differences for the item's impact on GMROI, particularly when volume discounts are available. Or, the model allows the GMROI impact to be calculated when comparing prices and volume requirements among suppliers.

The following assumptions, modifications and logic for the model are:

- An established target-selling price has been set. Of course, you can change it to evaluate the effects within the model.
- You have an estimate of the annual volume in units. This is used to calculate inventory turnover. Units are used because suppliers typically show price breaks based on unit volumes.
- Since the purchase price changes based on the purchase volume, the margin will change for each price break point.
- From classical inventory theory, average inventory is one-half the order quantity. As such, the average inventory is one-half of the price-break quantity.

Using these assumptions, the following calculations for each price break/volume option can be made:

- Gross Profit = Target Selling Price – Unit Cost for each quantity break
- Gross Margin % (GP %) = Gross Profit ÷ Target Selling Price
- Cost of Goods Sold % (CGS %) = 100 – GP%
- Average inventory = Quantity ÷ 2
- Turnover (ITO) = Annual volume ÷ Average Inventory
- GMROI is then calculated as (GP% ÷ CGS %) x ITO

ITEM 1
Target Selling Price: $5.00 **Projected Annual Volume: 400**

Quantity	$ Cost	$ Gross profit	Average Inventory	GP %	CGS %	ITO	GMROI
20	2.82	2.18	10	43.6	56.4	40	$30.92
40	2.73	2.27	20	45.4	54.6	20	$16.63
100	2.58	2.42	50	48.4	51.6	8	$7.50
200	2.45	2.55	100	51.0	49.0	4	$4.16

Table 2

This is a modest example with reasonable gross profits, turnover rates and GMROI, all within the ranges shown for the companies listed in Table 1. In fact, the GMROI of $4.16 for the largest purchase quantity is higher than the corporate GMROI of 3 of the 5 companies shown in Table 1. But what if the least cost break was not used and small quantities with higher costs were purchased instead? The GMROI increases dramatically. And note that the highest GMROI occurs at the highest cost, lowest volume break.

Here is another example.

ITEM 2
Target Selling Price: $28.00 **Projected Annual Volume: 5,000**

Quantity	$ Cost	$ Gross profit	Average Inventory	GP %	CGS %	ITO	GMROI
10	27.71	.29	5	1.0	99.0	1,000.0	$10.47
100	17.18	10.82	50	38.6	61.4	100.0	$62.98
175	16.74	11.26	87.5	40.2	59.8	57.1	$38.44
500	15.95	12.05	250	43.0	57.0	20.0	$15.11
1,000	15.83	12.17	500	43.5	56.5	10.0	$7.69
5,000	15.35	12.65	2,500	45.2	54.8	2.0	$1.65
10,000	15.30	12.70	5,000	45.4	54.6	1.0	$.83

Table 3

In this example, all price breaks, with the exception of the smallest quantity of 10, provide decent margins. But, look at the GMROI. The greatest GMROI is for the second smallest price break quantity. And the largest quantity with the lowest cost has a GMROI of less than $1.00. If the projected annual volume is increased to 10,000, or even 20,000, the GMROI's for each price break increase, but the quantity of 100 still yields the greatest GMROI.

INITIAL OBSERVATIONS

When I first started this research, I expected to see the "best" GMROI increase with larger lot sizes/lower cost as the projected annual volume increased. That was not the case. What I found was that the quantity break that yielded the highest GMROI did not usually change with increases in projected volume.

I looked at many different items using the supplier's actual price lists. I modified annual sales and changed the selling price to further increase the margins. It did not make a difference in the price break that produced the highest GMROI.

In testing this approach with a variety of items, the lowest quantity price break produced the best GMROI for 75% of the items I tested. Two pricing situations accounted for the highest GMROI occurring on a price break other than the lowest quantity/highest price. In a few cases, the cost decline between the highest price and the next lower break was substantial enough to drive a large margin increase that resulted in the best GMROI occurring at the second highest price. The other case resulted when the package size changed such that the ITO increased rather than declined.

Looking at the results of model tests for the items, the conclusion I reached was that in most cases, the modest or minimal decreases in purchase price moving to higher volumes are more than offset by much lower turnover rates. While the unit cost is lower when

moving to higher volume levels, the inventory profitability as measured by GMROI declines.

It may well be that a focus on lowest cost is driving strategies that are counter productive to higher turnover and inventory asset utilization.

Extending the model

In the examples above, the analysis is based solely on the price/quantity breaks. In reality, other costs exist, whether or not they are included in the calculation. Major costs might include domestic freight charges, international freight charges depending on the INCOTERMS, special handling or storage requirements or the cost to process a purchase order.

Most cost estimates do not include a provision for order costs. Since this analysis looks at the impact on GMROI, it may be appropriate to include some estimate of purchase order costs. These can be included as an addition to the unit price.

The sidebar provides a brief discussion on order costs. In doing the analysis, I tend to ignore the handling cost per unit. Under most circumstances, the handling cost of a unit is the same regardless of the size of the order; so for purposes of the analysis, the per unit cost to handle an order of 1,000 units is about the same of the per unit handling cost of an order for 100 units. As a result, this is a wash between various quantity breakpoints and does not need to be considered.

However, the order cost and cost per line should be included. With single line, single delivery PO's costs behave like a fixed cost and can be allocated on a cost per unit basis. In the model, I added this allocated, prorated cost to the Unit Cost. This, in turn, results in a lower gross profit and gross profit percent which will lower the GMROI for each quantity/price break.

Table 4a shows the model for another product based solely on the volume pricing. Table 4b adds in an order cost of $20 per order that is prorated on a per unit basis.

ESTIMATING ORDER COSTS

Estimating order costs is dicey at best. Most organizations do not have a good handle on this, but the costs associated with handling and processing an order are real and are important in this analysis.

In the case of purchase orders there are three types of costs:

- A fixed cost per order
- A cost per line
- A cost per unit

These costs accrue at various points in the PO process: at order creation and release, at receiving, inspection, put-away, supplier invoice posting, reconciliation and payment.

It is important to recognize these costs and how they apply, based on how the product is ordered and received.

A single PO placed for a specific quantity of product to be delivered complete, at one time may have substantially different processing costs from the same order placed with time-phased deliveries.

ITEM 3
Target Selling Price: $60.00 **Projected Annual Volume: 100**

Quantity	$ Cost	$ Gross profit	Average Inventory	GP %	CGS %	ITO	GMROI
1	49.99	10.01	.5	16.7	83.3	200.0	$40.05
40	40.00	20.00	20	33.3	66.7	5.0	$2.50

Table 4a

ITEM 3
Target Selling Price: $60.00 **Projected Annual Volume: 100**
Order Costs: $20.00

Quantity	$ Cost including pro-rated order cost	$ Gross profit after inclusion of order cost	Average Inventory	GP %	CGS %	ITO	GMROI
1	69.99	(9.99)	.5	-16.7	116.7	200.0	($28.55)
20 *	50.99	9.01	10	15.0	85.0	10.0	$1.76
40	40.50	19.50	20	32.5	67.5	5.0	$2.41

** No quantity or price break is applicable, but this line is added to show the impact of the prorated order cost to the per unit cost.*

Table 4b

In this case, the inclusion of a prorated order cost moved the best GMROI up to the next higher volume/price point.

In testing of multiple items, including an order cost moved the best GMROI bracket up in 75% of the cases.

Adding in freight

Many organizations expense freight charges and do not include them in the value of their inventory. However, freight costs are real and including them as part of the cost (landed cost) allows for an additional element to be added into this model. By using landed cost along with the prorated order costs allows for the review of GMROI, gross profit and GP % within the model.

In Table 4c, freight charges are added to the purchase cost and the prorated order cost.

ITEM 3
Target Selling Price: $60.00 **Projected Annual Volume: 100**
Order Costs: $20.00 **Freight of $4.00 per unit added to quantity of 1.**
Freight of $2.00 per unit added to quantities of 20 and 40.

Quantity	$ Cost including prorated order cost and freight	$ Gross profit after inclusion of order cost and freight	Average Inventory	GP %	CGS %	ITO	GMROI
1	73.99	(13.99)	.5	-23.3	123.3	200.0	($37.79)
20 *	52.99	7.01	10	11.7	88.3	10.0	$1.33
40	42.50	17.50	20	29.2	70.8	5.0	$2.06

* No quantity of price break applicable, but added to show the impact of the prorated order cost to the per unit cost.

Table 4c

The addition of freight has shifted the GMROI to the highest quantity/lowest price bracket. Also note that the inclusion of freight has reduced the calculated GP % by 10% compared with Table 4b.

Adapting the Model to Manufacturing

GMROI has experienced wide usage in retail and wholesale/distribution, but has had limited use in manufacturing. Retailers and distributors buy and resell products without conversion or processing. Dealing only with Finished Goods allows for easy use of GMROI.

Under certain circumstances, GMROI can be successfully used in manufacturing. Typically this is best done when 1) materials tend to be vertically oriented from raw materials, through WIP and finished goods and can be linked by product line or family either through internal control processes or master data classification or 2) products are tightly segmented by programs and/or customer contracts.

At the item level, the model is applicable to evaluation of raw materials regardless of the ability to do GMROI within the organization.

To use the method outlined here with GMROI tied to pricing/quantity breaks the critical element is selecting a proxy for the target selling cost. Possibilities might include:

- The item's standard cost
- An industry wide retail price if the item is also sold at retail
- A calculated markup based on your internal material overhead rate
- A calculated markup percentage based on your organization's normal gross profit

Regardless of the method you choose, if done consistently, you will see the differences between the volume/pricing options as expressed in the model.

CONCLUSION

The method presented in this document represents a new way of evaluating purchase options and trade-offs for materials combining cost, gross profit and inventory turnover. As such, it represents a new tool in the toolbox and can be used to calculate GMROI when quantity discounts and price breaks apply.

Historically, purchasing and procurement have had a focus on cost reduction. The approach presented demonstrates that in at least some cases, selecting a lower price option may reduce overall inventory turnover and inventory profitability. This finding has financial, cultural, strategic and tactical implications. This is particularly important for slow moving items.

When I have analyzed inventory performance by ABC code[†], it is common to see low turnover for the B and C items. It is very possible that purchase of these items based on lowest cost, highest quantity is one of the contributing factors for the low performance that is observed.

Options

Consider using the tool when evaluating purchases and use it to set the order policy variables in your ERP system.

Including an order cost allocation and freight impacts an item's profitability, even in organizations where these costs may not be identified or allocated. This approach provides a method to include these costs for analysis.

One approach to obtaining lower costs but with lower minimum purchase quantities is to partner with select suppliers and negotiate volume purchase agreements with lower costs but with just-in-time and/or period order quantity type deliveries of the physical product.

I encourage you to evaluate this approach within your own organization. It can help you improve your inventory performance.

[†] For more on ABC Reporting and Analysis, see the document, **The Inventory Curve Guide to ABC Codes.**

About the author

"Looking at inventory performance improvement through a different lens."

David Armstrong is a consultant, writer and commentator on inventory, supply chain and operations. He has over 40 years experience with end-to-end supply chains and related functional areas in consumer products and high-tech manufacturing, wholesale/distribution and retail in both operations and systems. Continuous improvement and lean approaches are a fundamental in his approach.

He has been published in the Harvard Business Review and Handling and Shipping Magazine and taught at The University of Colorado – Denver and Front Range Community College.

The flow of inventory and related information through the supply change is a primary interest and David has developed new concepts and novel ideas related to better understanding the characteristics of inventory and improving its performance in organizations. In doing so, he asks, "what is the data telling us" and balances theory with data. He is tenacious, pragmatic, is more concerned with satisficing than optimizing and spans boundaries in his thinking between systems, operations, physics and cognitive disciplines.

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