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ANALYSIS

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The Effects of Inflation on Cross-Country Profit Comparisons

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This paper explores ways of integrating the effects of inflation into a firm's profitability measures. Using quantifiable means, such as carrying time, the authors demonstrate how the profit performances of firms operating in separate countries can be adjusted to account for relative inflation differences. The paper's suggested methods also can be used as an adjustment to compare the performance of firms within the same country, but having different functional currencies. Inflation adjustments to profit indicators increase the degree of comparability of cross-country firms.

Many transfer pricing studies make use of financial data on companies engaged in a line of business similar to the target company to create an interquartile range for comparative purposes. Profit level indicators (PLIs) such as gross margin, operating margin, and return on assets, commonly are used to create an acceptable range of values to estimate the "normal" profits for similar companies. Unfortunately, most accounting level data do not explicitly account for the effect of inflation on income statement accounts.[1]

This is not troublesome if the companies used to compute the range, and the target company, use the same functional currency for accounting purposes. However, different currencies are affiliated with different rates of inflation. Cross-country margin comparisons need careful adjustment to improve their economic content.

Using common features of the financial markets, this paper presents several techniques the practitioner can use to adjust a firm's profit measures, including its cost plus, gross margin, Berry ratio, total cost plus, and operating margin, to reflect differences in inflation.

This paper first presents the economic theories linking inflation differences across countries to differences in spot exchange rates, and forward exchange rates to differences in nominal interest rates. Using these relationships, expected inflation adjustments can be made to these profitability measures to allow cross-country comparisons. The paper then discusses approaches used to estimate inflation rate uncertainty, or inflation rate risk, which is often confused with expected inflation. The confusion is usually compounded since higher levels of inflation frequently correspond to higher variability of inflation or greater inflation risk. By addressing expected and unexpected changes separately, we hope to present analysts with flexibility in applying the suggested inflation adjustments.

The Economics of Interest Rates and Inflation

Irving Fisher [2] formalized the link between inflation and interest rates. In essence, Fisher stated the equation:

$$i_i = (1+r_i)(1+p^e) - 1 \quad \textbf{[1]}$$

where ii is the nominal interest rate, ri is the real interest rate, and pe is the expected change in the price level, or the expected rate of inflation. The "Fisher" equation states that the nominal interest rate can be decomposed into two components--the real interest rate and the inflation premium. The nominal interest rate is the interest rate that is most easily observed, with common examples being U.S. government debt interest rates or yields, or a bank's posted mortgage rate. On the other hand, real interest rates are more difficult to observe, as they reflect "real" variables relating to the underlying structure of the economy, such as the legal and regulatory environment. According to the Fisher equation, the only difference between the nominal interest rate and the real interest rate of a particular country is the inflation premium.[3]

The Fisher equation also can provide a link between the exchange rate and levels of inflation between two currencies. Assume that two companies operate in the countries Home (HC) and Foreign (FC), and both earn the same "real" returns. Then by setting the real interest rates equal and rearranging terms, equation **[1]** can be rewritten as: [4]

$$\frac{F_{FC}}{S_{FC}} = \frac{1 + i_{fc}}{1 + i_{hc}} \quad \textbf{[2]}$$

This also is known as the "uncovered interest rate parity" condition. The denominator S_{FC} is the spot exchange rate of the foreign currency and the numerator, F_{FC}, is the forward exchange rate of the foreign currency, or the expected future exchange rate.[5]

The uncovered interest rate parity condition implies that differences in expected exchange rates across countries can be accounted for by differences in nominal interest rates across countries, i_{fc} and i_{hc}. As the expected depreciation in a country's exchange rate increases, its interest rate relative to the base country also will increase.

However, expected exchange rate changes are not the same as unexpected exchange rate changes, otherwise known as exchange rate risk. As will be illustrated, the expected inflation (or exchange rate) will have a simple and quantifiable effect on the profits of a firm. It is possible to estimate an expected inflation adjustment that can then be incorporated into cross-country analyses of the performance of comparable firms.

Expected Movements

The preceding equations are concerned with the issue of expected or forecast interest rates. It is straightforward to obtain financial market information to calculate equation **[2]** and estimate the ratio of interest rates between two countries to get information on expected exchange rates and inflation rate differences. However, many accounting techniques do not directly address the impact of inflation on financial statements. For low inflation countries such as the United States, the impact of inflation may not introduce significant distortions in profit level indicators. However, this is not the case in countries with moderate to high inflation.

In the case of margin measurements, it is easy to see that inflation probably will not have a significant effect as long as both the denominator and numerator are affected by the same rate. Unfortunately, sales and costs may not be *realized* at the same time. Usually, a company incurs costs first, with sales revenues generated later. This is known as positive carrying time, which implies that some operational leverage or borrowing is needed or is inherent in a company's production process. An example of positive carrying time would be a company that borrowed at the beginning of the production period to pay its production and distribution expenses. When sales are realized at the end of the period, the loan is repaid from sales receipts, and the balance is treated as profit.[6]

Adjusting a company's profitability ratios to reflect inflation requires that the correct interest rate be chosen to quantify the carrying time. The proper implied interest rate to be used in the adjustment must be stated in the same currency as the company's functional currency. Since interest rates differ across countries, the expense related to carrying time will differ across countries as their interest rates, and thus inflation rates, differ. For example, a Mexican company would require an analysis using a new peso based interest rate since it would use new pesos as its functional currency. Likewise, a U.S. company would use a dollar-based interest rate.

To see how expected inflation affects the profitability of a company, we will examine the case of a closely held Mexican manufacturer that incurs costs in Mexican new pesos and sells its output and receives new pesos. It is assumed that there are no other Mexican companies that can be treated as comparables to test its cost plus markup. However, there is an unrelated U.S. company that manufactures a comparable product and incurs manufacturing costs and receives revenue in U.S. dollars. Both companies have average carrying times of 90 days.[7]

The Adjusted Cost Plus Markup

The cost plus markup (gross profit/cost of goods sold) for the U.S. manufacturer is 6%. The current U.S. interest rate is embedded in the cost plus markup, so estimating the Mexican cost plus markup should reflect the difference between the U.S. inflation rate and the Mexican inflation rate. It is assumed that the annual U.S. inflation rate is 4%, while the Mexican inflation rate is 24%.[8] The "uplift" needed for the U.S. cost plus markup to equate to a comparable Mexican company can be estimated by:

Mexican Cost Plus = U.S. Cost Plus + (Mex. Inflation – U.S. Inflation) **[3]**

Mexican Cost Plus = 6% + (24%*(90/360) – 4%*(90/360)) **[4]**

Mexican Cost Plus = 6% + (5%) = 11% **[5]**

In other words, the Mexican company earns the same cost plus markup as the U.S. company, adjusted to reflect the extra 5% inflation incurred during the 90 days.[9]

The cost plus markup that the closely held Mexican manufacturer can expect to earn varies with the differences in inflation rates between the United States and Mexico. Table 1 gives the cost plus markup calculations for various U.S. and Mexico inflation rate scenarios. For Table 1, it is assumed that a comparable U.S. company earns a cost plus of 6% and that both companies have carrying times of 90 days. To simplify the analysis, the U.S. manufacturer receives sales in U.S. dollars, while the Mexican company receives new pesos.

Table 1. The Adjusted Cost Plus Markup

U.S. Inflation Rate	Mexican Inflation Rate	Mexican Cost Plus
0%	12%	9%
4%	12%	8%
8%	12%	7%
0%	16%	10%
4%	16%	9%
8%	16%	8%
0%	24%	12%
4%	24%	11%
8%	24%	10%

Other Financial Ratios

Equation **[3]** also gives the analyst the advantage of applying the inflation adjustment to other financial ratios. As shown in the above cost plus markup section, sales must exceed costs to account for both normal profits and inflation. In the example, sales would need to exceed costs by approximately 11% in Mexico in order to achieve "normal" profits. The inflation uplift can also be applied to a gross margin (gross profit/sales) analysis. Table 2 illustrates the gross margin calculation when U.S. inflation is 4% and Mexican inflation is 24%.

Table 2. The Adjusted Gross Margin

	Sales	**Cost of Goods Sold**	**Gross Margin** [10]
United States (in $)	106	100	5.7%
Mexico (in Ps)	222	200	9.9%

In this sense, an inflation adjustment is straightforward when comparing gross margins. This adjustment, however, it not as great (4.2 percentage points in this example) as for corresponding cost plus markup adjustments (5 percentage points in the cost plus markup example).

In addition to the cost plus markup and the gross margin, the inflation adjustment can be applied to operating margins (operating income/sales). When analyzing the effects of inflation on operating margins, one must consider not only sales and cost of goods sold, but also operating expenses. As described above, costs occur on day zero and sales are received on day 90. However, operating expenses associated with the sales occur throughout the 90 day period. To simplify the analysis, we assume that operating expenses are incurred on day 45, the midpoint of the carrying time. In this sense, the sale price for a transaction would be the sum of the following:

- The cost of goods sold,
- Normal markup (non-inflation) on cost of goods sold,
- 90 days of inflation markup on cost of goods sold, and
- 45 days inflation markup on operating expenses.

Table 3 shows the adjusted operating margin for a company with cost of goods sold of 70 and operating expenses of 30 under annual inflation rates of 0, 4, and 24%. It is assumed that the normal markup on cost of goods sold for this entity is 50%.

Table 3. Adjusted Operating Margin

Cost of Goods Operating Sales Operating
Sold Expenses Margin

No Inflation 70 30 105.0 4.8%

4% Inflation 70 30 105.9 [11] 5.3%

24% Inflation 70 30 110.19. 2%

With the assumptions used to calculate the adjusted operating margin, the various Berry ratios (gross profit / operating expenses) may also be estimated for different inflation rates. The Berry ratio estimates, using the above assumptions, are shown in Table 4.

Table 4. The Adjusted Berry Ratio

Cost of Goods Operating Sales Berry Ratio
Sold Expenses

No Inflation 70 30 105.0 1.17

4% Inflation 70 30 105.9 1.20

24% Inflation 70 30 110.1 1.34

The mathematics of the total cost plus (operating income/total costs) and the operating margin are very similar. Using the assumptions for the operating margin analogy, the following estimates are made regarding the various inflation-adjusted total cost plus markups.

Table 5. The Adjusted Total Cost Plus

Cost of Goods Operating Sales Total Cost Plus
Sold Expenses

No Inflation 70 30 105.0 5.0%

4% Inflation 70 30 105.85 5.85%

24% Inflation 70 30 110.1 10.1%

The analytics of expected inflation markups are straightforward, and should make cross-country profit comparisons simpler when using income statement based profit level indicators.[12] The adjustment mechanisms can also be extended to companies within the same country using different functional currencies. However, integrating the impact of unexpected inflation into the analysis can be very difficult.

Unexpected Movements

The above examples assumed that the future was known in that the U.S. and Mexican inflation rates were known with certainty. In the real world, future inflation rates are unknown and some currencies are more volatile than others. For example, the expected inflation rates in Mexico and Brazil may be 24%, but the Brazilian rate may be more volatile. With the volatility comes risk, which affects the business environment in Brazil. Therefore, a Brazilian manufacturer must be compensated for expected inflation *and* the extra volatility of its currency. (It is assumed in the foregoing examples that both Mexico and the United States have the same low level of inflation volatility.) For the sake of simplicity, the inflation uncertainty premium can be treated as an addition on top of the expected inflation adjustment.[13] The additional uplift needed to compensate the Brazilian company for inflation volatility is shown in Table 6.

Table 6. The Effect of Unexpected Inflation on the Markup

	Normal Profit	**Expected Inflation**	**Total Markup**
United States	.5%	1%	6%
Mexico	5%	6%	11%
Brazil	5% + *V* [14]	6%	11% + *V*

Unfortunately, analyzing the effect of unexpected exchange rate movements, thus unexpected inflation rate changes, is not as simple as adjusting for expected inflation differences. Companies concerned with inflation uncertainty may hedge using various futures and other derivative securities. While ignoring transaction costs, the prices of these derivative securities should provide a lower bound estimate of what a firm could expect to pay for full exchange rate risk insurance *ex ante*. This method requires using current futures and spot prices to estimate the risk premium and an estimate of the length of time of "borrowing" implied by the carrying time. This method may be useful in setting a forward-looking transfer pricing policy, such as an advanced pricing agreement.[15]

Conclusion

By utilizing the concept of carrying time and the uncovered interest rate parity condition, an inflation adjustment to a firm's-profit level indicator can be estimated that improves the level of comparability between firms in different countries or having different functional currencies. Adjustments in a firm's accounts receivable, accounts payable, and inventory costing methods are sometimes made to increase the degree of comparability among a sample of firms. But many accounting techniques lack methods of integrating the "cost" of inflation above the operating profit line.

Expected inflation can be incorporated into a variety of profit level indicators. We have illustrated how the cost plus, the gross margin, the operating margin, the Berry ratio, and the manufacturer's cost plus measurements can be adjusted to account for expected changes in the inflation rate. The increased variability that usually accompanies higher rates of inflation implies that these adjustments may only be lower bound estimates of the overall effect of inflation. Unfortunately, there are no simple methods for estimating the additional markup needed to account for unexpected inflation rate changes.

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[1] Inflation can also directly affect the balance sheet. However, this possibility is not addressed in this essay.

[2] Irving Fisher (1867-1947) was an American economist. One of his most famous works is his entitled, *The Theory of Interest* (1930).

[3] The Fisher equation also implies that the observed return earned by two assets with identical "real" characteristics should differ only by differences in expected inflation. Fisher, Irving (1896) "Appreciation and Interest," Publications of the American Economic Association, Vol. 11.

4 See Appendix A for a detailed mathematical derivation.

5 Financial economists generally treat this parity condition as if it were true since arbitrage opportunities can arise if the equality does not hold.

6 Positive carrying time, or leverage, is also obtained when large inventories are held, or when accounts receivable (payable) is relatively greater (less) than a bench mark or industry average. For the same level of sales (in terms of quantity), a company with higher operating leverage can expect to earn a higher price on its sales -- due in part to the increased implied interest expense that is passed on to its customers.

7 Carrying time may imply the difference between the date costs are incurred and either the date the sale is booked or when the sales revenue is realized. The appropriate definition of carrying time may depend upon other circumstances, so no particular definition is chosen for our examples. However, the same definition should be used through any analysis using this technique for consistency.

8 It may appear that nominal interest rates can be substituted for inflation rate measures in the analysis, if they are chosen to have the same term to maturity as the carrying time. However, using interest rates instead of inflation rates will overstate the nominal return or profits already imbedded in the cost plus markup.

9 This analysis is somewhat of a simplification of the Fisher equation. To be exact, the Mexican cost plus return (1 + cost plus) can be calculated:

as insert graphic Using this method and substituting for the relevant variables, the expected cost plus markup for a comparable Mexican manufacturer is 11.2%.

10 These figures correspond to cost plus markups of 6% and 11% for the United States and Mexico, respectively.

11 For illustration, this calculation is 105.85 = 105 + 70*(4%*(90/360)) + 30*(4%*(45/360)).

12 There is no reason why inflation adjusted return on asset measures could not be derived using the above methods. However, the modifications needed to reach an adjusted return on asset measure would be substantial. The nominal value of sales increases with the rate of inflation, but asset values can behave differently. Since asset prices are derived from capitalizing the flow of benefits that the asset generates, inflation would increase the nominal value of the benefits in each period while simultaneously decreasing them through an implied higher discount rate. While the overall impact of positive inflation is probably also positive, the inflationary effect on asset prices is very sensitive to the age of the assets and how benefits are structured over time. While deriving inflation adjusted return on assets measures are possible, these modified profit level indicators are extremely sensitive to the assumptions used to derive them and require significantly more information to derive them.

13 Since volatility usually varies positively with the inflation rate, the adjustment to the higher inflation country will provide only a lower bound estimate of the total inflation related adjustment.

14 V represents the extra payment necessary to compensate for the volatility of the inflation rate.

15 However, this method fails to serve as an appropriate ex post adjustment process. A problem arises because risk is inherently an ex ante concept. Adjusting profitability for differences in expected inflation is acceptable when inflation volatility is low. This is because without the volatility, ex post profits are the same as ex ante profits. However, medium to high inflation can also produce increased inflation volatility that may cause all of the methods described in this essay inappropriate. In any event, this is an unresolved problem, and a subject for future research.

APPENDIX A:
MATHEMATICAL DERIVATION

To derive the uncovered interest rate parity condition, begin with the "Fisher" equation restated as

$$1 + i_i = (1+r_i)(1+p^e)$$ **[A1]**

or,

$$\frac{1 + i_i}{1 + p^e} = (1 + r_i)$$ **[A2]**

Long run economic equilibrium implies that real returns will equalize across countries, so that for countries FC and HC,

$$\frac{(1 + p^e_{FC})}{(1 + p^e_{HC})} = \frac{1 + i_{FC}}{1 + i_{HC}}$$ **[A3]**

However, the expected inflation rate can be restated as the expected percentage increase in the currency over the period. This is illustrated by

$$\frac{(1 + \Delta FC/FC)}{(1 + \Delta HC/HC)} = \frac{1 + i_{FC}}{1 + i_{HC}}$$ **[A4]**

The left hand side of equation A4 can be rewritten as

$\frac{1}{FC}$ (FC + ΔFC) = $\frac{(FC + \Delta FC)}{(HC + \Delta HC)}$ + $\frac{F_{FC}}{}$

1 FC S_{FC}

(HC +ΔHC) =

HC HC

giving the final result

$$\frac{F_{FC}}{S_{FC}} = \frac{1 + i_{FC}}{1 + i_{HC}}.$$ **[A6]**

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