# An Update to D'Arcy's "A Strategy for Property-Liability Insurers in Inflationary Times"*

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In 1980, D'Arcy wrote a paper to provide insurers with a strategy to immunize against inflation. Over the past year (2008), it appeared that inflation was going to be a significant obstacle for the insurance industry on the basis of a sharp increase in the cost of commodities and increasing severity trends for property coverage as a result. These inflationary concerns were eclipsed by a massive credit crises spurred on by years of questionable lending practices and commodity prices dropped precipitously in response. At this moment, the U.S. government is planning on spending initiative to stave off a long recession. To finance this initiative, the government could both print and borrow money, which could possibly lead to the kinds of inflationary figures last seen in the late 70s. Given the threat inflation poses to insurance firms, the following is an update to this seminal paper.

Insurance company profits are the sum of underwriting profit (premium less incurred loss) and investment income on the premium prior to paying incurred loss amounts as well as the capital necessary to support the operation. Each of these components will be discussed separately.

## DATA CAVEATS

A majority of the analysis relies on calendar year data taken from Best's *Aggregates & Averages*. Accident and policy year data would be preferable since these are closely tied to the years in which the business was assumed or written. An example of bias in calendar year data this is that during the soft market years of the late 90s, the largest underwriting losses were realized years later when the insurance companies took large reserve hits.

The Consumer Price Index (CPI) is the measure used as a proxy for inflation of insurers. As measured by industry sources the insurance industry has absorbed higher cost increases than the CPI would suggest but it's directionally consistent.

## UNDERWRITING PROFIT MARGIN[1]

Insurance companies are unique in that they sell their product without truly knowing the underlying costs for the coverage afforded. When prices of goods rise at unanticipated rates,

[1] Underwriting Profit Margin is defined as 100% less the Combined Ratio before dividends. The Combined Ratio is the sum of the Net Loss Ratio and the Underwriting Expense Ratio. The Net Loss Ratio is defined as Loss plus Loss Adjustment Expense divided by Net Earned Premium. The Underwriting Expense Ratio is defined as Underwriting Expenses over Net Written Premium.

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insurance companies find they have undercharged for their coverage. In addition, regulators may put more scrutiny on insurers charging higher rates or from restricting coverage in a tough economic climate.

Below is a regression equation D'Arcy fitted to explore the relationship between underwriting profit margin (UPM) and the inflation rate.

$$\text{UPM} = -0.617*\text{Inflation} + [2.955] \rightarrow R^2 = 27.7\% \{ 1951 - 1976 \} \quad (1)$$

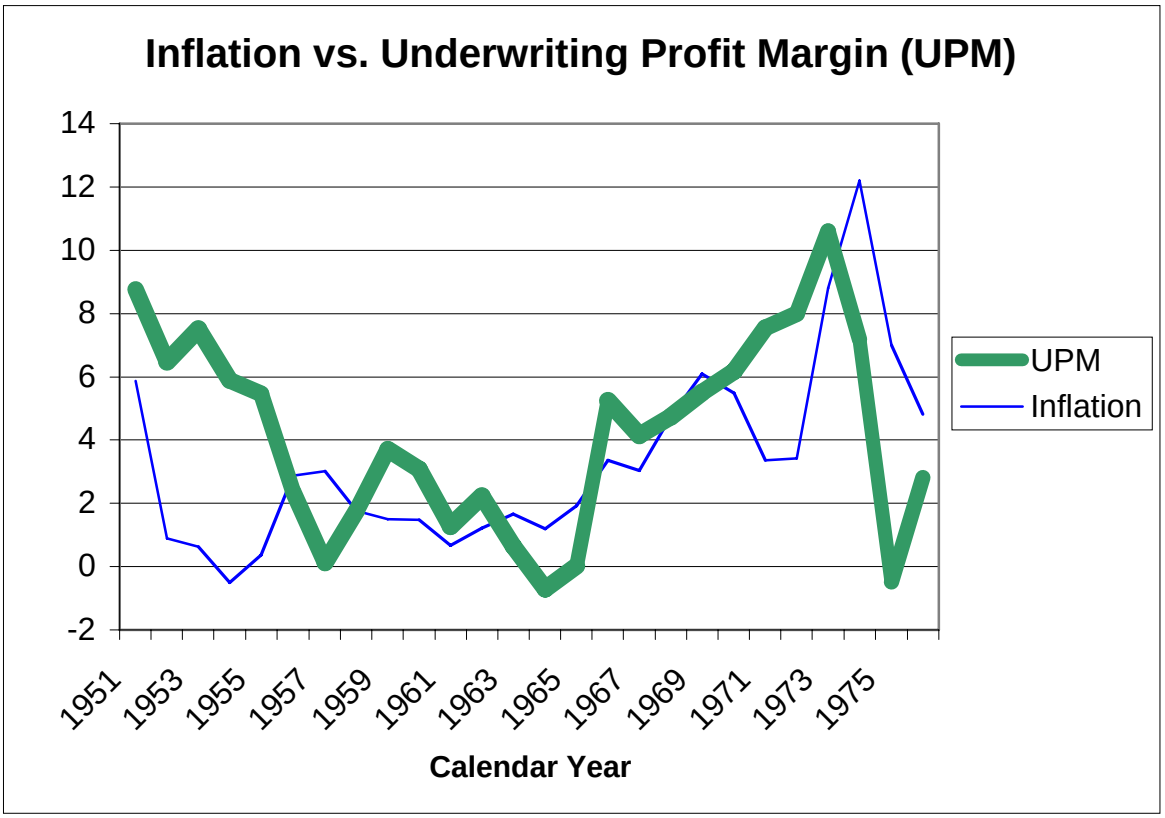


**Exhibit 1 – Graph of Equation #1, which shows a negative correlation between inflation and underwriting profit margin.**

This equation displays that underwriting profits and inflation are negatively correlated since the coefficient [-0.617] applied to the inflation variable is negative. Performing the same regression analysis on data from 1977-2006 resulted in the following.

$$\text{UPM} = 0.593*\text{Inflation} + [-9.586] \rightarrow R^2 = 8.7\% \{ 1977 - 2006 \} \quad (2)$$

The correlation coefficient, from here out referred to as $R^2$, is so low that any observed relationship is essentially meaningless. In addition, the equation suggests that the UPM and inflation are positively correlated!

In response to the poor fit, an attempt was made to model the UPM with the "Year-Over-Year Change in Inflation" rather than the absolute value. Unfortunately no meaningful relationship was observed after this transformation. The fitted equations are in Appendix B.

In an attempt to replace the calendar year statistics, Equation (3) is based on Industry Schedule P Accident Year data. [2] This equation displayed no measurable relationship between UPM and inflation over the years listed. Accident Year data is a better measure of insurer profitability but the fit over this period is not meaningful.

$$\text{UPM} = 1.201*\text{Inflation} + [-1.735] \rightarrow R^2 = 0.4\% \ \{\ 1995 - 2007\ \} \qquad (3)$$

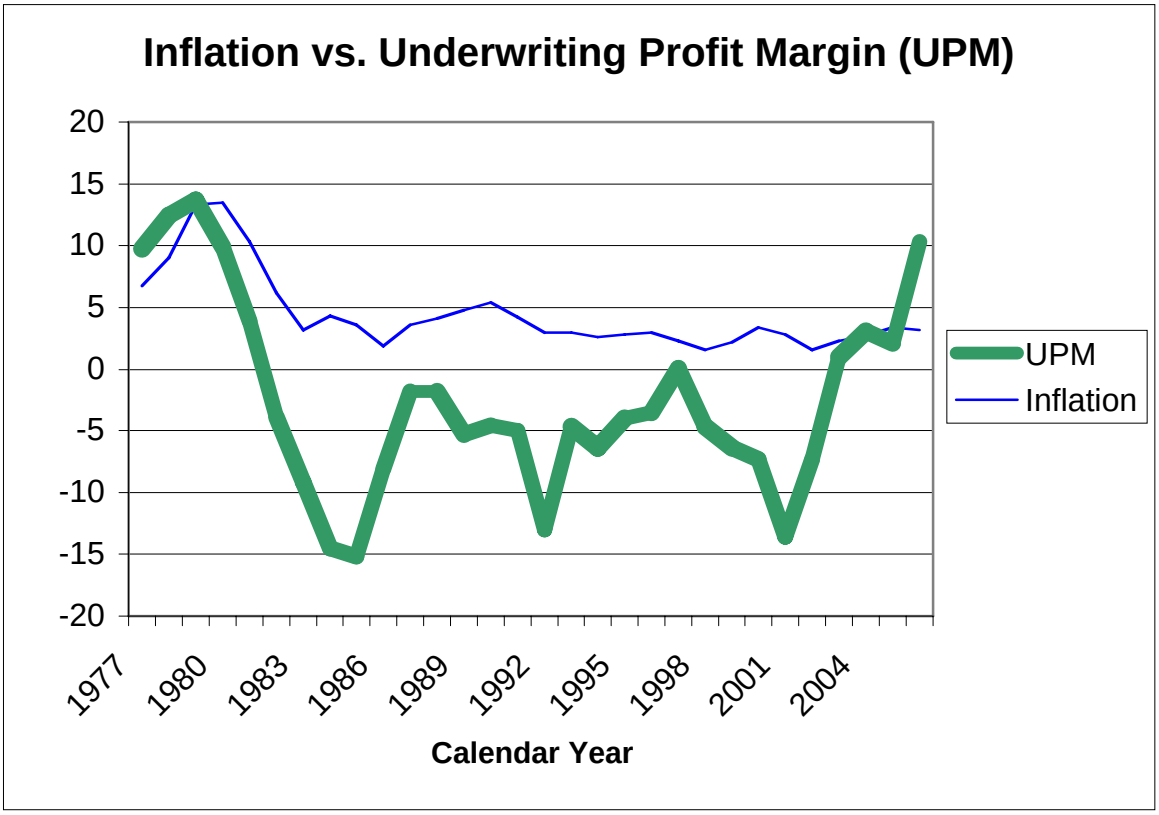


**Exhibit 2 – Graph of Equation #2, which shows a no meaningful relationship between inflation and underwriting profit margin.**

## Is There Any Possible Explanation For The Lack Of A Meaningful Fit?

Inflation has remained in a narrow band over the subsequent 30 years since D'Arcy scripted his paper. Since 1983, the CPI has stayed between 1.6% (1998) and 5.4% (1990) after exceeding 13% in 1979 and 1980. On the other hand, profit margins have varied greatly. Notably there have been two

[2] The Underwriting Profit Margin was derived replacing the Calendar Year with Accident Year Schedule P Loss and LAE Ratios. The same calendar year expense ratios from Best's were used.

soft markets (1981-1985: 1997-2001) followed by two hard markets. These cycles appear uncorrelated to inflation.

The underwriting cycle is the key driver behind the dramatic changes in profit margins. Trying to appropriately model the underwriting cycle and its varied causes are outside the scope of this paper and doing so would relegate the important questions regarding inflation and its impact on insurance profitability to obscurity. The prevailing wisdom behind the cause of the underwriting cycle is the amount of excess capital in the industry. [3]

## Autoregression Model

In an attempt to factor out the underwriting cycle's impact on the underwriting profit margin (UPM) and directly observe the inflationary effect, a two-factor autoregressive model was fitted to the insurance data compiled.

$$UPM_{(t)} = a*UPM_{(t-1)} + b*Inflation_{(t)} + c \qquad (4a)$$

The premise of this model is that the current year's underwriting profit margin (UPM) is based on last year's. When actuaries price business, the assumption is that the best predictor for the current year is the prior year's data appropriately adjusted. This model should be somewhat familiar except for its over-reliance on a single prior year rather than multiple years. An obvious shortcoming of this model is that it completely misses the inflection points where the market hardens (see 1987). The last two soft market corrections have been rather abrupt as can be observed on Exhibit 3 below.

$$UPM_{(t)} = 0.84*UPM_{(t-1)} - 0.364 * Inf_{(t)} + 0.911 \rightarrow R^2 = 70\% \{ 1951 - 2006 \} \qquad (4b)$$

$t = 11.130$ $t = -2.285$

[3] One belief is that the first soft market was, in part, caused by cash-flow underwriting (a term that means writing business to a loss knowing that extremely high returns on bonds/assets would compensate for underwriting losses) . These high returns were caused in response to the high inflation experienced in the late 70s/early 80s.

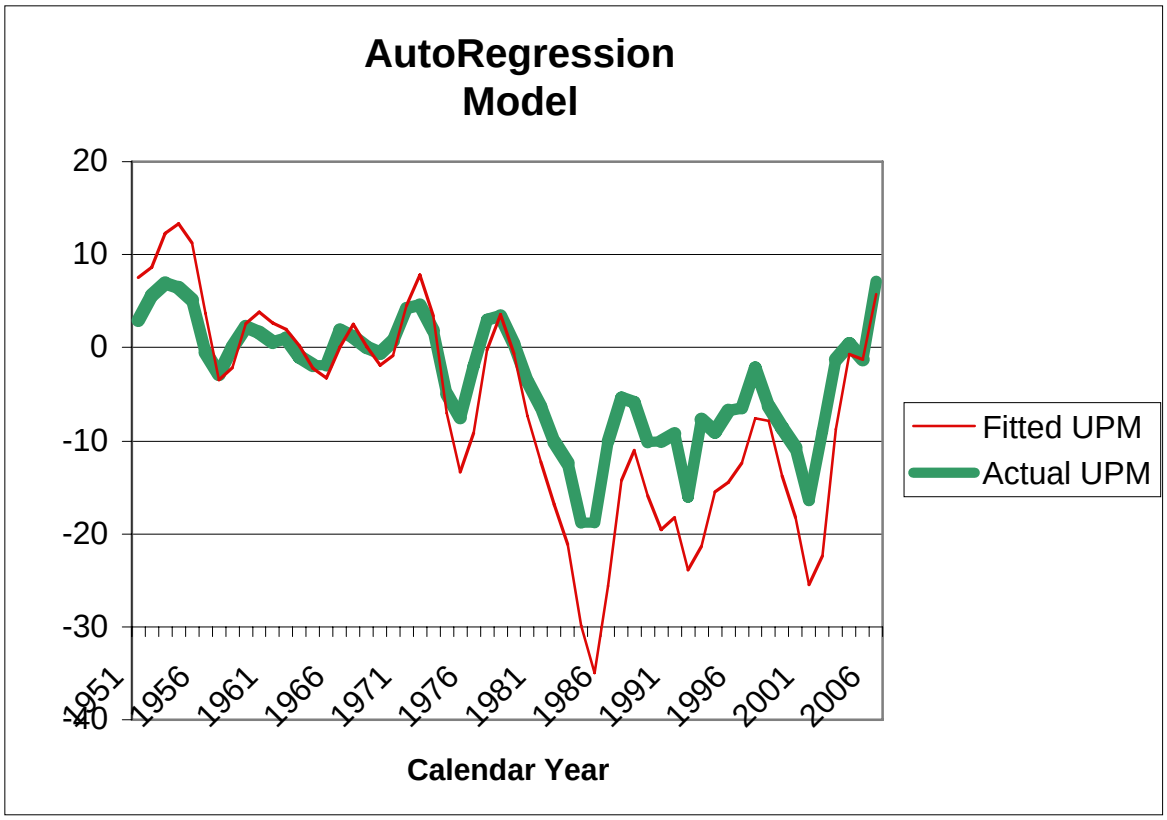


**Exhibit 3 – Graph of Equation #4b, which displays the actual and fitted underwriting profit margins.**

The $R^2$ of the equation is reasonably good and the coefficient applied to the prior years' UPM (0.84) shows a strong positive correlation. The *t*-values on each independent variable above are significant above the 95% level. The ability to model a proxy for the underwriting cycle has given us another indication that inflation and underwriting profits are negatively correlated (the negative coefficient in front of the inflation variable implies a negative correlation).

Inflation is likely a second order type variable in terms of its impact on the UPM. The impact inflation has on Underwriting Profit Margins is likely to be obscured unless there's a large spike as there was in the late 70s. A big increase could catch insurance companies flat-footed; especially because that would necessitate obtaining substantial rate increases in lines of insurance that may be heavily regulated. For longer tailed lines, delays in recognizing the inflationary trend could lead to significant underwriting losses and an inability to properly price their products. The next section speaks to inflations' impact on specific lines of insurance.

## Personal Auto

Personal auto is the largest line of insurance and drives the overall industry result. It is a completely data-driven line and has been both profitable and predictable. At this point, industry trend factors lag only six months behind the closing date of claims so any inflationary spikes should be recognizable by insurers. Decisions these firms make not to file for rate increases (to ignore the loss cost trends) would be of a competitive nature. I believe the regulatory hurdles personal auto carriers face are much lower than in the early 80s since they have the data and wherewithal to file and support increases in rates. Massachusetts and New Jersey (whom historically had a hard time attracting carriers) have opened up due to some easing on regulatory restrictions. Given the time it takes to settle claims, there is some reserve risk facing personal auto insurers. In an inflationary environment, an outstanding reserve for $100,000 could grow to $120,000 in the 18 months it takes to settle. The threat inflation poses to this line is moderate in light of the reserve risk but lower than in the past due to carriers having the ability to read and react and lower regulatory hurdles.

## Property Coverage

Property coverage already experienced an inflationary spike in the past year due to substantial increases in commodity costs and the high cost of gasoline and coal needed to transport building materials. The hurricane catastrophe models already build in "demand surge" since after big events scarcity drives up the cost of key materials. By considering such inflationary forces in the policies they sell, insurers should be better braced to respond to a significant inflationary spike. Many homeowners policies have a built-in inflation guard that automatically increases the amount of coverage purchased. One concern is that in certain jurisdictions, homeowners is still a highly regulated line with rates that, even without inflationary pressures, are inadequate. The threat inflation poses to this line is moderate but the short time to settlement gives insurers the ability to react.

## Workers Compensation

Workers compensation is particularly troubling from an inflationary perspective due to the absence of a limit on medical coverage. Even without additional inflationary pressures, new expensive procedures and medications have increased costs at a pace much higher than the medical CPI. The additional danger for workers compensation is the effect of compounding inflationary increases due to the amount of time it takes to settle claims. There is also the indemnity (wage replacement) component of the workers compensation policy that has recently served to temper the inflationary impacts caused by the aforementioned medical increases. Even if wages were to increase at a higher pace, most states have caps based on the average weekly wage in the state. Workers compensation is highly regulated line and prices can be constrained by states. Generous changes in coverage can be applied retroactively without allowing companies financial recourse. The largest

market, California, had some coverage expansion in the mid-90s that resulted in high severity trends that took years to be properly implemented into the bureau's rates. The threat inflation poses to workers compensation is high for the aforementioned reasons.

## Other Casualty

Casualty lines of insurance such as professional and general liability along with umbrella are long-tailed. The danger in assuming risk in these lines is that any trend shortfall in the pricing won't be discovered or factored into policies until multiple renewals have ensued. Losses on policies written today may incur five years of higher than anticipated inflation. Underwriting losses for "other casualty" are typically realized at a later date when the reserves are adjusted to factor in these higher loss ratios. The reserve risk companies assume in writing long-tailed lines is due to the most common reserving methods' reliance on initial expected loss ratios to determine IBNR. Following the last two soft markets, IBNR reserves were increased dramatically due to inadequate pricing. The risk posed by inflation is moderate to high depending on the specific circumstances of the line of business covered.

## Reinsurance

Reinsurance companies can be exposed to significant inflation risk due to "trend leveraging" where more claims exceed a fixed retention and the increases above the retention are greater than the underlying ground-up inflation rate. One of the dangers in writing reinsurance is that these companies aren't always privy to what is happening in the primary market so they can assume business without have the ability to properly gauge the underlying trends or primary rate changes. Reinsurance companies have many ways to limit the realized inflationary impact in the coverage they offer. Loss ratio caps, aggregate limits and limited reinstatements are all common treaty features that can insulate reinsurers from the impacts of inflation. On the plus side, reinsurers are not subject to the same regulatory constraints primary companies are. In particular, the ability to cancel a treaty indiscriminately or offer the primary carrier more restrictive coverage (than the underlying policies provide) can protect reinsurers from assuming inflationary risky business. In Europe, a response to dealing with inflation is a common treaty feature referred to as an index clause. This is an agreement to index the retention amount with an inflationary adjustment.[4] This serves to keep the cost of reinsurance and the number of expected ceded claims in a layer flat over a number of years. The threat inflation poses to this line is high since any coverage response requires an awareness of changes at the primary level.

[4] Stephen D'Arcy mentioned that in response to the last inflation spike, General Re tried to negotiate index clauses in some U.S. contracts but these never gained traction.

## INVESTMENT INCOME RETURNS (IIR)[5]

Insurance companies can target low or even negative underwriting profit margins due to the income earned on their invested assets. However when inflation rates rise, their portfolios of bond assets lose value. Insurance companies have an incentive to own bonds since statutory accounting rules allow them to keep bonds at par value even if they have a significant unrealized loss position. If companies sell these bonds in an inflationary environment, they would realize a loss. Similar to the approach D'Arcy used with underwriting profit margins, he fitted insurance companies investment income returns (IIR) with inflation rates.

$$\text{IIR} = -0.818*\text{Inflation} + [7.815] \rightarrow R^2 = 22.6\% \ \{\ 1951 - 1976\ \} \qquad (5)$$

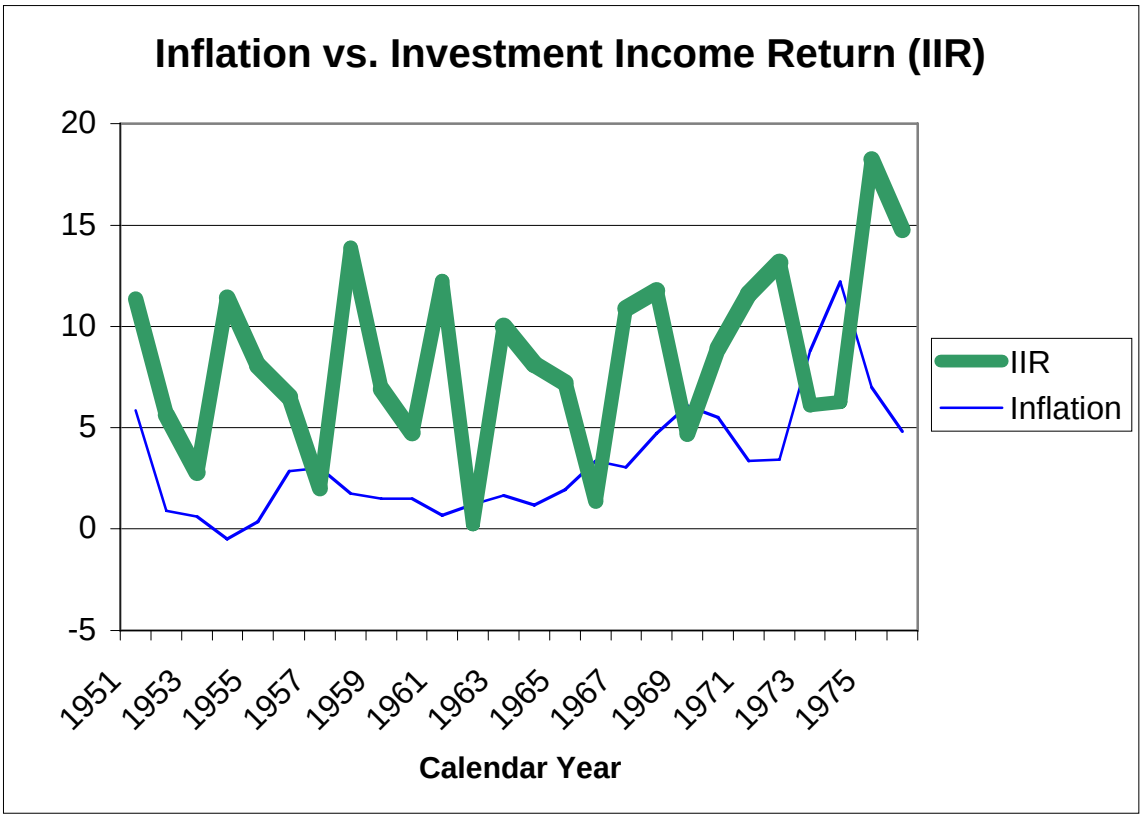


**Exhibit 4 – Graph of Equation #5, which shows a negative correlation between inflation and investment income returns.**

[5] Investment Income Return (IIR) is the total of income earned through dividends, interest, realized capital gains or losses for bonds and real estate, and both realized and unrealized gains and losses for stock. Unrealized capital gains or losses on bonds are not a factor in statutory investment profit or loss for insurers.

$$IIR = -0.297*Inflation + [14.333] \rightarrow R^2 = 14.5\% \{ 1977 - 2006 \} \quad (6)$$

This equation displays that investment income return and inflation are negatively correlated. Performing the same regression analysis on data from 1977-2006 resulted in the following. Note that the negative correlation still holds.

The limitation to utilizing statutory investment income for this study is that unrealized losses on bond portfolios are not captured in the investment returns. If the investment returns were to capture these unrealized losses, the likely result would be a stronger negative correlation. One observation about the 1977-2006 investment income returns is that they don't fluctuate to the same extent as in the earlier period. Also, the $R^2$ of Eq. (6) ($R^2$ = 14.5% for 1977-2006) is significantly lower than Eq. (5) ($R^2$ = 22.6% for 1951-1976) and could possibly be the result of insurance companies becoming more sophisticated in managing their portfolios of assets with respect to inflation and other sources of volatility. The amount of knowledge and use of financial instruments at these companies disposal is much greater today than in the past. One thing worth noting, as the insurance industry heads towards fair value accounting, unrealized losses on bond holdings will find their way into quarterly earnings and seemingly increase the impact inflation has on insurers' returns. Assuming most insurers hold their bonds to maturity, there will be more volatility in earnings. The next section updates correlations performed on different classes of assets with inflation.

## Treasury Bills (T-Bills)[6]

As we have entered this credit crisis, Treasury (T-Bill) yields have gone down dramatically due to the desire for safety over return. When yields fall, there are realized gains for those who already own them. T-Bills rise in value at times of economic uncertainty due to their short duration. An investor fearful of locking up capital in longer duration or riskier assets could invest in T-Bills until the uncertainty passes. In doing so, the investor typically sacrifices yield for security. The following equations display the positive correlations between government securities and the inflation rate. This relationship is the key to D'Arcy's immunization strategy.

[6] Treasury Bills (or T-Bills) are government securities that mature in one year or less. Like zero-coupon bonds, they do not pay interest prior to maturity; instead they are sold at a discount of the par value to create a positive yield to maturity. Many regard T-Bills as the least risky investment available to U.S. investors. The data used for this study relied on average yields for 3-month T-Bill returns for data from 1977-2007. For the prior data (1926-1976), holding period returns on the shortest term bills not less than one month to maturity held for one month were used.

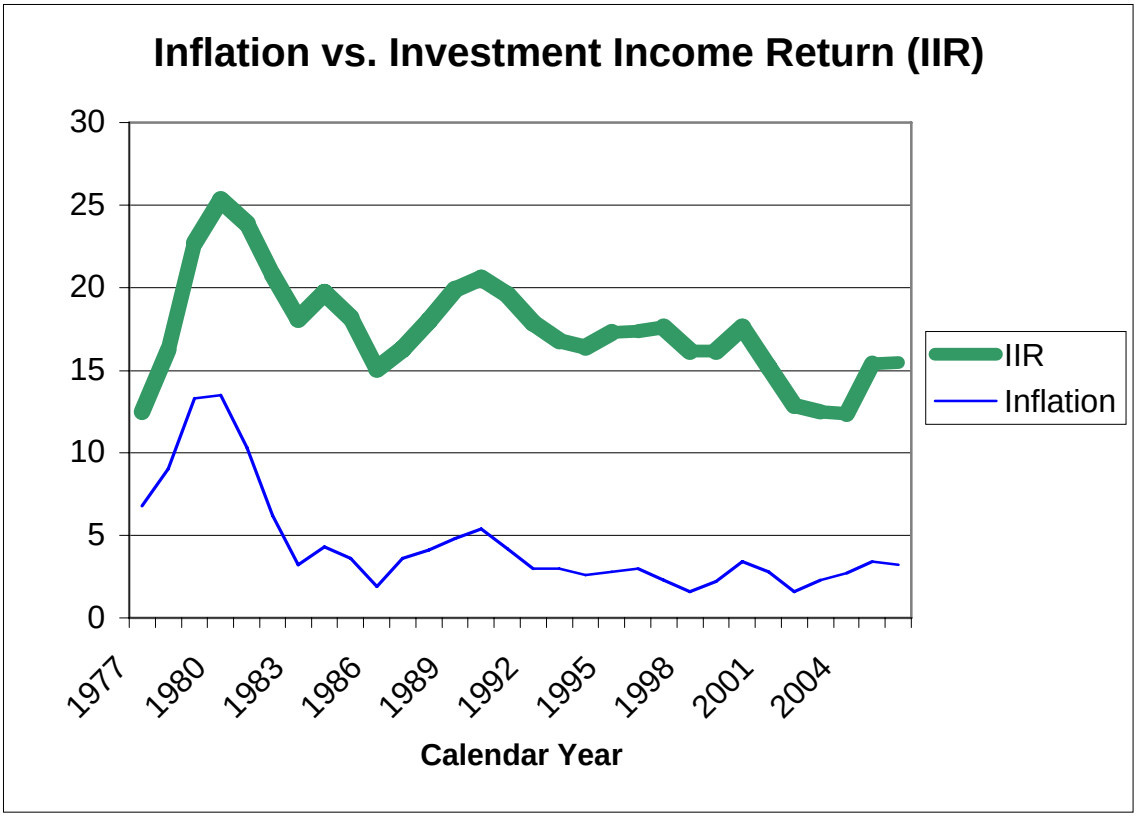


**Exhibit 5 – Graph of Equation #6, which shows a weak but negative correlation between inflation and investment income returns.**

$$\text{T-Bill} = 0.556*\text{Inflation} + [1.873] \rightarrow R^2 = 70.6\% \{ 1951 - 1976 \} \quad (7)$$

$$\text{T-Bill} = 0.770*\text{Inflation} + [3.177] \rightarrow R^2 = 47.0\% \{ 1977 - 2006 \} \quad (8)$$

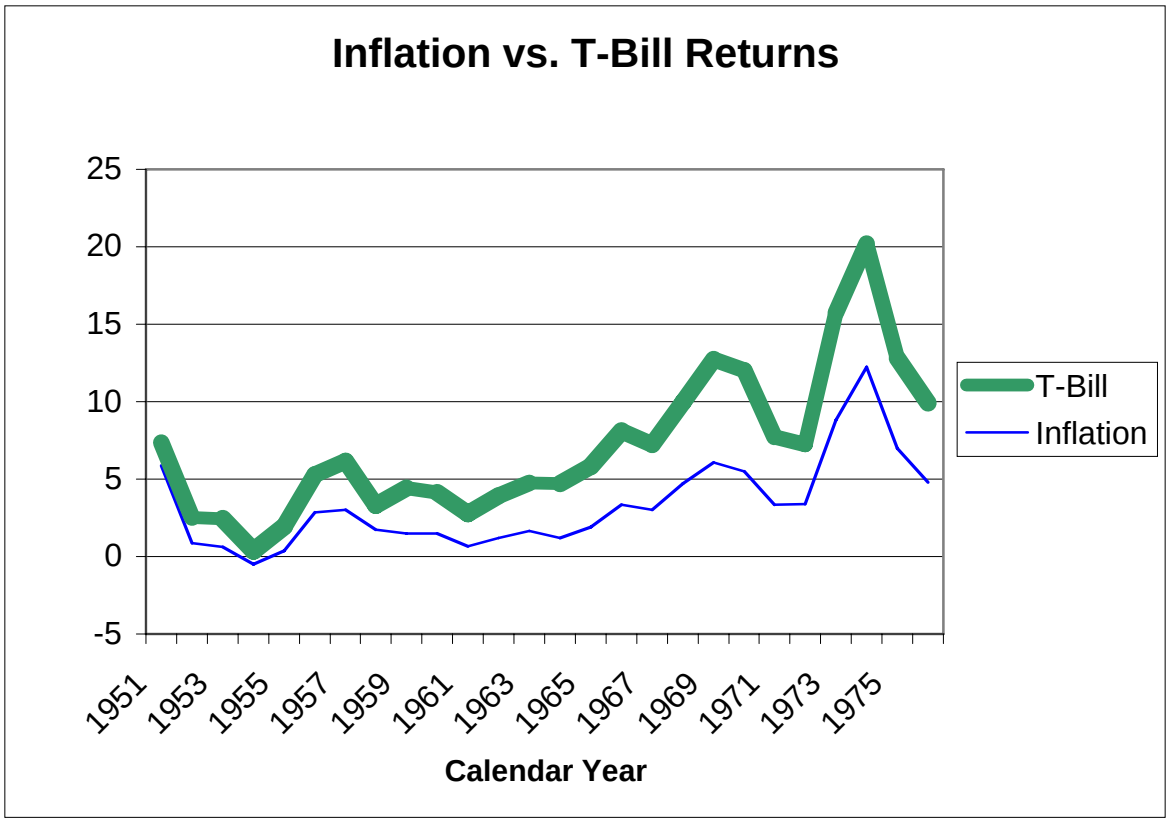


**Exhibit 6 – Graph of Equation #7, which displays a positive correlation between inflation and T-Bill returns.**

## Long-Term Corporate Bonds

Long-Term Corporate Bonds (LTCorp) show little correlation with inflation with $R^2$ values close to 0%. It would be interesting to see how bonds from the less-cyclical sectors or companies with stronger ratings perform on relative basis against inflation since these may provide an alternative immunization source offering potentially higher yields for a portfolio.

$$\text{LTCorp} = -0.084*\text{Inflation} + [3.929] \rightarrow R^2 = 0.1\% \{ 1951 - 1976 \} \quad (9)$$

$$\text{LTCorp} = 1.321*\text{Inflation} + [4.582] \rightarrow R^2 = 5.4\% \{ 1977 - 2006 \} \quad (10)$$

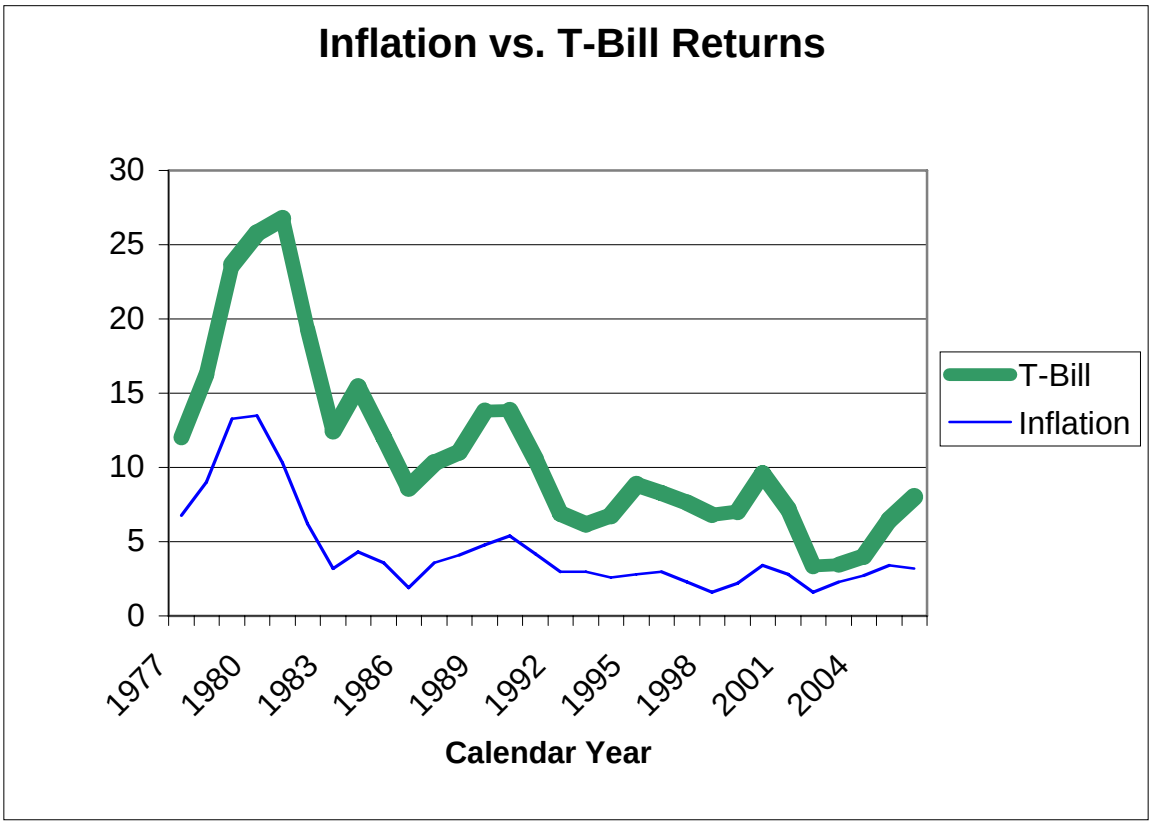


**Exhibit 7 – Graph of Equation #8, which displays a positive correlation between inflation and T-Bill returns.**

### Stocks

Stock returns in the latest period show no correlation with inflation. In the past, significant negative correlations existed. There are sectors that are less sensitive to inflation shocks. Utility and health care stocks are considered by experts to be defensive. These may have a place in a portfolio looking for an effective hedge against inflation.

$$\text{Stock} = -3.114*\text{Inflation} + [22.773] \rightarrow R^2 = 23.0\% \{ 1951 - 1976 \} \quad (11)$$

$$\text{Stock} = -0.087*\text{Inflation} + [13.183] \rightarrow R^2 = 0.0\% \{ 1977 - 2006 \} \quad (12)$$

## THE STRATEGY

D'Arcy recommended using T-Bills to immunize PC insurers against deteriorating profit margins as well as portfolio losses on bonds due to inflationary pressures. Based on the data since 1977, T-Bills are still the most effective hedge. There are certainly questions as to how significant inflationary

effects are on insurer profit margins. In response to those questions, there are too many factors for profit margins not to be affected. The data over the past 20 years didn't have the inflationary hurdles that would test the insurers' success in immunizing their risk and asset portfolios.

Inflation needs to be an element of concern for insurance companies. Primary companies need to be proactive in analyzing and selecting trend factors in order to keep prices and reserves adequate. Reinsurance companies need to consider the frequency of claims over fixed retentions and/or utilize treaty features to insulate their risk portfolios against the inflationary risks they face.

As noted in the paper, insurers' asset portfolio returns have been much more consistent than in the past and have significantly exceeded risk-free. Purchasing T-Bills to immunize an asset portfolio is like a form of insurance. It provides a hedge against inflation and economic uncertainty but a price is paid in terms of sacrificing yield (i.e., expected income). D'Arcy has regressed three different asset types but there are a slew of different hedges against inflation. Commodities, derivatives, treasury inflation protected securities (TIPS), real estate, and ETFs can all assist in diversifying the risk inflation poses.

This paper was written in response to increased inflation risk observed in the summer of 2008. Between stocks, bonds, and derivatives, a large amount of capital has exited the industry over the past six months. The danger of inflation has been replaced with that of an economic depression. In his seminal paper, D'Arcy excludes the depression years from his analysis despite there being huge reductions in the cost of goods (negative inflation). Despite insurers' abilities to save on losses in this environment, sharp premium declines resulted in high expense ratios and profit margins suffered.[7] One asset class that has held up, especially on a relative basis, have been government securities. Currently, the yields on these securities are paltry thus making the cost of immunization higher than ever. In 2009, insurance carriers need to consider the impact of the U.S. government's stimulus package, which involves huge deficit spending. In this highly volatile climate, finding assets that can immunize insurers against inflation is as critical a challenge for the industry as it was when D'Arcy wrote this paper some 30 years ago.

## Acknowledgment

I would like to thank Gary Bluhmson, Robert Giambo and Jeff Englander who all contributed time and intellectual capacity to this paper. All errors are my own.

7 D'Arcy writes on page 118: "The pre-1933 period does not conform with the negative relations outline above. Underwriting profitability actually declined in 1930, 1931, and 1932 as price levels dropped substantially. One possible explanation for this atypical correspondence is the pervasive effect of the Depression. Despite price level reductions, economic conditions were so poor that insurance premium receipts declined, causing expense ratios to climb…The usefulness of this model will thus be restricted to inflationary conditions and would not necessarily apply to deflationary situations."

## REFERENCES

[1.] D'Arcy, Stephen P., "A Strategy for Property-Liability Insurers in Inflationary Times," CAS *Discussion Paper Program* 1981, pp. 110-147.

[2.] *Best's Aggregates and Average: Property/Casualty*, (Oldwick, New Jersey: A.M Best and Company) 2007.

# APPENDIX A

## An Update to D'Arcy's "A Strategy for Property-Liability Insurers in Inflationary Times"

Inf — Inflation (CPI)
UPM — Underwriting Profit Margin
IIR — Investment Income Return
IIR — Investment Income ReturnIns_Ret — Insurance Return [ = IIR + UPM ]
T-Bill — Treasury Bills
LTCorp – Longer Term Corporate Bonds

| Variable | 1951-2006 | 1951-1976 | 1977-2006 |
|---|---|---|---|
| UPM | UPM = -0.163*Inf + [-2.658] | UPM = -0.617*Inf + [2.955] | UPM = 0.593*Inf + [-9.586] |
| $R^2$ | 0.6% | 27.7% | 8.7% |
| Ins_Ret | Ins_Ret = -0.422*Inf + [7.693] | Ins_Ret = -1.434*Inf + [10.77] | Ins_Ret = 0.296*Inf + [4.748] |
| $R^2$ | 5.2% | 42.4% | 3.4% |
| IIR | IIR = -0.259*Inf + [10.351] | IIR = -0.818*Inf + [7.815] | IIR = -0.297*Inf + [14.333] |
| $R^2$ | 2.1% | 22.6% | 14.5% |
| LTCorp | LTCorp = -0.014*Inf + [6.067] | LTCorp = -0.084*Inf + [3.929] | LTCorp = 1.321*Inf + [4.582] |
| $R^2$ | 0.0% | 0.1% | 5.4% |
| Stock | Stock = -1.192*Inf + [17.701] | Stock = -3.114*Inf + [22.733] | Stock = 0.087*Inf + [13.183] |
| $R^2$ | 4.6% | 23.0% | 0.0% |
| TBill | T-Bill = 0.743*Inf + [2.344] | T-Bill = 0.556*Inf + [1.873] | T-Bill = 0.77*Inf + [3.177] |
| $R^2$ | 50.0% | 70.6% | 47.0% |
| Adapt UPM | UPM = 0.84*UPM(-1)-0.364*Inf + [0.911] for the 1951 to 2006 Period | | |
| $R^2$ | 69.1% | | |

# APPENDIX B

## An Update to D'Arcy's "A Strategy for Property-Liability Insurers in Inflationary Times"

DInf - Change in Inflation (CPI)
UPM - Underwriting Profit Margin
Ins_Ret - Insurance Return [ = IIR + UPM ]

Ins_Ret - Insurance Return [ = IIR + UPM ]

| Variable | 1951-2006 | 1951-1976 | 1977-2006 |
|---|---|---|---|
| UPM | UPM = 0.59*DInf + [-3.273] | | UPM = 1.528*DInf + [-6.855] |
| $R^2$ | 3.0% | | 16.2% |
| Ins_Ret | Ins_Ret = -0.551*DInf + [6.003] | Ins_Ret = -1.441*DInf + [5.927] | Ins_Ret = 0.783*DInf + [6.111] |
| $R^2$ | 3.5% | 24.4% | 6.8% |