Background

- Typical regression-based models miss key inflection points in trend curve
- Significant contributor to past underwriting cycles
- Better understanding of detailed components and drivers of trend has helped
- Need to better predict inflection points in trend curve led to development of economic-based forecasting model keying on leading relationship between changes in general economy and changes in health care costs
Which variables to model?
Relationship between economic forces and health care trends

- Published studies have shown that changes in personal disposable income (PDI) lead health care trends by two to four years
  - CMS, Projections of National Health Expenditures: Methodology and Model Specifications, 2/21/2006
- Used National Health Expenditures (NHE) and the health care components of Personal Consumption Expenditures (PCE) as our measure of health care costs

<table>
<thead>
<tr>
<th>Employment changes and general economic conditions (GDP) also have a leading relationship with health care costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our modeling based on combined PDI, GDP and Employment produced more accurate results than models based on any one of the single input variables</td>
</tr>
<tr>
<td>Combined Model</td>
</tr>
<tr>
<td>PDI Model (3 yr. lag)</td>
</tr>
<tr>
<td>GDP Model (3 yr. lag)</td>
</tr>
<tr>
<td>Employment Model (3 yr. lag)</td>
</tr>
</tbody>
</table>
Why a 3-Year (+/-) Lag?

- Significant time can pass between earnings growth and benefit changes
- Additional delays occur between decision to increase benefits and next renewal and open enrollment dates
- As benefit increases work through the system, demand for health care increases, placing upward pressure on costs

Historical Relationship between Lagged PDI and Health Care Costs

![Graph showing the historical relationship between lagged PDI and health care costs. The graph compares NHE Private Health Insurance Medical Cost Trends vs. 3-Year Lagged Trends in Real Personal Disposable Income. The x-axis represents the years from 1962 to 2006, and the y-axis represents trends in percent from -5 to 25. The graph includes two lines: one for NHE Private Health Insurance and another for Real Personal Disposable Income.](image-url)
Historical Relationship between Lagged Real GDP, Non-Farm Employment and Health Care Costs

Development of the Model

- Utilized vector auto-regression (VAR) statistical model
  - VAR is extension of Box-Jenkins class of time series models (autoregressive, moving average, ARIMA models) which perform better in forecasting compared to regression models
  - VAR effectively blends recent innovations in statistics with accepted economic theories
  - VAR models are relied on by the Federal Reserve to develop economic forecasts in support of monetary policy decisions
- Several variables were tested to arrive at real PDI, real GDP and non-farm employment as most predictive of NHE
- Primary goal of economic-based model is to project future direction of trend changes and anticipate inflection points, not to pinpoint trend magnitude
Results of Macroeconomic Forecasts

Testing the model from 1990-2006 produces the following results:

<table>
<thead>
<tr>
<th>Projection Period</th>
<th>Percent Directional Agreement</th>
<th>% of Forecasts within 50 bps</th>
<th>% of Forecasts within 100 bps</th>
<th>Std. Error Forecast vs. Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Quarter</td>
<td>81.8%</td>
<td>68.7%</td>
<td>94.0%</td>
<td>0.51%</td>
</tr>
<tr>
<td>Quarters 1-4</td>
<td>90.5%</td>
<td>82.8%</td>
<td>98.4%</td>
<td>0.32%</td>
</tr>
<tr>
<td>Quarters 3-6</td>
<td>88.7%</td>
<td>79.0%</td>
<td>98.4%</td>
<td>0.32%</td>
</tr>
<tr>
<td>Quarters 5-8</td>
<td>93.3%</td>
<td>80.0%</td>
<td>98.3%</td>
<td>0.35%</td>
</tr>
</tbody>
</table>

In the 2 years R&A has applied this model, directional accuracy one quarter ahead has been 100%.

Future Enhancements to Model

- Demographic adjustments to NHE / PCE
- Work / calendar day adjustments
- Isolate core unit cost changes (medical CPI) from utilization and mix of services
- Medicare / Medicaid populations (?)
Necessary, But Not Sufficient

- Economic trend model is a supplemental tool to provide insight into pressures affecting future direction of trend
- It is an imperfect tool:
  - Based on government data – requires numerous adjustments and assumptions to get to a reasonable proxy to private commercial per capita costs
  - Economic relationships, while statistically meaningful and supported by anecdotal reasoning, cannot currently be supported by direct cause-and-effect relationships
- Any individual insurer’s experience WILL differ from NHE/PCE results, due to differences in geography, demographics, products, contracting, etc.
  - Economic modeling is no replacement for detailed, component-driven trend analysis
- Recognizing these limitations, economic modeling can be a useful directional indicator for guiding future trend assumptions, and to date has proven more effective than simple regression-based forecasts

Reden & Anders
Macroeconomic Trend Forecasting Model

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