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Comment

What Drives the Real Funds Rate?

It's simple: the GDP Gap!

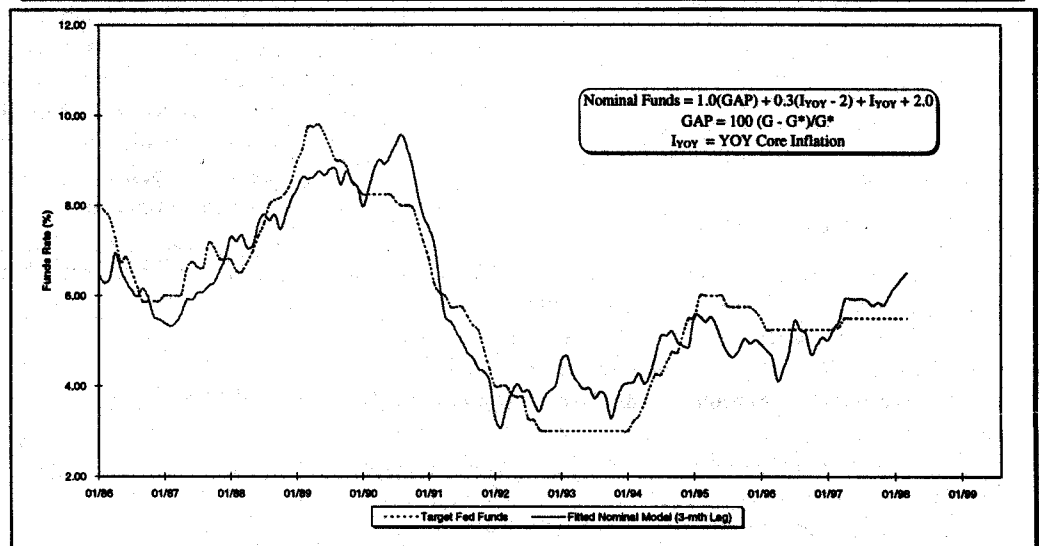
Fixed Inc. Strategy

Investment Highlights:

- **Gap and Inflation Drive the Nominal Funds Rate**
- **Real Funds equals Gap + 2.5%**
- **According to our Model, Real Rates are currently not Restrictive**

In Greenspan's recent H-H testimony, he stressed the importance of the real funds rate (nominal funds minus inflation) and how the firming of the real funds rate in 1997 due to the decline in inflation "was by no means inadvertent". **Since the real rate, not the nominal, determines how restrictive or accommodative monetary policy truly is, we examine the factor(s) that drive the real rate to ascertain how tight or loose monetary policy currently is.** First, we revisit the Taylor rule¹, initially concentrating on the two factors that influence nominal funds: GDP output gap and inflation. **We then focus on the factor(s) determining the real rate. We find that the GDP gap is the primary force driving real rates.**

Graph 1: Regression Taylor Model: Fitted Nominal Funds vs Target Fed Funds



■ Taylor Rule

Dr. John Taylor formally introduced the Taylor rule in 1993 to model the real Fed Funds rate. **The two primary factors that drive the model are the GDP gap and inflation (see equation below).** Intuitively, these two factors have economic appeal. This policy rule states that if the economy is growing beyond potential or if the inflation rate is greater than the Fed's assumed target of 2%, the Fed will increase the Funds rates to "lean against the wind".

The long term “equilibrium” real rate is estimated to equal 2%. From 1985 to 1992, this model appeared to provide a good correlation with target funds. However, the fit has been, at best, fair since then.

The original Taylor model was based on the fixed-weight GDP measurement, not the chain-weighted GDP as used in our model. In his original article, Dr. Taylor assumed a constant trend growth of 2.2% in potential real GDP. Conversely, our gap is relative to potential real GDP, as determined by the Congressional Budget Office (CBO). Graph II charts the level of real GDP versus CBO’s non-inflationary GDP. We splined the quarterly GDP data into a monthly time series. Finally, we used core YOY inflation (released monthly) instead of the GDP deflator. While the results were quite similar with either of these inflation measurements, core inflation did provide a slightly better fit than the GDP deflator. Although the original Taylor model has not provided a very robust fit for the past four years, this does not detract from the theory behind his policy rule. **Dr. Taylor correctly identified the two factors that drive the Funds rate; empirical analysis confirms this. The rule just needs a slight modification.**

Taylor Rule:

$$FF = 0.5(\text{Gap}) + 0.5(I - 2.0) + I + 2.0_R$$

where

$$\text{Gap} = 100 * (G - G^*) / G^*$$

G = Real GDP
 G* = Potential GDP
 I = YOY Inflation
 2.0_I = Target Inflation Rate
 2.0_R = Equilibrium Real Rate

■ **Modified Taylor Rule**

Using simple regression analysis, we see in Table I that nominal funds are correlated with the output gap and core YOY inflation, respectively. Combining these two factors increases the R² (.86); this two factor modified Taylor model best explains nominal funds. **Our estimated funds rate closely tracks the actual rate (Graph I), confirming the importance of these two factors.** The second equation in the box below transforms the original regression equation into a form compatible with Taylor’s rule.

2-Factor Modified Taylor Model:

$$FF_t = 1.0(\text{Gap}_{t-3}) + 1.3(I_t) + 1.35$$

$$= 1.0(\text{Gap}_{t-3}) + 0.3(I_t - 2.0) + I_t + 1.95$$

where

I = YOY Inflation

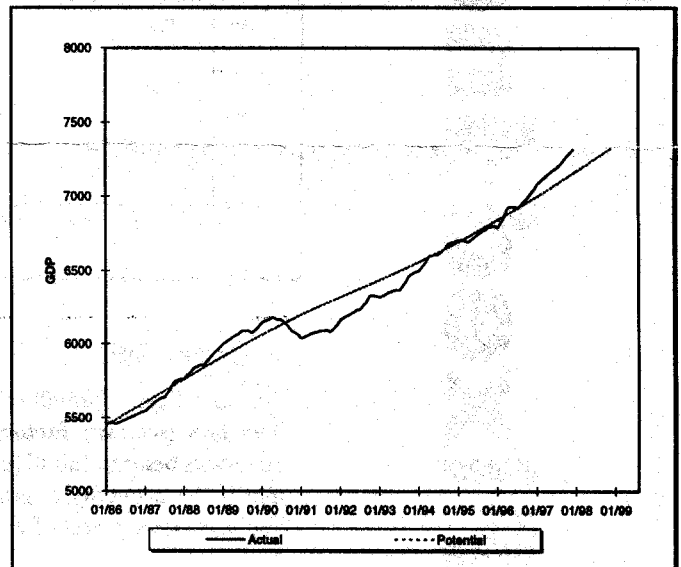
Table I: Nominal Funds

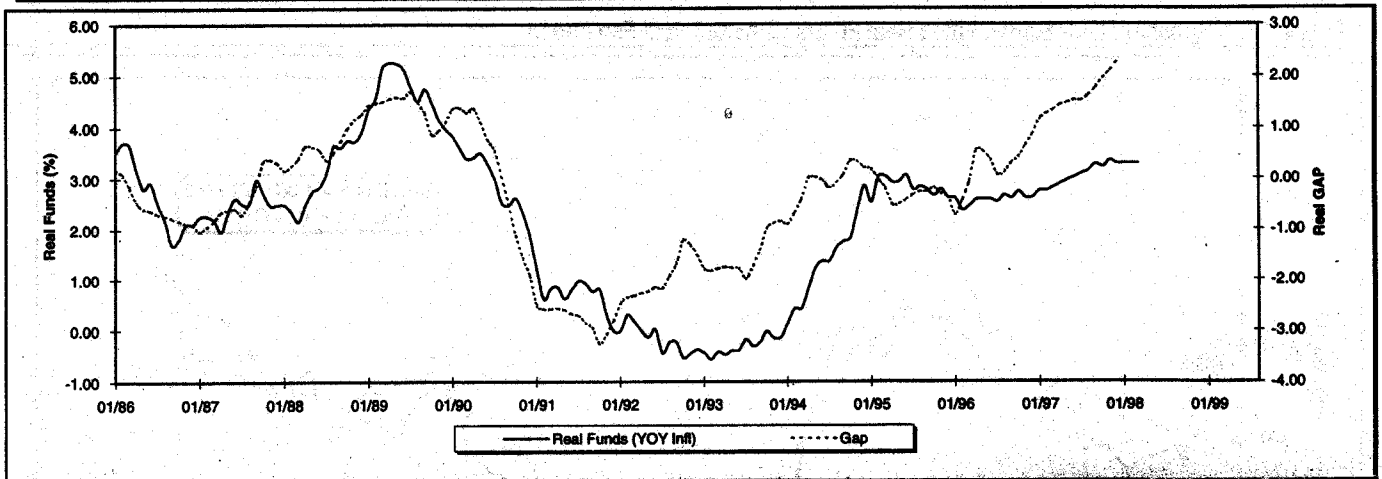
Indep Var =>	Gap+Infl	Gap	Infl
R-Sq	86.0%	46.0%	34.0%
F-test	428.4	118.2	72.7

There are 2 differences between our model and the original Taylor rule. First, we found that the coefficients for the gap and inflation equaled 1.0 and 0.3 respectively, versus 0.5 for both in the original Taylor rule. These were the optimal coefficients, as determined by our regression analysis. Second, GDP gap appears to be a leading indicator; accordingly, we lagged this variable by 3 months with respect to Fed funds. Interestingly, the constant term (i.e., long term real rate) equals 1.95%, very close to Taylor’s estimate of 2.00%. We also found that there is zero correlation between gap (3 month lag) and inflation. Therefore, there is no multi-collinearity in our model. Since these two variables are independent, we feel confident that our model is a viable one. We should note that our model has the benefit of a certain degree of hindsight since both the GDP and gap have been subject to revisions over time.

While there is no guarantee that these relationships will hold in the future, the Merrill modified model definitely quantifies the two factors that drive the nominal Funds rate: GDP gap and core inflation. The purpose of this model is not so much to predict the Funds rate but rather to identify the factors driving the nominal rate. **However, we should focus on the real funds rate, not the nominal, since it is the real rate that determines how restrictive or accommodative monetary policy really is. Here, the gap is the primary force driving real rates; it is much more important than inflation.**

Graph II: GDP: Actual vs. Potential



Graph III: Real Funds (YOY Infl) vs Gap (not lagged)


■ Real Gap Model

With a simple algebraic transformation of the modified Taylor rule, we then derive the equation for real funds (confirmed with regression analysis).

Real Fed Funds (2 Factor Model) $R^2 = .79$:

$$\begin{aligned} \text{Real FF}_t &= (\text{Nominal FF}_t - I_t) \\ &= 1.0(\text{Gap}_{t-3}) + 0.3(I_t) + 1.35 \end{aligned}$$

where

$$I = \text{YOY Inflation}$$

Although this two factor model has a reasonable R^2 (.79), we believe it to be potentially misleading due to over-fitting. First, we found that there is zero correlation between the real rate and realized inflation on a coincident basis (Table II). Zero correlation implies that we should exclude inflation as a second factor. Although the goodness of fit decreased from .79 to .76 in our one factor model, the F test (which adjusts for the degrees of freedom) was significantly higher. Second, Graph III clearly shows there is a strong inter-relationship between the real Fed Funds rate and the GDP gap. We see that they closely track each other although the real funds rate seems to slightly follow the gap, reflecting the 3 month lag in the implementation of monetary policy. As such, we conclude that our one factor model is more appropriate than the two factor model when determining the real funds rate. In summary, the GDP gap, not realized inflation, is the critical factor in determining the real funds rate.

Although we did not find a relationship between real funds rate and realized inflation on a coincident basis, it would be misleading to assume there is no relationship between real funds and inflation expectations.

We think that inflation expectations are an important factor in determining the real rate. Perhaps it is more accurate to say that expectations are embedded in the GDP gap (the greater the gap, the higher the inflationary expectations). This explains why the gap alone is the primary determinant for real rates.

Real Fed Funds (1 Factor Model) $R^2 = .76$:

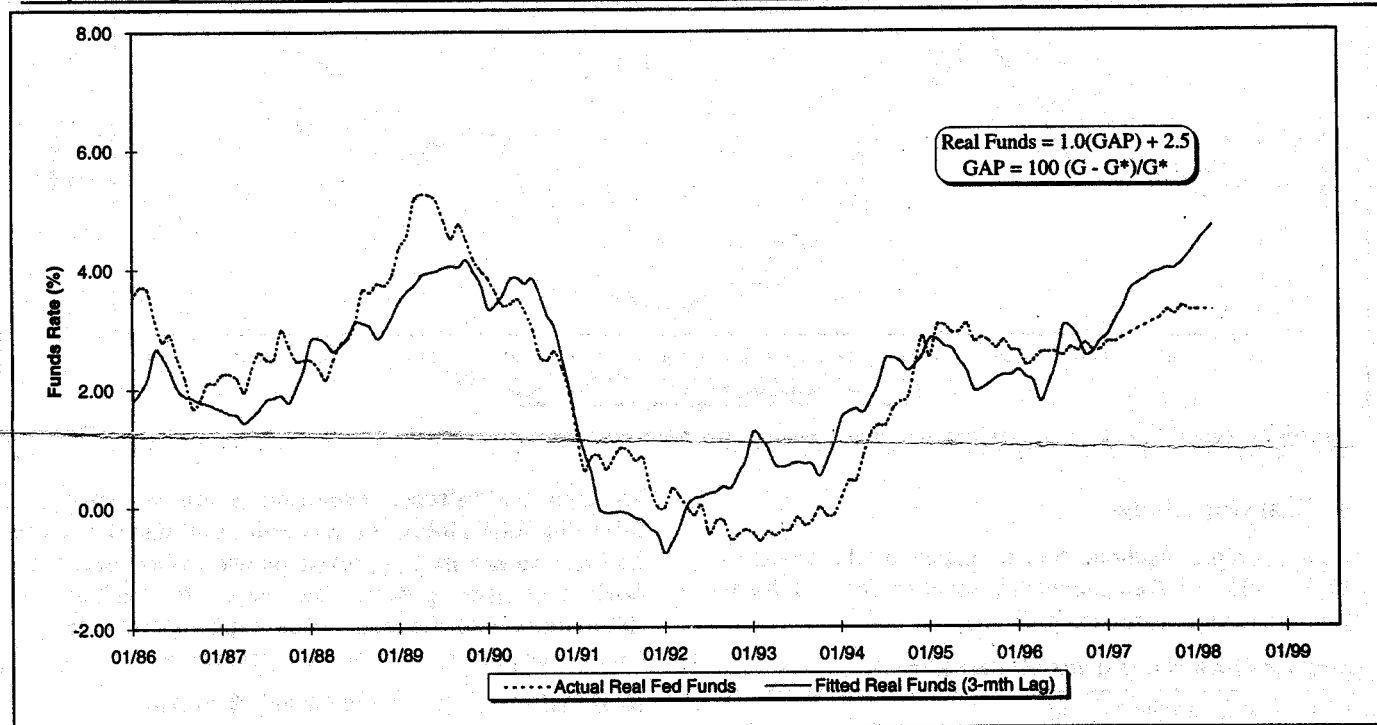
$$\begin{aligned} \text{Real FF}_t &= (\text{Nominal FF}_t - I_t) \\ &= 1.0(\text{GAP}_{t-3}) + 2.5 \end{aligned}$$

Table II: Real Funds

Indep Var →	Gap+Infl	Gap	Infl
R-Sq	79.0%	76.0%	0.0%
F-test	262.4	439.1	2.0

Graph IV illustrates the fitted real funds rate when using the one factor model (GDP gap is the single independent variable, lagged by 3 months). As is clearly evident, the fitted real funds rate closely tracks the actual real rate ($R^2 = .76$). The equation is simple and has strong economic appeal: real funds equals the gap plus 2.5%. Interestingly, the constant term (2.5%) is very close to the long term average for the non-inflationary growth in real GDP (2.34%, as determined by the CBO). Since gap is expressed as a percentage, the two terms are additive. In short, the real rate simply equals excess real growth (or shortfall) plus the long term allowable real GDP growth (2.5%). This equation highlights the close relationship between real growth and real rates; in general, high real growth increases the demand for real borrowing, increasing real rates.

Graph IV: Regression GAP Model: Fitted Real Funds vs Actual Real Fed Funds



■ **Real Rate Outlook**

While we do not think investors should use our gap model to predict the absolute level of real rates, we believe that **this model is a valuable tool to show the bias or direction for real rates.** If we assume that the CBO is not under-estimating allowable growth, our model shows that **real rates are currently not restrictive.** Indeed, the model helps explain the tightening bias the Fed maintained until Dec. 1997. If not for the Asian crisis, we believe the Fed would have tightened at the Nov. 1997 FOMC meeting (based on Greenspan's Oct. 8 speech). As Greenspan strongly implied in the recent H-H testimony, Fed policy is on hold due to the conflicting dynamics of the Asian

turmoil versus the strong domestic economy. The risk is that these countervailing forces make it harder for the Fed to conduct a preemptive monetary policy. Eventually, one of these factors should predominate, forcing the Fed to change monetary policy. The potential then exists that the Fed may be forced to overshoot due to the lag in implementation. **In short, we think that either the gap must narrow due to Asia or the real funds rate must increase, either due to a tightening in monetary policy or a continued decline in inflation. While volatility may be low near term since Fed is on hold, volatility should return with a vengeance once the Fed shifts policy.**

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- 1) J. Taylor, "Discretion versus policy rules in practice," Carnegie-Rochester Conference Series on Public Policy 39, 1993, pp 195-214

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