ASSET PRICES, WEALTH, AND INFLATION PREDICTABILITY

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Abstract

This study examines the relationship between wealth, consumption and inflation. The study investigates whether the movements in asset prices can, among other things, have significant impact on the level of inflation. The study finds, from a permanent-transitory decomposition analysis of the variables, that consumption shocks are transitory while wealth shocks are permanent. It also finds evidence that the consumption-wealth ratio significantly predicts not only future asset returns, but also future inflation, over the entire time-horizon considered**.** These results imply that asset values appear to give helpful information about inflation in advance of its appearance, and to that extent it can help guide monetary policy.

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1. Introduction

The connection between financial markets and the real economy has become over the last decade a very important aspect of the research in financial economics. Most of the studies in that area have essentially investigated the financial market-real economy linkage, by analyzing the effects of macro-monetary variables on financial variables. One particularity of this study is the direction of its investigation approach, which departs from the financial market to the real economy. More specifically, it investigates whether there's a significant empirical relation between asset prices and inflation through wealth, and relies on the intertemporal budget constraint between consumption and wealth, evaluated at its market value.

The main assumption that we make in this study is that the intertemporal budget constraint between consumption and wealth holds at all times. Hence, the value of wealth which is a forward-looking measure and embodies important information about its future expected returns, should also embody important information about expected inflation. Wealth here is decomposed into three different components: financial assets, tangible assets, and human assets. We make also the assumption that the value of each wealth component reflects the present values of the stream of revenues expected from the asset. The human asset's value is proxied by labor income. The rationale behind this assumption is the idea of considering labor income as the dividend on human capital, as in Campbell (1996), in Understanding Risk and Return. This wealth decomposition then allows us to assess the relationship between individual components of wealth, with future inflation, future consumption growth, and future asset returns. More specifically, we assess the predictability content of the consumption-wealth ratio for the various wealth components, and, we examine the long-term behavior of expected inflation, expected consumption growth, and expected asset returns. The empirical part of the study relies extensively on Vector Autoregression Analysis VAR, and particularly on Error Correction Models ECM, as well as long-horizon regressions.

From a permanent-transitory decomposition of the variables from this study, we find that consumption shocks are transitory while wealth shocks are permanent. This study also finds the evidence that the consumption-wealth ratio significantly predicts not only future asset returns, but also, and for the entire horizon considered, future inflation. In addition they suggest also that the consumption-wealth ratio predicts future inflation growth, over a period lasting about eight consecutive quarters, a period which begins about four quarters later (four quarters delay).

The possible implications of the above results for financial economics, as well as for macro monetary, could be described as follows. On one hand, according to the finance theory, the price of an asset is generated by the discounted value of its expected payoffs. The discount factor is determined by the growth in the marginal value of wealth, and measures the degree of impatience for acquiring more wealth. On the other hand, the consumption-based asset pricing model in particular exploits the condition that at an optimum, the marginal utility of consumption equals the marginal value of wealth in the sense that a marginal dollar saved is just as good as a marginal dollar spent. Hence the consumption-based model uses the marginal utility of consumption as a perfect substitute for the marginal value of wealth. Therefore the finding that consumption exhibits transitory shocks and gradually adjusts itself to changes in wealth, may then imply that these two marginal utilities are persistently not equal as the consumption-based model originally assumes. This could suggest for example that, asset prices can surge due either to high expectations from future payoffs on these assets, or due to an increase in the growth of marginal value of wealth (our discount factor, which itself could be caused by an increase in the degree of impatience from agents). In either case this surge in asset prices will lead to an increase in the value of wealth, and, the fact that consumption adjusts itself relatively slowly with respect to changes in wealth may imply that:

First, the marginal value of wealth is persistently higher than the marginal utility of consumption, i.e agents are more eager to accumulate wealth than to spend it, so that the envelope condition between wealth and consumption exploited and implied by the traditional consumption-based CAPM has not been satisfied, at least for the US data, during the period covered by this study.

Second, the excess of savings implied by the delay of consumption adjustment to changes in wealth, seems to feed not only the inflation level in a persistent way, but also the growth of inflation over a period lasting about eight consecutive quarters, a period of inflation growth that appears to begins with a delay of about four quarters (four quarters later). The market mechanisms connecting this excess of saving to inflation require further market microstructure investigations. However one could only suspect for the moment, that it's driven most likely by an excess of wealth hunger or impatience from investors.

Third, as to whether the Federal Reserve should consider asset prices in pursuing its inflation target policy or not, and how? The question requires some further investigations too. However the results from this study suggest that the role of movements in asset prices on inflation, need to be given more serious consideration. After all, the idea that assets are claims on future goods and services suggests that their prices should contain important information about future consumptions.

The rest of the paper is structured as follows: In the next section we present a review of results from previous studies related to this topic (section 2), then in section 3 we provide some explanations and/or justification for our empirical analysis approach. In section 4 we present the details of model derivations; the empirical analysis as well as the main results are presented in section 5, and the conclusion is presented in section 6.

2. Literature History

Prior to this study, various other studies have investigated, in one way or another, the connections between asset prices, asset returns, inflation, as well as the interconnection between them and/or with other macroeconomic aggregates. Stock and Watson (2003) investigate, for the G7 countries, the role of assets prices in forecasting output and inflation. It was an attempt to address issues faced by researchers in using monetary aggregates, because it requires an ongoing redefinition, as new financial instruments are introduced. Their definition of assets prices includes: interest rates, differences in interest rates (spreads), returns, exchange rates, and other measures related to the value of financial and tangible assets (stocks, bonds, housing…). Their main findings can be summarized in the following two points:

i) Some asset prices have substantial and statistically significant marginal predictive content for output growth at some times in some countries. Whether this predictive content can be exploited reliably is less clear, for this requires knowing a priori what asset prices work when and in which country. They find evidence that asset prices are useful for forecasting output growth, and in a stronger way than inflation.

ii) They also find that forecasts based on individual indicators are unstable, i.e finding an indicator that predicts well in one period is not a guarantee that it will predict well in later periods. In addition they conclude, although the most common econometric method of identifying a potentially useful predictor is to rely on in-sample significance tests such as Granger causality tests, doing so provides little assurance that the identified predictive relation is stable.

One possible explanation that Stock and Watson (2003) provide for some of their conclusions, which could be perceived negatively, is that their results can also reflect the limitations of conventional models and econometric procedures, not a fundamental absence of predictive relations in the economy. A few years earlier, Alex D. Patelis (1997), investigated whether monetary policy does have significant effects on stock returns. More specifically, whether shifts in the stance of monetary policy can account for the predictability of excess stock returns. He empirically investigates what part of stock return predictability is attributable to monetary policy, and finds that monetary policy variables are significant predictors of future returns. Boudoukh, Richardson, and Whitelaw (1994), investigate the relation between stock returns and inflation. They use a cross section of industries and find a negative relation between stock returns and inflation at short horizons, a positive relation between stock returns and inflation at long horizons, and, a cross sectional variation in this relation across industries. Bernanke and Gertler (1999), (in Monetary Policy and Asset Price Volatility) investigate whether asset prices should be taken into account while implementing inflation targeting policy. They also suggest that central banks pursuing inflation targets, should ignore movements in asset values that do not influence aggregate demand. They believe that it is desirable for central banks to focus only on underlying inflationary pressures, and, asset prices can become relevant only to the extent that they may signal potential inflationary or deflationary forces. More recently, Martin Lettau and Sydney Ludvigson (2003), investigate the wealth-consumption linkage. They try to explain why there are movements in asset values that often seem to be disassociated with important movements in consumer spending. According to their results, only a small fraction of the variation in household net worth is related to variation in aggregate consumer spending. Their finding that most changes in asset values are transitory and unrelated to consumer spending, which itself is the largest component of aggregate demand, seems to support the relevance of the recommendation made by Bernanke and Gertler as mentioned earlier.

3. Long –Horizon Regression Models

Provided that consumption, financial assets, tangible assets, and labor income are found to be cointegrated, we would expect the cointegrating residuals, which in this study is represented by the consumption-wealth ratio, to contain some predictive content for a combination of expected future inflation, expected future consumption growth, and expected future asset returns. In this sense of the interpretation, it means that current consumption-wealth ratio could reflect the long-term rational expectations of either future inflation, future consumption growth, or future asset returns, or some combination of those. In order to assess these predicting contents, we estimate long-horizons simple regressions for future inflation π_{t+h}, future consumption growth $\sum \Delta c_{t+h}$, and future asset real returns r_{t+h}, against the cointegrating residuals $cf\tau y_t$. We use the following specification: $\Sigma\Delta c_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_{t+h}$, for future consumption growth, with

$$\Sigma\Delta c_{t+h} = \Delta c_{t+1} + \Delta c_{t+2} + ... + \Delta c_{t+h},$$

$\pi_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_{t+h}$, for inflation,

and $r_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_{t+h}$, for market returns.

The results from these estimations are presented in Table 2.

Alternatively we also use the same wealth decomposition in order to assess whether, besides the marginal predictive content for future inflation and future asset returns, there's some predictive content for these two variables relying on consumption growth, or on any one(s) of the wealth components. For this purpose, we estimate the following models for future inflation and future returns respectively:

$\pi_{t+h} = \beta_0 + \beta_1 \Delta c_t + \beta_2 \Delta f_t + \beta_3 \Delta \tau_t + \beta_4 \Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$, for future inflation and,

$r_{t+h} = \beta_0 + \beta_1 \Delta c_t + \beta_2 \Delta f_t + \beta_3 \Delta \tau_t + \beta_4 \Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$, for future returns.

The results are provided in Table 3.

In order to investigate whether there is some predicting content in the consumption-wealth ratio for inflation and assets returns not only in levels, but also for the change in future average inflation, for the accumulated future inflation growth, and future asset returns growth, we've also estimated long-horizon regressions of inflation and asset returns against the cointegrating residuals. We defined future average inflation by the h-step ahead average inflation growth, $\Delta\overline{\pi}_{t+h}$, then we defined the long-horizon cumulative inflation growth by $\Sigma\Delta\pi_{t+h}$, and finally, we defined future average asset returns growth by the h-step ahead growth of assets' average real returns $\Delta\bar{r}_{t+h}$. Each one of these three variables is determined as follows:

$\Delta\bar{\pi}_{t+h} = (100/h)*\Delta^h\pi_{t+h}$, where $\Delta^h\pi_{t+h} = \pi_{t+h} - \pi_t$

$\Sigma\Delta\pi_{t+h} = (100)*(\Delta\pi_{t+1} + \Delta\pi_{t+2} + ... + \Delta\pi_{t+h})$

$\Delta\bar{r}_{t+h} = (100/h)*\Delta^h r_{t+h}$, where $\Delta^h r_{t+h} = r_{t+h} - r_t$

The results are presented in Table 4.

From the wealth decomposition adopted in the study, we investigate the relation between these different components and future changes in inflation, and future changes in assets returns. More precisely, we want to find out more specifically which wealth components exhibit some significant predictive content for future inflation growth, as well as for future asset returns' growth. In order to achieve this we estimate long-horizon regressions of future average inflation growth, future cumulated inflation growth, and future average asset returns' growth respectively, against consumption growth, financial assets growth, tangible assets growth, labor income growth, and the cointegrating residuals. The specification for each model is as follows:

$\Delta\bar{x}_{t+h} = \beta_0 + \beta_1\Delta c_t + \beta_2\Delta f_t + \beta_3\Delta\tau_t + \beta_4\Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$, for average inflation and assets returns growth,

With $\Delta\bar{x}_{t+h} = \Delta\bar{\pi}_{t+h}$ for future average inflation growth,

$\Delta\bar{x}_{t+h} = \Delta\bar{r}_{t+h}$ for future average asset returns' growth,

And $\Sigma\Delta\pi_{t+h} = \beta_0 + \beta_1\Delta c_t + \beta_2\Delta f_t + \beta_3\Delta\tau_t + \beta_4\Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$, for cumulated future inflation growth. The results are presented in Table 5

4. Details on the methodological approach

The use of long horizon regression in this study to investigate empirically whether there's some significant predicting content for inflation, asset returns and consumption growth, in the consumption-wealth ratio, is inspired to us from Fama and French (1988, 1989), who use this method while investigating the relation between dividend yields and expected stock returns, and, the relation between business conditions and expected stock returns, respectively. An alternative strategy to long-horizon regressions is that of inferring long-term behavior of expected inflation, expected consumption growth, and expected asset returns, from short-horizon vector autoregressions (VARs). Campbell and Shiller (1986) use this approach to investigate the relation between the dividend-price ratio and expectation of future dividends and discount factors.

The other empirical method that we follow in this study which is that of a VAR analysis, and particularly that of ECM, are inspired to us from Engle and Granger (1987), as well as Campbell and Shiller (1988). Engle and Granger describe cointegrated variables as being in equilibrium[2] when the stationary linear combination of their levels is at its unconditional mean. Most of the time however as they point out, this combination of levels is not at that unconditional mean, and the system is out of equilibrium; but because the combination of levels is stationary, there's a tendency for the system to return to equilibrium. They call this stationary combination of levels "the equilibrium error". They define an Error Correction Model, as a description of a stochastic process by

[2] This notion of equilibrium is specific to the error-correction model defined here, and has no clear relation to the other concepts of equilibrium used in economics. It can just be understood as a stationary point characterized by forces which tend to push the economy back towards the equilibrium whenever it moves away.

which the economy eliminates or corrects the equilibrium error. Such a definition of the ECM suggests a world in which economic theory describes the long run rather than the short run, and in which unspecified factors cause the economy to respond slowly to random shocks. Campbell and Shiller (1988), demonstrate that there are two possible interpretations of error correction models: First, the error-correction representation resulting from cointegrated variables can be thought of as a statement about Granger causality: The stationary linear combination of levels of variables must Granger cause the change in at least one of the cointegrated variables. They show that granger causality from a variable z_1 to a variables z_2 can arise for two reasons. The variable z_1 may **cause** z_2 in common language sense, or instead the variable z_1 may **anticipate** or **forecast** z_2. Second, While the motivation for cointegration given by Engle and Granger stresses the idea that the equilibrium error causes changes in the variables of the model, Campbell and Shiller (1988) emphasize also that the equilibrium error may as well result from agents' forecasts of these variables. In this respect, this empirical framework allows us to identify the long-run equilibrium relationship between consumption, financial assets, tangible assets, and labor income. Following the latter interpretation by Campbell and Shiller (1988), we can use the estimates of the equilibrium error to assess the predictability of future inflation, future consumption growth, and future assets returns. In that sense, considering the wealth decomposition adopted in this study, the equilibrium error can alternatively be looked at, as reflecting long-term rational expectations by agents, of future inflation, or future consumption growth, or future asset returns, or some combination of these. This is done essentially using long-horizon regressions of future inflation, future consumption growth, and future asset returns against the estimates of the equilibrium error. The next section provides us with the details of the rational expectations model between the consumption-wealth ratio, and future inflation, future consumption growth, and future asset returns; It also provides us with the details of the long-horizon models used in the study.

5. Empirical Analysis

5.1 Econometric Analysis and Variable Description

We depart from a more general VECM representation as:

$$\Delta X_t = \mu + \gamma\alpha' X_{t-1} + \Gamma(L)\Delta X_{t-p} + e_t, \qquad (1)$$

We denote by $x_t = (c_t, f_t, \tau_t, y_t)'$ the vector of dependent variables in the model, representing log of real consumption expenditures, log of real net financial assets, log of real tangible assets, and log of real labor income respectively. The Augmented Dickey Fuller test is performed on these four variables. Said and Dickey (1984) demonstrate that the ADF test is asymptotically valid in the presence of a moving average (MA) component, provided that sufficient lagged difference terms are included in the test regression. We choose to run the test with the more general specification that includes both a constant and a linear trend, and without additional exogenous variables. The standard recommendation is to choose a specification that is a plausible description of the data under both the null and alternative hypotheses, (Hamilton 1994, p. 501). In specifying the number of lagged difference terms to be added to the test regression, the usual recommendation is to include a number of lags sufficient to remove serial correlation in the residuals. The unit roots test on each variable in the system suggests that all the variables contained in x_t are first order integrated, or I(1). In order to obtain a correctly specified error-correction model, we begin by testing for both the presence and number of cointegrating relations in x_t. Prior for doing that, two important issues needed to be investigated. That's whether to include the trend and/or the drift parameters in the model, and what is the appropriate lag length of the system. Johansen (1994) suggests that:

One should include a time trend in the VECM if we suspect that:

- The components of the vector $\alpha' X_t$ (or some of them) are trend stationary, so that they veer apart or,
- X_t is trend stationary rather than a multivariate unit root with drift process. We may want to test this hypothesis under the trend stationarity hypothesis that the matrix $A(1) = \gamma\alpha'$ has full rank (*n*). One of Johansen's cointegration tests, the trace test, has this as alternative hypothesis.

Now regarding the cointegrating restrictions on the intercept parameters, we can consider for example a VECM specified as above in (1), where there exists a vector α_0 such that $\mu = \gamma'\alpha_0$. The VECM can therefore be also written as:

$$\Delta X_t = \gamma(\alpha_0 + \alpha' X_{t-1}) + \Gamma(L)\Delta X_{t-p} + e_t \tag{2}$$

In this case the components of $(\alpha_0 + \alpha' X_t)$ are **zero-mean stationary**, implying that ΔX_t is zero-mean stationary, and therefore X_t has no drift! Consequently, cointegrating restrictions on the intercept parameters are only appropriate if the time series run approximately parallel without drift.

We follow these recommendations by Johansen (1994) and, the plot of all our four variables (expressed in logs) suggests that we should not include drift, nor trend in our analysis.

The remaining issue which is the lag-length, is dealt with by relying on the minimum value of the Akaike Information Criterion, AIC.

The cointegration test suggest the presence of a single cointegrating vector; which we impose in the VECM specifcation from now on. The cointegrating coefficient on consumption is normalized to one, and we denote the single cointegrating vector for $x_t = (c_t, f_t, \tau_t, y_t)'$ as $\alpha = (1, -\alpha_f, -\alpha_\tau, -\alpha_y)'$.

We therefore consider from now on, the VECM representation specified as below, using lower case for the system vectors of variables:

$$\Delta x_t = \gamma\alpha' x_{t-1} + \Gamma(L)\Delta x_{t-1} + e_t, \tag{3}$$

Δx_t is the vector of log first differences, $(\Delta c_t, \Delta f_t, \Delta\tau_t, \Delta y_t)$, and $\gamma = (\gamma_c, \gamma_f, \gamma_\tau, \gamma_y)'$ is the (4×1) vector of adjustment coefficients that tells us which variables subsequently adjust to restore the common trend when a deviation occurs. The Granger Representation Theorem states that, if a vector x_t is cointegrated, at least one of the adjustment parameters, γ_c, γ_f, γ_τ, or γ_y must be nonzero in the error-correction representation (19). Thus if x_j does at least some of the adjusting needed to restore the long-run equilibrium subsequent to a shock that distorts this equilibrium, γ_j should be different from zero in the equation for Δx_j of the error-correction representation. $\Gamma(L)$ is a finite order distributed lag operator, and $\alpha = (1, -\alpha_f, -\alpha_\tau, -\alpha_y)'$ is the (4×1) vector of cointegrating coefficients. Throughout this paper, we use "hats" to denote the estimated values of parameters. The term $\alpha' x_{t-1}$ gives last period's equilibrium error, or cointegrating residual, represented from now on, by the term $cf\tau y_t$.

We use for this study quarterly time series from 1950Q1 to 2006Q1. Our consumption and labor income data are from the US Bureau of Economic Analysis, wealth data are from the Board of Directors of the Federal Reserve (z1 tables), and our asset return data are from the Center for Research on Security Prices CRSP.

5.2 Main Results and Interpretation[3]

We conducted the stationarity test on all the four variables of the system: c_t, f_t, τ_t, and y_t, respectively consumption, net financial assets, tangible assets, and labor income, all variables are in logs. The results from the stationarity tests suggest that all four variables are I(1). The cointegration test for these four variables is conducted, using the cointegrating rank test and an AIC minimum value at a lag length of 4 periods (Table A). They suggest the presence of a single cointegrating vector, at a significance level of 5% (Table B). The estimates of the cointegrating vector represented in the model by α, is then given by $\hat{\alpha}' =$ (1, 0.024, -0.6231, -0.4525). All the coefficients are normalized with respect to consumption. Also, the estimates of the unrestricted long-run adjustment

[3] All the coefficients in bold throughout the results, are significant at 5%

coefficients, whose vector is represented by γ in the model, are given by $\hat{\gamma}' =$ (-0.00728, -0.01383, 0.00040, 0.00388), for consumption, net financial assets, tangible assets, and labor income, respectively.

Table 1: Error Correction Model Estimates

	Dependent Variables			
	Δc_t	Δf_t	$\Delta \tau_t$	Δy_t
$cfty_{t-1}$ t-Value	**-0.00728 (-5.73)**	-0.01383 (-1.46)	0.00040 (0.19)	0.00388 (1.66)
Δc_{t-1} t-Value	0.10524 (1.40)	0.00788 (0.01)	0.05397 (0.43)	**0.42404 (3.10)**
Δc_{t-2} t Value	0.04163 (0.54)	0.26677 (0.47)	0.24718 (1.92)	0.05106 (0.36)
Δc_{t-3} t Value	0.05568 (0.73)	-0.31752 (-0.56)	**0.28290 (2.21)**	**0.34894 (2.51)**
Δf_{t-1} t Value	0.03563 (0.86)	0.24421 (0.80)	**0.31959 (4.59)**	0.14881 (1.97)
Δf_{t-2} t Value	-0.00616 (-0.15)	-0.13318 (-0.43)	0.08784 (1.24)	-0.09865 (-1.29)
Δf_{t-3} t Value	0.05148 (1.26)	-0.25899 (-0.85)	**0.19258 (2.80)**	0.09909 (1.33)
$\Delta \tau_{t-1}$ t Value	**0.03000 (3.21)**	0.02724 (0.39)	0.02890 (1.84)	**0.05001 (2.93)**
$\Delta \tau_{t-2}$ t Value	0.01351 (1.42)	0.01344 (0.19)	0.02065 (1.29)	**0.04764 (2.73)**
$\Delta \tau_{t-3}$ t Value	0.01515 (1.58)	0.04952 (0.69)	0.00431 (0.27)	**0.06503 (3.70)**
Δy_{t-t} t Value	0.04350 (1.09)	-0.10332 (-0.35)	-0.07000 (-1.04)	-0.00097 (-0.01)
Δy_{t-2} t Value	-0.00769 (-0.20)	-0.21282 (-0.73)	0.00504 (0.08)	**0.15972 (2.22)**
Δy_{t-3} t Value	-0.01337 (-0.35)	0.16172 (0.57)	-0.09533 (-1.48)	**-0.14762 (-2.11)**
R-squared **Pr > F**	**0.1549** **0.0033**	0.0143 0.9997	**0.3167** **<.0001**	**0.3408** **<.0001**

Result #1: We apply the method suggested by Gonzalo and Granger (1995), to identify the common factors, i.e which ones are the common long-memory components in the system of variables from the study. According to that method, the presence of a single cointegrating equation suggests that there are three permanent components and one transitory component. Since the last three adjustment coefficients are not statistically significant (very low t-statistics), Gonzalo and Ng (2001) suggest to restrict them to zero, so that my restricted vector of adjustment coefficients estimates becomes, $\hat{\gamma}$ = (-0.00728, 0, 0, 0). We use these values to obtain the orthogonal matrix $\hat{\gamma}_{\perp}$ defined such that $\hat{\gamma}'_{\perp}\hat{\gamma} = 0$. We then implement the permanent-transitory decomposition of the variables in the system. The decomposition indicates that the common factors, i.e those variables that exhibit a permanent shock, are financial assets, tangible assets, and labor income; consumption shocks however are transitory. Therefore, following the Engle and Granger (1987) interpretation, a deviation from the common trend shared by consumption, financial assets, tangible assets, and labor income, can better be described as transitory movements mostly in consumption. This means that consumption is the variable that adjusts itself to push the system back to the equilibrium after a temporary move away from it. These results are consistent with the idea that agents are expected to adjust their consumption expenditures to changes in their wealth, with a certain time delay which could be referred to as, the delay of consumption adjustment to wealth.

Table 2: Long Horizon regression of future inflation, consumption growth, and future real returns, against the cointegrating residuals, cfty.

		Panel A		***Panel B***		***Panel C***	
Horizon	***Variables***	π_{t+h}	R^2	$\Sigma\Delta c_{t+h}$	R^2	r_{t+h}	R^2
1	intercept	**-0.027**	0.0915	**0.017**	0.0074	**0.004**	0.0594
		(-3.51)		**(2.65)**		**(3.94)**	
	cfty	**-0.047**		0.011		**0.005**	
		(-4.63)		(1.26)		**3.67**	
2	intercept	**-0.029**	0.0980	**0.030**	0.0072	**0.003**	0.0446
		(-3.69)		**(3.01)**		**(3.41)**	
	cfty	**-0.050**		0.016		**0.004**	
		(-4.80)		(1.24)		**(3.15)**	
3	intercept	**-0.031**	0.1051	**0.041**	0.0055	**0.003**	0.0409
		(-3.89)		**(3.10)**		**(3.26)**	
	cfty	**-0.052**		0.019		**0.004**	
		(-4.98)		(1.09)		**(3.00)**	
4	intercept	**-0.031**	0.1034	**0.046**	0.0018	**0.003**	0.0362
		(-3.84)		**(2.81)**		**(3.06)**	
	cfty	**-0.052**		0.013		**0.004**	
		(-4.92)		(0.61)		**(2.81)**	
5	intercept	**-0.027**	0.0915	**0.048**	0.0002	**0.004**	0.0594
		(-3.51)		**(2.57)**		**(3.94)**	
	cfty	**-0.047**		0.005		**0.005**	
		(-4.63)		(0.19)		**(3.67)**	
6	intercept	**-0.029**	0.0980	**0.047**	0.0004	**0.003**	0.0446
		(-3.69)		**(2.26)**		**(3.41)**	
	cfty	**-0.049**		-0.008		**0.004**	
		(-4.80)		(-0.31)		**(3.15)**	
7	intercept	**-0.031**	0.1051	**0.048**	0.0018	**0.003**	0.0409
		(-3.89)		**(2.13)**		**(3.26)**	
	cfty	**-0.052**		-0.019		**0.004**	
		(-4.98)		(-0.62)		**(3.00)**	
8	intercept	**-0.031**	0.1034	**0.051**	0.0033	**0.003**	0.0362
		(-3.84)		**(2.10)**		**(3.06)**	
	cfty	**-0.052**		-0.027		**0.004**	
		(-4.92)		(-0.84)		**(2.81)**	
12	intercept	**-0.029**	0.0914	**0.061**	0.0105	**0.003**	0.0359
		(-3.52)		**(2.02)**		**(3.05)**	
	cfty	**-0.050**		-0.059		**0.004**	
		(-4.59)		(-1.50)		**(2.79)**	
20	intercept	**-0.027**	0.0794	0.073	0.0371	**0.003**	0.0321
		(-3.18)		**(1.95)**		**(2.88)**	
	cfty	**-0.047**		**-0.137**		**0.0035**	
		(-4.23)		**(-2.79)**		**(2.63)**	

Model Panel A: $\pi_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_t$

Model Panel B: $\Sigma\Delta c_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_t$, with $\Sigma\Delta c_{t+h} = \Delta c_{t+1} + \Delta c_{t+2} + ... + \Delta c_{t+h}$

Model Panel C: $r_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_t$

<u>Result #2:</u> The results from long-horizon regression of future inflation, consumption growth, and future real returns, against the cointegrating residuals, cfty, presented in Table 2 indicate the following:

In panel A, the regression of future inflation on the cointegrating residuals over a period horizon of 20 quarters, indicates a negative, statistically significant, and persistent relation between the cointegrating residuals and future inflation. In panel C, the regression of future asset returns against the cointegrating residuals, indicates a statistically significant, positive, and persistent relation between the cointegrating residuals and future real asset returns throughout the entire period horizon considered. Results from Panel B however, indicates no statistically, nor economically significant relation between future consumption growth, and the cointergrating residuals, at short or medium horizons, instead it shows some significant relation at long horizon.

All the variables used in Panels B and C, both the dependent variables and the independent variable are stationary, so that we can rely on the regular t-statistic to assess the statistical significance of the coefficient estimates. For Panel A, the dependent variables is I(1), and since it's not expressed in first differences, the statistical significance should be assessed using autocorrelation and heteroscedasticity consistent standard errors, which are supposed to be smaller than those obtained here using the simple OLS procedure. However even with these regular OLS t-stat (which are expected to be much smaller), the coefficients are still highly significant.

One can look at these results in Table 2, as implying that the consumption-wealth ratio embodies some significant marginal prediction content for future inflation, and for future asset returns, at all time horizons, as well as some marginal forecasting or predictive content for future consumption growth, but at long-horizons only. In other words, there's enough evidence to infer that the consumption-wealth ratio significantly reflects, among other things, agents long-term rational expectations of future inflation and future real asset returns, and, to some extent only, future consumption growth.

The results in Table 2 suggest that an increase in the consumption-wealth ratio is likely to indicate either a lower inflation level in the future, or higher real future asset returns, or both. In the same way, a decrease in the consumption-wealth ratio is likely to indicate either a higher inflation level in the future, or lower real future asset returns, or both.

The economic interpretation that we can derive from the statements above is that when agents become wealthier, following for example asset prices surge, they do not convert instantaneously their additional wealth into consumption expenditures. During the delay required by consumption to adjust itself to the changes in wealth (See result #1), this additional wealth has the time to feed future inflation and future asset returns. Further studies are needed here in order to explain how, since this investigation doesn't make any behavioral assumption regarding the preferences of agents. One can only notice here that there has been consistently, over the entire time horizon considered, a discrepancy between the intertemporal marginal value of wealth and that of consumption. In other words a discrepancy between agents' impatience to accumulate more wealth, and to spend that wealth.

Table 3: Long-Horizon multiple regression of future inflation and future returns

Panel A. Long-Horizon multiple regression of future inflation π_{t+h}									
h	1	2	3	4	6	8	12	16	20
Const	**-0.026**	**-0.028**	**-0.030**	**-0.028**	**-0.028**	**-0.028**	**-0.028**	**-0.023**	**-0.021**
	(-3.23)	**(-3.35)**	**(-3.56)**	**(-3.29)**	**(-3.35)**	**(-3.29)**	**(-3.26)**	**(-2.68)**	**(-2.34)**
Δc_t	-0.057	-0.060	-0.0114	-0.055	-0.060	-0.054	0.063	0.035	0.033
	(-0.61)	(-0.64)	(-0.12)	(-0.56)	(-0.64)	(-0.56)	(0.66)	(0.36)	(0.35)
Δf_t	-0.015	-0.019	-0.013	-0.007	-0.019	-0.007	-0.005	-0.012	-0.007
	(-1.24)	(-1.59)	(-1.04)	(-0.57)	(-1.59)	(-0.57)	(-0.41)	(-0.96)	(-0.54)
$\Delta \tau_t$	-0.088	-0.036	-0.040	0.011	-0.036	0.011	0.034	0.095	**0.133**
	(-1.79)*	(-0.73)	(-0.79)	(0.22)	(-0.73)	(0.22)	(0.66)	(1.85)*	**(2.56)**
Δy_t	-0.021	-0.024	-0.004	-0.003	-0.024	-0.003	-0.0015	-0.039	-0.022
	(-0.44)	(-0.49)	(-0.08)	(-0.07)	(-0.49)	(-0.07)	(-0.03)	(-0.79)	(-0.44)
$cf\tau y_t$	**-0.048**	**-0.050**	**-0.052**	**-0.049**	**-0.049**	**-0.049**	**-0.048**	**-0.041**	**-0.037**
	(-4.52)	**(-4.56)**	**(-4.69)**	**(-4.39)**	**(-4.56)**	**(-4.39)**	**(-4.19)**	**(-3.60)**	**(-3.21)**
R^2	0.1272	0.1277	0.1116	0.1016	0.1277	0.1016	0.0942	0.0967	0.0978
$\bar{R}^2$	0.1062	0.1066	0.0900	0.0797	0.1066	0.0797	0.0720	0.0745	0.0755

Model Panel A: $\pi_{t+h} = \beta_0 + \beta_1 \Delta c_t + \beta_2 \Delta f_t + \beta_3 \Delta \tau_t + \beta_4 \Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$.

Panel B. Long-Horizon multiple regression of future real returns, r_{t+h}									
h	1	2	3	4	6	8	12	16	20
Const	**0.004**	**0.004**	**0.004**	**0.003**	**0.004**	**0.003**	**0.0035**	**0.003**	**0.003**
	(3.94)	**(3.93)**	**(3.91)**	**(3.24)**	**(3.93)**	**(3.24)**	**(3.33)**	**(2.81)**	**(3.00)**
Δc_t	-0.011	0.005	-0.020	-0.004	0.005	-0.004	-0.007	0.011	-0.021
	(-0.98)	(0.47)	(-1.69)*	(-0.33)	(0.47)	(-0.33)	(-0.58)	(0.97)	(-1.79)*
Δf_t	**0.004**	-0.001	-0.001	-0.0008	-0.001	-0.0008	-0.001	-0.002	-0.002
	(2.80)	(-0.76)	(-0.93)	(-0.54)	(-0.76)	(-0.54)	(-0.94)	(-1.62)	(-1.19)
$\Delta \tau_t$	0.002	0.004	0.010	-0.005	0.004	-0.005	0.0005	0.0024	0.005
	(0.36)	(0.67)	(1.66)*	(-0.74)	(0.67)	(-0.74)	(0.08)	(0.38)	(0.73)
Δy_t	**-0.0115**	**-0.014**	-0.010	-0.002	**-0.014**	-0.002	-0.006	-0.001	0.006
	(-2.01)	**(-2.45)**	(-1.78)*	(-0.34)	**(-2.45)**	(-0.34)	(-0.96)	(-0.13)	(1.00)
$cf\tau y_t$	**0.0045**	**0.0048**	**0.0046**	**0.0039**	**0.0048**	**0.0039**	**0.0041**	**0.0037**	**0.0037**
	(3.55)	**(3.66)**	**(3.52)**	**(2.91)**	**(3.66)**	**(2.91)**	**(3.00)**	**(2.68)**	**(2.68)**
R^2	0.1210	0.0821	0.0878	0.0524	0.0821	0.0524	0.0533	0.0508	0.0546
$\bar{R}^2$	0.0999	0.0599	0.0656	0.0293	0.0599	0.0293	0.0301	0.0275	0.0312

Model Panel B: $r_{t+h} = \beta_0 + \beta_1 \Delta c_t + \beta_2 \Delta f_t + \beta_3 \Delta \tau_t + \beta_4 \Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$.

Result #3:

Results from long-horizon multiple regression of future inflation, and future real returns respectively, are presented in Table 3. The content from panel A suggests that only tangible assets growth appears to have some marginal predictive content for future level of inflation, mostly at a long horizon, besides the consumption-wealth ratio. Consumption growth, financial assets' growth, and labor income growth, do not appear instead, to have any significant predictive content for future inflation level, at any horizon.

From panel B, one can observe that the results from Table 2-C are confirmed. In addition they show that only the first period-ahead real returns, is significantly related to financial asset growth and also, that real returns for five of the first six periods ahead, are significantly related to labor income growth. These results from panel B seem to suggest that future returns besides being predicted by the consumption-wealth ratio, are essentially driven by financial asset growth, at any given time period. They reflect, among other things, agents' rational forecasts of real aggregate returns for the following period. Labor income growth on the other hand, seems to significantly reflect agents' rational forecasts of future aggregate returns, for the following six quarters.

Table 4: Long-Horizon simple regression of average inflation growth, cumulative inflation, and average return growth.

H	*Variables*	*Panel A* $\Delta\overline{\pi}_{t+h}$	R^2	*Panel B* $\Sigma\Delta\pi_{t+h}$	R^2	*Panel C* $\Delta\overline{r}_{t+h}$	R^2
1	intercept	-0.2052		-0.2052		-0.00000111	
		(-0.45)	0.0009	(-0.45)	0.0009	(-0.00)	0.0000
	cfty	-0.2695		-0.2695		0.00000457	
		(-0.45)		(-0.45)		(0.00)	
2	intercept	-0.1188		-0.2376		0.0169	
		(-0.48)	0.0011	(-0.48)	0.0011	(0.27)	0.0003
	cfty	-0.1585		-0.3169		0.0228	
		(-0.49)		(-0.49)		(0.27)	
3	intercept	-0.1497		-0.4492		0.0364	0.0030
		(-0.86)	0.0035	(-0.86)	0.0035	(0.79)	
	cfty	-0.1989		-0.5966		0.0484	
		(-0.87)		(-0.87)		(0.80)	
4	intercept	-0.2971		-1.1882		0.0334	
		(-1.92)	0.0166	(-1.92)	0.0166	(1.07)	0.0055
	cfty	-0.3888		-1.5545		0.0445	
		(-1.90)*		(-1.90)*		(1.08)	
5	intercept	**-0.3148**		**-1.5741**		0.0235	0.0034
		(-2.24)	0.0225	**(-2.24)**	0.0225	(0.83)	
	cfty	**-0.4114**		**-2.0572**		0.0317	
		(-2.22)		**(-2.22)**		(0.85)	
6	intercept	**-0.3279**		**-1.9671**		0.0197	
		(-2.81)	0.0349	**(-2.81)**	0.0349	(0.86)	0.0036
	cfty	**-0.4276**		**-2.5654**		0.0268	
		-2.78		**(-2.78)**		(0.88)	
7	intercept	**-0.2968**		**-2.0775**		0.0159	0.0029
		(-2.75)	0.0336	**(-2.75)**	0.0336	(0.76)	
	cfty	**-0.3878**		**-2.7146**		0.0216	
		(-2.73)		**(-2.73)**		(0.79)	
8	intercept	**-0.2684**		**-2.1469**		0.0114	0.0027
		(-2.74)	0.0336	**(-2.74)**	0.0336	(0.74)	
	cfty	**-0.3514**		**-2.8110**		0.0157	
		(-2.72)		**(-2.72)**		(0.77)	
12	intercept	**-0.1513**		**-1.8160**		0.0026	0.0004
		(-2.06)	0.0197	**(-2.06)**	0.0197	(0.25)	
	cfty	**-0.1976**		**-2.3717**		0.0040	
		(-2.05)		**(-2.05)**		(0.28)	
16	intercept	-0.0633		-1.0134		-0.0013	0.0001
		(-1.08)	0.0056	(-1.08)	0.0056	(-0.17)	
	cfty	-0.0822		-1.3154		-0.0012	
		(-1.07)		(-1.07)		(-0.13)	
20	intercept	0.0314		0.6284		-0.0027	0.0005
		(0.64)	0.0021	(0.64)	0.0021	(-0.39)	
	cfty	0.0418		0.8355		-0.0029	
		(0.65)		(0.65)		(-0.32)	

Model Panel A: $\Delta\overline{\pi}_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_{t+h}$,

With $\Delta\overline{\pi}_{t+h} = (100/h) * \Delta^h \pi_{t+h}$, where $\Delta^h \pi_{t+h} = \pi_{t+h} - \pi_t$

Model Panel B: $\Sigma\Delta\pi_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_{t+h}$, With $\Sigma\Delta\pi_{t+h} = (100) * (\Delta\pi_{t+1} + \Delta\pi_{t+2} + ... + \Delta\pi_{t+h})$

Model Panel C: $\Delta\bar{r}_{t+h} = \beta_0 + \beta_1 cf\tau y_t + \varepsilon_{t+h}$,

With $\Delta\bar{r}_{t+h} = (100 / h) * \Delta^h r_{t+h}$, where $\Delta^h r_{t+h} = r_{t+h} - r_t$

Result #4:

The results from long-horizon simple regression of average inflation growth, cumulative inflation, and average return growth are presented in Table 4. Panels A and B show a negative, and statistically significant relation between the cointegrating residuals and future inflation growth (Tables 4-A, and 4-B), for about eight consecutive quarters, beginning from the 5^{th} quarter. From panel C on the other hand, future aggregate returns' growth are neither statistically nor economically, significantly related to the cointegrating residuals (Table 4-C), at any period within the time-horizon considered. All the variables used here are stationary, so that one can rely on the regular t-statistic to assess the statistical significance of the regression coefficients.

Tables 4-A and 4-B suggest that, the consumption-wealth ratio not only predicts the future level inflation all over the horizon considered in this study, but it also has a significant predictive content for future inflation growth, for the period going from one year ahead, and during about eight quarters (two years). Therefore an increase in the consumption-wealth ratio for example, in addition to indicate either a lower future inflation, or higher future asset returns, or both, is also likely to indicate decrease in future inflation growth for a period of about two years, beginning one year later. It would be logic therefore to infer that the consumption-wealth ratio embodies some significant marginal prediction content not only for future inflation, and for future asset returns, but also some forecasting or predictive content for future inflation growth at one-year horizon, for about two years. In other words, there's enough evidence to infer that the consumption-wealth ratio significantly reflects, among other things, agents long-term rational expectations of not only future inflation, and future asset returns, and, to some extend, future consumption growth, but also expectations about inflation growth beginning one year ahead. However if as the results show, the consumption-wealth ratio persistently predicts future returns, it doesn't predict at any time horizon, the future growth of aggregate returns.

Table 5: Long-Horizon multiple regression of average inflation growth, cumulative inflation, and average return growth

Panel A. Long-Horizon multiple regression of future average inflation growth, $\Delta\bar{\pi}_{t+h}$									
h	1	2	3	4	6	8	12	16	20
Const	0.0417 (0.09)	-0.1404 (-0.55)	-0.0672 (-0.37)	-0.1127 (-0.81)	**-0.2481** **(-2.11)**	**-0.2132** **(-2.11)**	-0.1429 (-1.89)*	-0.0418 (-0.71)	0.0559 (1.11)
Δc_t	**-14.191** **(-2.60)**	**-8.4431** **(-2.81)**	**-4.2413** **(-1.99)**	**-3.4145** **(-2.09)**	**-4.6334** **(-3.36)**	**-3.0954** **(-2.61)**	**-2.2471** **(-2.58)**	**-2.2830** **(-3.43)**	**-1.2074** **(-2.19)**
Δf_t	-0.1735 (-0.25)	-0.2992 (-0.78)	**-0.5790** **(-2.12)**	-0.2540 (-1.22)	-0.1177 (-0.67)	-0.2026 (-1.34)	-0.1517 (-1.38)	-0.1358 (-1.63)	**-0.1667** **(-2.43)**
$\Delta\tau_t$	-4.7444 (-1.66)*	**-3.8721** **(-2.46)**	-0.6741 (-0.60)	-0.5094 (-0.59)	-0.9776 (-1.35)	-0.5603 (-0.90)	-0.8137 (-1.76)*	**-0.7624** **(-2.16)**	-0.4354 (-1.48)
Δy_t	2.7774 (1.00)	**3.1299** **(2.04)**	1.6769 (1.54)	1.1261 (1.35)	1.2923 (1.84)	-0.0837 (-0.14)	0.3088 (0.69)	0.0169 (0.05)	-0.2789 (-0.96)
$cf\tau y_t$	-0.1565 (-0.26)	-0.3115 (-0.92)	-0.1398 (-0.58)	-0.1896 (-1.03)	**-0.3805** **(-2.46)**	**-0.3257** **(-2.45)**	**-0.2222** **(-2.23)**	-0.0921 (-1.19)	0.0495 (0.75)
R^2	0.0562	0.0784	0.0499	0.0393	0.0946	0.1027	0.0931	0.1443	0.1224
$\bar{R}^2$	0.0337	0.0564	0.0272	0.0163	0.0729	0.0813	0.0710	0.1230	0.1001

Model Panel A: $\Delta\bar{\pi}_{t+h} = \beta_0 + \beta_1\Delta c_t + \beta_2\Delta f_t + \beta_3\Delta\tau_t + \beta_4\Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$.

With $\Delta\bar{\pi}_{t+h} = (100/h) * \Delta^h\pi_{t+h}$, where $\Delta^h\pi_{t+h} = \pi_{t+h} - \pi_t$

Panel B. Long-Horizon multiple regression of cumulative inflation growth, $\Sigma\Delta\pi_{t+h}$									
h	1	2	3	4	6	8	12	16	20
Const	0.0417 (0.09)	-0.2807 (-0.55)	-0.2015 (-0.37)	-0.4510 (-0.81)	**-1.4887** **(-2.11)**	**-1.7061** **(-2.11)**	-1.7146 (-1.89)*	-0.6684 (-0.71)	1.1180 (1.11)
Δc_t	**-14.191** **(-2.60)**	**-16.886** **(-2.81)**	**-12.724** **(-1.99)**	**-13.658** **(-2.09)**	**-27.800** **(-3.36)**	**-24.763** **(-2.61)**	**-26.965** **(-2.58)**	**-36.528** **(-3.43)**	**-24.148** **(-2.19)**
Δf_t	-0.1735 (-0.25)	-0.5984 (-0.78)	**-1.7371** **(-2.12)**	-1.0159 (-1.22)	-0.7062 (-0.67)	-1.6210 (-1.34)	-1.8207 (-1.38)	-2.1720 (-1.63)	**-3.3336** **(-2.43)**
$\Delta\tau_t$	-4.7444 (-1.66)*	**-7.7442** **(-2.46)**	-2.0222 (-0.60)	-2.0377 (-0.59)	-5.8658 (-1.35)	-4.4824 (-0.90)	-9.7647 (-1.76)*	**-12.199** **(-2.16)**	-8.7090 (-1.48)
Δy_t	2.7774 (1.00)	**6.2597** **(2.04)**	5.0305 (1.54)	4.5044 (1.35)	7.7540 (1.84)	-0.6697 (-0.14)	3.7062 (0.69)	0.2712 (0.05)	-5.5792 (-0.96)
$cf\tau y_t$	-0.1565 (-0.26)	-0.6231 (-0.92)	-0.4196 (-0.58)	-0.7585 (-1.03)	**-2.2833** **(-2.46)**	**-2.6053** **(-2.45)**	**-2.6664** **(-2.23)**	-1.4737 (-1.19)	0.9903 (0.75)
R^2	0.0562	0.0784	0.0499	0.0393	0.0946	0.1027	0.0931	0.1443	0.1224
$\bar{R}^2$	0.0337	0.0564	0.0272	0.0163	0.0729	0.0813	0.0710	0.1230	0.1001

Model Panel B: $\Sigma\Delta\pi_{t+h} = \beta_0 + \beta_1\Delta c_t + \beta_2\Delta f_t + \beta_3\Delta\tau_t + \beta_4\Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$

Panel C. Long-Horizon multiple regression of average return growth, $\Delta\bar{r}_{t+h}$									
h	1	2	3	4	6	8	12	16	20
Const	0.0002 (0.13)	0.0375 (0.60)	0.0295 (0.64)	0.0414 (1.36)	0.0263 (1.16)	0.0106 (0.70)	-0.0005 (-0.05)	-0.0047 (-0.62)	-0.0021 (-0.30)
Δc_t	0.0073 (0.48)	-0.2786 (-0.38)	0.7642 (1.42)	0.2854 (0.80)	-0.1001 (-0.37)	**0.3777** **(2.11)**	0.0103 (0.08)	0.0572 (0.66)	-0.0471 (-0.62)
Δf_t	**0.0073** **(3.81)**	**0.4855** **(5.15)**	**0.3331** **(4.84)**	**0.2710** **(5.97)**	**0.1844** **(5.40)**	**0.1145** **(5.01)**	**0.0870** **(5.61)**	**0.0371** **(3.42)**	**0.0562** **(5.88)**
$\Delta \tau_t$	0.0074 (0.93)	0.2735 (0.71)	-0.0491 (-0.17)	0.3061 (1.64)	0.1152 (0.82)	**0.1992** **(2.12)**	0.1106 (1.71)*	0.0220 (0.48)	0.0506 (1.24)
Δy_t	-0.0106 (-1.38)	**-1.0330** **(-2.74)**	**-0.8143** **(-2.96)**	**-0.5512** **(-3.04)**	-0.2251 (-1.65)	-0.1354 (-1.48)	-0.0058 (-0.09)	0.0052 (0.12)	-0.0688 (-1.71)*
$cf\tau y_t$	0.00038 (0.23)	0.0450 (0.54)	0.0430 (0.71)	0.0598 (1.50)	0.0354 (1.18)	0.0216 (1.08)	0.0024 (0.17)	-0.0043 (-0.43)	-0.0021 (-0.23)
R^2	0.0766	0.1489	0.1454	0.1885	0.1414	0.1640	0.1538	0.0665	0.1651
$\bar{R}^2$	0.0545	0.1286	0.1250	0.1691	0.1208	0.1440	0.1333	0.0434	0.1440

Model Panel C: $\Delta\bar{r}_{t+h} = \beta_0 + \beta_1\Delta c_t + \beta_2\Delta f_t + \beta_3\Delta\tau_t + \beta_4\Delta y_t + \beta_5 cf\tau y_t + \varepsilon_{t+h}$

With $\Delta\bar{r}_{t+h} = (100/h) * \Delta^h r_{t+h}$, where $\Delta^h r_{t+h} = r_{t+h} - r_t$

Result #5: The results from long-horizon multiple regression of average inflation growth, cumulative inflation, and average return growth are presented in Table 5. All variables are stationary therefore we can rely on the basic t-statistic to assess the significance first of the coefficients. These results first of all confirm all the findings in mentioned earlier under *Results #4*, regarding the relation between the consumption-wealth ratio and future inflation growth and future asset returns growth. In addition, from Panels A and B, it can be seen that the coefficient associated to consumption growth is statistically significant over the entire horizon. Also the coefficient of financial asset growth is significant only for the third quarter, then again for the 20th quarter. On the other hand it can be seen from Table 5-C, that the coefficient of financial asset growth is persistently highly significant over the entire horizon, also the coefficient of labor income growth is significant from the second quarter to the fourth quarter.

These results suggest, or rather, confirm that consumption growth is a significant predictor of future inflation growth, whereas there's an unstable relation between financial asset growth and inflation growth, at the 3rd period and at a very long horizon. However, as results #3 show, consumption growth is not related, at any time within the horizon considered, to future level of inflation. Results from Panel C on the other hand, suggest that financial assets' growth is a significant predictor for asset returns, or, alternatively they indicate also that financial asset growth are the reflect of expected future growth of aggregate real returns. The significance of the coefficient for labor income growth may suggest, either that there's some significant predictive content for the growth of future real returns in labor income growth, for consecutively three quarter after the first quarter, it may also suggest that labor income growth for the three consecutive quarters following the next one, are the reflect among other things, of rational expectations from future growth of real returns.

6. Conclusions

This article investigates the relationship between wealth and inflation, by using Campbell and Mankiw (1988) derivation of the intertemporal relationship between the consumption-wealth ratio and future consumption growth and future asset returns. It extends this relation, in order to allow in the equation not only future consumption growth and future assets' returns, but also future inflation. Wealth is decomposed into financial assets, tangible assets, and human assets, to assess the relation between individual components of wealth, and future inflation, as well as future asset returns. We made the assumption that the value of each wealth component reflects the sum of the present values of the stream of revenues expected from these assets. The human asset's value is proxied by labor income, with the idea that labor income represents the dividend on human capital, as in Campbell (1996).

The study finds strong evidence that the consumption-wealth ratio significantly predicts future inflation level, and future asset returns at all time horizons. In addition the study finds also that the consumption-wealth ratio predicts future inflation growth over a period of about two years, a period that begins a year later.

The results obtained in this study strongly suggest that the equilibrium condition exploited by the consumption-based model, and that requires that at an optimum, the marginal utility of consumption equals the marginal value of wealth, hasn't been satisfied for the US economy during the time horizon considered. One possible implication of these results for financial economics, could well be that asset prices surge due either to high expectations from future payoffs, or due to an increase the marginal value of wealth, appear to have inflationary effects. However, we can only suspect that the discrepancy between the marginal value of wealth and the marginal utility of consumption observed in our results, could be caused itself by an increase in the degree of impatience from agents.

In any case, the finding that consumption adjusts relatively slowly to changes in wealth imply that: first, the marginal value of wealth is persistently higher than that of consumption, therefore the equilibrium condition between wealth and consumption exploited and implied by the traditional consumption-based CAPM has not been satisfied, at least for US data. Second, the excess of savings implied by the delay of consumption adjustment to changes in wealth, meantime feeds not only the inflation level in a persistent way, but also feeds the growth of inflation during a period of about 8 consecutive quarters, a period that begins about 4 quarters from the shock. Although further investigations are needed in order to explain the reasons why, one can only suspect for the moment that it's an inflation driven most likely by an excess of wealth hunger or (impatience) from investors. Third, as of whether the FED should consider asset prices in pursuing its inflation target policy or not, and how? The question requires some further investigations too. However the results from this study suggest that the inflationary effects of movements in asset prices need to be given more serious consideration.

7. Appendices

7.1 Data Description

CONSUMPTION

Consumption is measured as expenditure on non-durables and services. The quarterly data are seasonally adjusted at annual rates, in billions of chain- weighted 2000 dollars. Real consumption data are obtained by deflating consumption data by the GDP deflator, with 2000 the base year. The source is the U.S. Department of Commerce, Bureau of Economic Analysis.

LABOR INCOME

Labor income data are represented in this study by wage and salary disbursements, and are deflated by the GDP deflator. The quarterly data are seasonally adjusted, in current dollars. The source is the Bureau of Economic Analysis.

THE OTHER WEALTH VARIABLES

Total wealth is household net worth in billions of current dollars, measured at the end of the period, not seasonally adjusted. Tangible Assets are measured in this study as Real estate + Equipments and software + Consumer durable goods. Financial Assets are measured here as Deposits + (Credit market instruments + Corporate equities + Mutual fund shares + Security credit + Life insurance reserves + Pension funds reserves + Investments in banks personal trusts + Equities in non-corporate business) – Credit market instruments liabilities – Security Credit liabilities – Trade payables – Deferred and unpaid life insurance premiums. All these variables are deflated in this study, by the GDP deflator in order to have their values in real terms. The source for these data is the Board of Governors of the Federal Reserve System. A complete description of these data may be found at http://www.federalreserve.gov/releases/Z1/Current/.

ASSET RETURNS

They are represented in this study by the three-month value weighted returns from market index. Values for the real return variable are obtained by deflating the nominal value weighted returns by the GDP deflator. The source for these data is the Center for Research on Security Prices (CRSP).

7.2 Minimum Information Criterion

Lag	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	-11.78861	-11.63212	-11.57118	-11.50699	-11.4516	-11.39751
AR 1	-36.77828	-36.69077	-36.65201	-36.7775	-36.83518	-36.87385
AR 2	-36.99628	-36.97361	-36.88726	-36.88588	-36.86558	-36.93982
AR 3	-36.99651	-36.9579	-36.89507	-36.886	-36.83848	-36.84815
AR 4	**-37.02186**	-36.95866	-36.90829	-36.80901	-36.76287	-36.78745
AR 5	-36.98839	-36.96623	-36.87961	-36.79413	-36.812	-36.75959

The MIC for the appropriate number of lag length periods in the Vector Error Correction Model estimation. It indicates a number of lag length of four periods.

7.3 Cointegration Rank Test Using Trace

H0: Rank=r	H1: Rank>r	Eigenvalue	Trace	5% Critical Value	Drift in ECM	Drift in Process
0	0	0.1979	60.8726	39.71	NOINT	Constant
1	**1**	**0.0406**	**14.1274**	**24.08**		
2	2	0.0136	5.3317	12.21		
3	3	0.0114	2.4329	4.14		

The results from the Trace test suggest a single cointegrating equation

7.4 Long-Run Parameter (alpha) Estimates When RANK=1

Variable	
lco	1.00000
lnfa	0.01237
lta	-0.62314
ly	-0.45246

Estimates of the cointegrating coefficients, alpha

7.5 Adjustment Coefficient (Gamma) Estimates When RANK=1

Variable	
lco	-0.00728
lnfa	-0.01383
lta	0.00040
ly	0.00388

Estimates of the long-run adjustment coefficients, gamma

7.6 Tentative Model for Consumption-Wealth-Inflation Linkage

This section presents a theoretical framework for the linkage between aggregate wealth, real consumption, and inflation. More specifically, this section presents a theoretical framework that connects consumption, financial assets, tangible assets, and human assets, to expected future inflation, future consumption growth, and future returns. The methodology we use here is that of a representative agent economy in which all wealth, including human capital, is tradable. Let W_t be beginning of period aggregate wealth defined as the sum of financial assets F_t, tangible assets T_t, and human assets H_t. That's, defined as: $W_t = F_t + T_t + H_t$ where

$W_t =$ Market Value of wealth at time t,

$F_t, T_t,$ and H_t, Market value of financial, tangible and human assets at time t, measured as the present value at time t, of the stream of expected future returns from $F_t, T_t,$ and H_t, respectively. The human assets here can consist of the training, the experience, the knowledge, or any combination of these that an individual may posses, and is assumed here to have a marketable value at any time t of H_t included in the aggregate wealth value W_t.

We consider a simple accumulation equation for aggregate wealth, written as:

$$W_{t+1} = (1 + R_{w,t+1})(W_t - C_t) \quad (1)$$

Where $R_{w,t+1}$ is the net return on aggregate wealth.

Then we follow Boudoukh, Richardson, and Whitelaw (1994) by solving this equation for gross returns, to get:

$$\left(1+R_{w,t+1}\right)=\frac{W_{t+1}}{\left(W_t-C_t\right)}\text{, which can also be written as } \left(1+R_{w,t+1}\right)^{-1}=\frac{\left(W_t-C_t\right)}{W_{t+1}} \qquad (2)$$

We define W_t and w_t as the aggregate wealth at time t in nominal and real terms respectively, C_t and c_t as the nominal and real consumption at time t respectively, p_t as the price level at time t; equation (2) can be rewritten as:

$$\left(1+R_{w,t+1}\right)^{-1}=\frac{\dfrac{W_t-p_tc_t}{p_tc_t}}{\dfrac{W_{t+1}}{p_{t+1}c_{t+1}}\dfrac{p_{t+1}c_{t+1}}{p_tc_t}}=\frac{\dfrac{w_t}{c_t}-1}{\dfrac{w_{t+1}}{c_{t+1}}\dfrac{p_{t+1}}{p_t}\dfrac{c_{t+1}}{c_t}} \qquad (3)$$

The returns on aggregate wealth are decomposed as following:

$$\left(1+R_{w,t}\right)=\omega_f\left(1+R_{f,t}\right)+\omega_\tau\left(1+R_{\tau,t}\right)+\left(1-\omega_f-\omega_\tau\right)\left(1+R_{h,t}\right) \qquad (4)$$

Where $R_{f,t}$, $R_{\tau,t}$, and $R_{h,t}$ represent respectively the returns on financial, tangible, and human assets; and ω_f and ω_τ the respective shares of financial and tangible assets in the aggregate wealth. Following Campbell (1996), expression (4) can be transformed into an approximate equation for log returns into:

$$r_{w,t}\approx\omega_f r_{f,t}+\omega_\tau r_{\tau,t}+\left(1-\omega_f-\omega_\tau\right)r_{h,t} \qquad (5)$$

Taking the logs from each side of (3) gives us the following:

$$-r_{w,t+1}=\ln\left(\frac{c_{t+1}}{w_{t+1}}\right)-\ln\left(\frac{p_{t+1}}{p_t}\right)-\ln\left(\frac{c_{t+1}}{c_t}\right)+\ln\left(\frac{w_t}{c_t}-1\right) \qquad (6)$$

From this derivation, return on wealth, can be expressed as a combination of four terms:

(i) The inflation rate, i.e. $\pi_{t+1}=\ln\left(\frac{p_{t+1}}{p_t}\right)$,

(ii) The real consumption growth rate, i.e. $\Delta c_{t+1}=\ln\left(\frac{c_{t+1}}{c_t}\right)$,

(iii) The future log consumption-wealth ratio, i.e. $\ln\left(\frac{c_{t+1}}{w_{t+1}}\right)$, and

(iv) The log of the ratio of new investments and/or savings on consumption, i.e

$\ln\left(\frac{w_t}{c_t}-1\right)$.

This expression can be rewritten with the variables expressed in logs as:

$$-r_{w,t+1}=(c_{t+1}-w_{t+1})-\pi_{t+1}-\Delta c_{t+1}+\ln\{\exp[-(c_t-w_t)]-1\} \quad (7)$$

We set $(c_t-w_t)=x_t$ and $(w_t-c_t)=[-(c_t-w_t)]=(-x_t)$, respectively the log of real consumption-wealth ratio and its inverse, the log of real wealth-consumption ratio.

The last term of equation (7) is a non linear function of the log consumption-wealth ratio. Taking the first-order Taylor expansion of that last term from equation (7) around x, gives:

$$\ln[\exp(-x_t)-1]\approx\ln[\exp(-x)-1]+\frac{\exp(-x)}{\exp(-x)-1}(x_t-x) \quad (8)$$

Setting $[\exp(-x)-1]=\rho_c$ [4], we get:

$$\ln[\exp(-x_t)-1]\approx\ln(\rho_c)-\left(\frac{\rho_c+1}{\rho_c}\right)x+\left(\frac{\rho_c+1}{\rho_c}\right)(c_t-w_t) \quad (9)$$

Where ρ_c represents the steady state ratio of invested wealth, to total consumption $(W-C)/C$

Substituting this expression (9) into (7) yields:

$$-r_{w,t+1}=(c_{t+1}-w_{t+1})-\pi_{t+1}-\Delta c_{t+1}+\delta+\left(\frac{\rho_c+1}{\rho_c}\right)(c_t-w_t) \quad (10)$$

With $\delta=\ln(\rho_c)-\left(\frac{\rho_c+1}{\rho_c}\right)x$, a constant.

Solving (10) for (c_t-w_t), yields:

$$(c_t-w_t)=\left(\frac{\rho_c}{\rho_c+1}\right)(\pi_{t+1}+\Delta c_{t+1}-r_{w,t+1}-\delta)-\left(\frac{\rho_c}{\rho_c+1}\right)(c_{t+1}-w_{t+1}) \quad (11)$$

[4] $\rho_c=1$ could suggest for example that consumption and savings / investments are equal at the steady state, with savings/investments defined as $(W-C)$.

Solving this equation (11) forward yields:

$$(c_t - w_t) = \left(\rho_c \Big/ \rho_c + 1 \right) \left(\pi_{t+1} + \Delta c_{t+1} - r_{w,t+1} - \delta \right) + \left(\rho_c \Big/ \rho_c + 1 \right)^2 \left(\pi_{t+2} + \Delta c_{t+2} - r_{w,t+2} - \delta \right) + \dots$$

$$+ \left(\rho_c \Big/ \rho_c + 1 \right)^i \left(\pi_{t+i} + \Delta c_{t+i} - r_{w,t+i} - \delta \right) - \left(\rho_c \Big/ \rho_c + 1 \right)^i \left(c_{t+i+1} - w_{t+i+1} \right)^i \qquad (12)$$

Imposing the transversality condition that as $i \to \infty$, the last term of (12) tends to 0, i.e,

$\left(\rho_c \Big/ \rho_c + 1 \right)^i \left(c_{t+i+1} - w_{t+i+1} \right) \to 0$, equation (12) becomes therefore:

$$\left(c_t - w_t \right) = \sum_i^{\infty} \left(\rho_c \Big/ \rho_c + 1 \right)^i \left(\pi_{t+i} + \Delta c_{t+i} - r_{w,t+i} \right) + \left(\delta \Big/ \rho_c + 1 \right) \qquad (13)$$

Setting $\left(\rho_c \Big/ \rho_c + 1 \right) = \beta$, then taking the expectation from both sides of (13) and eliminating the constant, we get:

$$\left(c_t - w_t \right) = E_t \sum_{i=1}^{\infty} (\beta)^i \left(\pi_{t+i} + \Delta c_{t+i} - r_{w,t+i} \right) \qquad (14)$$

Where, $0 \le |\beta| \le 1$.

Considering the wealth decomposition into financial assets, tangible assets, and human assets, the left hand side of this equation can be transformed accordingly and the model becomes:

$$(c_t - \alpha_f f_t - \alpha_\tau \tau_t - \alpha_y y_t) = E_t \sum_{i=1}^{\infty} (\beta)^i \left(\pi_{t+i} + \Delta c_{t+i} - r_{w,t+i} \right) \qquad (15)$$

Where the parameters α_f, α_τ, and α_y are theoretically supposed to be equal to the shares of financial assets, tangible assets, and labor income, ω_f, ω_τ, and $\left(1 - \omega_f - \omega_\tau \right)$ respectively.

Expression (15) relates the consumption-wealth ratio to expected future inflation, the expected future consumption growth, and the expected future aggregate wealth return. It suggests that if there's a change to the consumption-wealth ratio, this change could be due to a change in future inflation or, to a change in future consumption growth or, to a change in future aggregate wealth return or, to some combination of the three. Therefore the consumption wealth-ratio could predict future inflation or, future consumption growth or, future aggregate wealth returns, some combination of the three, or none of the three individually. Alternatively, the current consumption-wealth ratio could reflect agents' rational forecasts of either expected future inflation, expected future consumption growth, expected future aggregate wealth returns, or some combination of these. In other words, considering our wealth decomposition, if c_t, f_t, τ_t, and y_t are cointegrated, then it should be the case that the cointegrating residuals predict the long run trend of the combination of these four variables. They may also alternatively be looked at, as reflecting long-term rational expectations by agents, of future inflation, future consumption growth, future asset returns, or some combination of these.

7.7 Details on the P-T decomposition of our variables

We depart from the estimates of the vector of the adjustment coefficients γ, and the vector of cointegration coefficients α.

$$\gamma = \begin{pmatrix} -0.00728 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \alpha = \begin{pmatrix} 1 \\ 0.0124 \\ -0.6231 \\ -0.4525 \end{pmatrix}$$

Then we determine the matrix $\gamma\gamma'$, and the matrix $\alpha\alpha'$ as follows:

$$\gamma\gamma' = \begin{pmatrix} 0.53 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \qquad \alpha\alpha' = \begin{pmatrix} 1 & 0.0124 & -0.6231 & -0.4525 \\ 0.0124 & 0.0002 & -0.0077 & -0.0056 \\ -0.6231 & -0.0077 & 0.3883 & 0.2819 \\ -0.4525 & -0.0056 & 0.2819 & 0.2047 \end{pmatrix}$$

The orthogonal matrices $\gamma_\perp$ and $\alpha_\perp$ are determined by taking the eigen vectors associated with the $n-r$ lowest eigen values of $\gamma\gamma'$ and $\alpha\alpha'$, as in Gonzalo and Ng, and we get:

$$\gamma_\perp = \begin{pmatrix} 0 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad \alpha_\perp = \begin{pmatrix} -0.5889 & 0.0158 & 0.1589 \\ -0.0162 & -0.9998 & -0.0097 \\ -0.4662 & -0.0044 & 0.7341 \\ -0.6600 & 0.0136 & -0.6601 \end{pmatrix}$$

● The Matrix G used in order to achieve the P-T decomposition, by Gonzalo and Ng (2001), is determined as follows:

$$G = \begin{bmatrix} \gamma_\perp' \\ \alpha' \end{bmatrix} \begin{matrix} (n-r)\times n \\ r \times n \end{matrix} \Leftrightarrow G = \begin{bmatrix} \gamma_\perp' \\ \alpha' \end{bmatrix} \begin{matrix} (4-1)\times 4 \\ 1 \times 4 \end{matrix} \Leftrightarrow G = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0.0124 & -0.623 & -0.4525 \end{pmatrix}$$

$$G^{-1} = \begin{pmatrix} -0.0124 & 0.623 & 0.4525 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

● Following Gonzalo and Granger (1995), the P-T decomposition of a system X_t, can be obtained according to the following:

$$\underset{n\times 1}{X_t} = \underset{n\times k}{A_1}\underset{k\times n}{\gamma'_\perp} X_t + \underset{n\times r}{A_2}\underset{r\times n}{\alpha'} X_t, \text{ with } k = n - r \text{ and where:}$$

$$A_1 = \alpha_\perp(\gamma'_\perp \alpha_\perp)^{-1} \text{ and } A_2 = \gamma(\alpha'\gamma)^{-1}$$

In our case we have to decompose X_t into $\underset{4\times 1}{X_t} = \underset{4\times 3}{A_1}\underset{3\times 4}{\gamma'_\perp} X_t + \underset{4\times 1}{A_2}\underset{1\times 4}{\alpha'} X_t$.

$$(\gamma'_\perp \alpha_\perp) = \begin{pmatrix} -0.0162 & -0.9998 & -0.0097 \\ -0.4662 & -0.0044 & 0.7341 \\ -0.6600 & 0.0136 & -0.6601 \end{pmatrix}$$

$$A_1 = \alpha_\perp(\gamma'_\perp \alpha_\perp)^{-1} = \begin{pmatrix} -0.0124 & 0.6231 & 0.4524 \\ 1 & 0 & 0 \\ -0.0 & 1 & -0.0 \\ -0.0 & 0 & 1 \end{pmatrix}$$

The Permanent Components in our system are determined by $A_1\gamma'_\perp X_t$, as following:

$$A_1\gamma'_\perp X_t = \begin{pmatrix} 0 & -0.0124 & 0.6231 & 0.4524 \\ 0 & 1 & 0 & 0 \\ 0 & -0.0 & 1 & -0.0 \\ 0 & -0.0 & 0 & 1 \end{pmatrix}\begin{pmatrix} c_t \\ f_t \\ \tau_t \\ y_t \end{pmatrix}$$

In order to determine the transitory component, we proceed as follows:

$$(\alpha'\gamma) = (-0.0073)$$

Then we determine A_2 as following:

$$A_2 = \gamma(\alpha'\gamma)^{-1} = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Now the Transitory component of our system is given by $A_2\alpha' X_t$, as below:

$$A_2\alpha' X_t = \begin{pmatrix} 1 & 0.0124 & -0.6231 & -0.4525 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} c_t \\ f_t \\ \tau_t \\ y_t \end{pmatrix}$$

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