Long-Term Disability Claims Rates and the Consumption-to-Wealth Ratio

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Abstract

A framework for linking long-term disability (LTD) claims rates to the macro-economy using the consumption-to-wealth ratio is developed from financial economic and option theories. Financial economic theory suggests that the consumption-to-wealth ratio reflects consumption smoothing and reveals expectations about future wealth. For individuals contemplating submitting an LTD claim, the expected payoff to exercising this insurance option is a function of their expectations about their future wealth. The lower (higher) their expectations about future wealth, the higher (lower) the expected payoff, and the higher (lower) claims rates are likely to be. Using cointegration analysis, we find that LTD claims rates and the consumption-to-wealth ratio are linked in a long-run equilibrium. When the consumption-to-wealth ratio is high (low), LTD claims rates are low (high).

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I. Introduction

This paper launches an empirical investigation into the relationship between group long-term disability (LTD) insurance claims rates and the economy using the consumption-to-wealth ratio. The consumption-to-wealth ratio for the typical individual varies over the business cycle and incorporates a significant amount of information, especially as it relates to economic conditions and expected future wealth. A high consumption-to-wealth ratio represents strong consumption relative to current wealth and is interpreted to reflect lower risk aversion on the part of individuals or expectations of higher future wealth.[1] A low consumption-to-wealth ratio occurs when consumption is weak relative to current wealth. It reflects a more risk-averse attitude lower expectations or lower expectations about future wealth. If individuals optimize their current and expected consumption/savings plans, then the consumption-to-wealth ratio summarizes the vast, economy-wide information set used to make their economic decisions.

The connection between LTD claims rates and the consumption-to-wealth ratio becomes clear when it is understood that LTD insurance is designed to hedge the risks associated with a significant drop in consumption due to the possibility of a future disabling event. It is well known in the financial economics literature [see, for example, Abel (1990), Campbell, Lo, and MacKinlay (1997), Campbell and Cochrane (1999), Cochrane (2001), Lettau and Ludvigson (2001), Lustig and Van Nieuwerburgh (2005)] that individuals dislike consumption volatility, especially drops in consumption. Individuals develop consumption habits over the long run in which they strive to increase, and at a minimum maintain, their standard of living over time.

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[1] We do not rule out the possibility that individuals can have some combination of lower risk aversion *and* expectations of higher future wealth when the consumption-to-wealth ratio is high. Similarly, individuals can have some combination of higher risk aversion and expectations of lower future wealth when the consumption-to-wealth ratio is low.

They dread recessions, when the possibility of unemployment rises, placing their future consumption - and the wealth needed to support that consumption - in jeopardy.[2]

Whether measured on an individual or aggregate macro-economic level, the consumption-to-wealth ratio is equal to total consumption divided by total wealth. Total consumption here is defined as expenditures on nondurable goods, durable goods, and services, and represents one of the most important variables in measuring the economic well-being of an individual or an economy. Wealth is defined as total quarterly income plus the market value of housing.[3] Wealth here can be viewed as both an immediate and a long-run source of funds for consumption.

Including the value of housing in wealth assumes that individuals consciously or unconsciously realize its potential as a self-insurance mechanism that can help smooth consumption in case of a disability, despite its illiquid nature.[4] Indeed, a Federal Reserve study by Greenspan and Kennedy (2005) shows that U.S. consumers do have access to their housing wealth; home equity extraction, net of closing and related costs, amounted to $439.5 billion in 2002, or 8.10% of disposal income. Thus, the value of one's house can play an important role in economic decisions, especially those related to maintaining consumption levels.

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[2] Much of this literature is tied directly to stock market research in which consumers are hypothesized to use the stock market as a mechanism to smooth their consumption intertemporally.

[3] Potential endogenity problems are avoided by excluding household debt in our analysis. Debt levels do play a role in one's ability to extract housing equity for consumption. However, we are arguing that the consumption-to-wealth ratio is forward looking and that higher (lower) levels of housing value represent an increase (decrease) in expected future wealth and the ability to smooth consumption in the future.

[4] In countries where home equity extraction is difficult, households are often forced to sell assets to finance consumption during a disability. For example, Gertler and Gruber (2002), using panel data from Indonesia, state that individuals in developing countries often do not have access to formal insurance markets and, therefore, rely on selling assets, among other things, to maintain consumption. They find that family consumption can fall significantly due to major illness if the household is poorly self-insured.

The relationship between group LTD claims rates and the economy depends, in part, on workers contemplating the submission of a claim while they endure a condition over a period of time. During this period they may be evaluating the costs and benefits of filing a claim based, in part, on their expectations for their job and the general economy. The magnitude of this situation should not be overlooked. According to the 2004 American Community Survey conducted by the U.S. Census Bureau, more than 2.0 million people between the ages of 21and 64 indicated that they had a physical, mental, or emotional condition lasting six months or more that made it difficult for them to work at a job or business, yet were still employed.[5] This finding suggests that many individuals have sufficient time to evaluate their economic situation before submitting a claim.

When an uninsured person has a condition that precludes him from working, it implies substantial risk to that individual's future consumption as his labor income is eliminated, and increases the possibility that his house may have to be sold to pay for living and medical expenses. An LTD insured person, however, has an option. That option is valuable because it has the potential to smooth and maintain consumption in the case of a disabling event, with minimal effects on future wealth. When an individual fears a downturn in the future due, for example, to pending unemployment, he tends to reduce consumption today relative to his current wealth in expectation of difficult times. This behavior represents consumption smoothing. The individual is increasing his savings (wealth) today in anticipation of having to use that extra savings in the near future so that consumption does not fall as much as it would otherwise. If this individual is suffering from a condition that precludes him from fully performing his job at the current time,

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[5] The Census Bureau data do not provide information about the insurance situation of these individuals. The data do suggest, however, that people work with conditions that preclude them from fully performing their jobs over long periods of time.

the expected payoff from exercising the option and filing an LTD claim increases. The filing of a claim reduces an individual's risk of a large drop in future consumption or a loss of future wealth. Thus, LTD claim submission is expected to be high when the consumption-to-wealth ratio is low, indicating that future consumption or wealth may be at risk. Similar reasoning suggests that low claims submissions are associated with a high consumption-to-wealth ratio.

The purpose of this paper is to explore the ability of the consumption-to-wealth ratio to predict LTD submitted claims rates across groups of individuals with different income levels. We postulate that individuals from different income levels are subject to different economic risks, and they view these risks, and the ability of LTD to mitigate them, differently.[6] Using cointegration analysis we find that LTD claims rates and the consumption-to-wealth ratio for each income group are in a long-run equilibrium. When disequilibria do occur over the short run, as LTD claims rates and the consumption-to-wealth ratio are subject to different shocks, claims rates and the consumption-to-wealth ratio subsequently adjust so that the system reverts to its long-run relationship.

There is very little academic research on private LTD insurance claims rates, especially as it relates to the macro-economy. One of the main contributions of this paper to the insurance literature is that it develops a macro-consumption-based platform on which to analyze disability insurance. Much of the disability insurance literature examines SSDI using labor models as an individual typically must first be unemployed to collect payment.[7]

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[6] For example, Autor and Duggan (2003) suggest that the gradual decline in the demand for less skilled nonelderly workers (likely to be low-income workers) in the U.S. over the past several decades led to an increase in the social security disability insurance (SSDI) earnings replacement rate for high school dropouts and an increase in SSDI applications and receipts after 1984.

[7] In addition, Autor and Dugan (2006) state that the Social Security Administration application process focuses primarily on the applicant's ability to work, rather than his medical condition, leading the authors to question whether SSDI is actually a form of unemployment insurance.

The remainder of this paper is organized as follows: Section II develops the relationship between LTD claims rates and the consumption-to-wealth ratio using option theory. Section III describes the LTD claims rates and data used to compute the consumption-to-wealth ratio. Since the LTD claims rates that we are examining cover a wide cross-section of individuals with varying levels of income, we employ consumption and wealth data from the Consumer Expenditure Survey (CEX). The CEX publishes consumption, total income, and market value of housing data categorized by consumer income quintiles. We estimate the consumption-to-wealth ratio for each income quintile as well as national aggregate data for benchmarking purposes. Section III also discusses and shows the results of unit root tests for each series to establish the level of integration. Section IV presents and discusses the results for two cointegration techniques used for testing the long-run relationship between LTD claims rates and the consumption-to-wealth ratio. In Section V, we conclude the paper.

II. Option Theory

LTD insurance policies are options that give the holder the right, but not the obligation, to exchange his future labor income stream for the LTD payments. The value of the option increases as the expected future wealth drops.[8] In other words, the option increases in value as its payoff increases. As the payoff of the option increases, the likelihood of submitted claim increases. The relationship is captured in the following equation:

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[8] LTD policies are basically put options. Like stock put options, the payoff increases as the value of the underlying asset falls.

$$LTD\ expected\ payoff = (LTD\ payments - expected\ future\ wealth) \quad (1)$$

The main difficulty with operationalizing this equation and connecting it to the economy is that the LTD expected payoff, LTD payments, and expected future wealth for the whole economy, its sectors, or even an individual are unobservable. With a few assumptions, we manipulate (1) into a testable equation suitable for regression analysis.

First, we assume that LTD payoff, or payments per claim, are independent of the business cycle:

$$LTD\ payoff_t = \forall_1 \quad (2)$$

where $\forall_1$ is a constant. Since the consumption-to-wealth ratio is forward-looking and varies over the business cycle, we assume that this quarter's expectation for future wealth is linearly related to the consumption-to-wealth ratio (*cw*) at time *t*:

$$E_t\ (future\ wealth) = \forall_2 + \exists_2(cw_t) + ,_{2,t} \quad (3)$$

where $\forall_2$ is a constant, $\exists_2$ is the slope of the equation, and $,_{2,t}$ is white noise. This equation states that when the consumption-to-wealth ratio is high (low), individuals are less (more) risk-averse or expect higher (lower) levels of future wealth. In other words, consumption begins to increase (decrease) this quarter, relative to this quarter's wealth, ahead of increases (decreases) in expected future wealth.[9] We next assume that the expected payoff is linearly related to LTD claims rates, ($LTD_{CR,t}$):

$$E_t(LTD\ payoff) = \forall_3 + \exists_3(LTD_{CR,t}) + ,_{3,t} \qquad (4)$$

Substituting equations 2, 3, and 4 into 1 results in the relation:

$$\forall_3 + \exists_3(LTD_{CR,t}) + ,_{3t} = \forall_1 - (\forall_2 + \exists_2(cw_t) + ,_{2t}) \qquad (5)$$

Rearranging and consolidating the errors terms into $,_t$ results in the following relation, which is the basis for our empirical testing:

$$LTD_{CR,t} = constant - \exists_{cw}(cw_t) + ,_t \qquad (6)$$

where the constant equals $(\forall_1 - \forall_2 - \forall_3)/b_3$ and $\exists_{cw} = b_2/b_3$. This equation states that there is an inverse relationship between the level of the consumption-to-wealth ratio and the level of

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[9] At times in the paper we motivate the discussion by referring to consumer habits and time-varying risk aversion. Habits and time-varying risk aversion are consistent with a time-varying consumption-to-wealth ratio. Our model, however, does not require habit preferences nor does it require risk aversion to varying over time. The preference requirements of our model are that the consumer is rational, forward-looking, and risk averse. A risk averse individual prefers smooth consumption to volatile consumption. All else being equal, a forward-looking risk-averse individual will increase consumption this quarter if wealth is expected to increase in the future, rather than wait and increase consumption abruptly in the quarter in which wealth reaches a higher level. A forward-looking risk averse individual will decrease consumption this quarter if wealth is expected to fall in the future and so that consumption does not fall so abruptly in the future. Thus, the main ideas and conclusions of this paper hold regardless of whether the consumer maintains habits or exhibit time-varying risk aversion. See Lettau and Ludvigson (2001), Campbell, Lo, and MacKinlay (1997, chapter 8), Campbell and Cochrane (1999), Cochrane (2001, page 444) for a detailed discussion of modeling these preferences.

claims rates. With a high consumption-to-wealth ratio, individuals with a condition, but who are still working, may postpone submitting a claim until economic conditions are such that the expected payoff to their LTD payments reaches a threshold. When economic conditions are poor and the payoff on the LTD option is high, submitted claims are likely to be high. Each of the variables in this relationship may be subject to shocks that may temporarily pull them apart; however, over the long run, claims rates should adjust to maintain a long-run equilibrium with the consumption-to-wealth ratio.

While LTD insurance represents an option to maintain an individual's long-run consumption, it makes sense to estimate equation (6) on an aggregate basis. By aggregating over many individuals, we should see a statistical relationship between aggregate claims rates and aggregate consumption-to-wealth ratios.

III. Data Description

A LTD claim is submitted to the insurer, Unum Group, after an elimination (grace) period of typically 90 to 180 days from the date of a disabling event. Typically, a person is considered disabled when it is determined that he is limited from performing the material duties of his regular occupation due to sickness or injury and has had a loss of 20 percent or more in monthly earnings due to that sickness or injury. Each of the time series of quarterly submitted claims rates is constructed by dividing the number of submitted claims in a quarter by the number of lives covered in that quarter. Two industries, as defined by SICs, are studied: manufacturing and wholesale/retail. Approximately 68.4 and 35.5 million life-quarters, for manufacturing and wholesale/retail respectively, are covered by the LTD policies during the 61-quarter sample period. The sample ranges from the first quarter of 1988 to the first quarter of 2003. These group policies were issued by Unum to companies of various sizes, ranging from several employees to thousands of employees, across the United States, Canada, and Puerto Rico.[10] In the manufacturing and wholesale/retail sectors, 77,218 and 44,198 claims, respectively, were submitted to the insurer during the entire sample period. We have no reason to believe any structural shifts occurred in the manufacturing and wholesale/retail sectors of Unum's LTD business that would have a significant impact on the econometric analysis of claims rates over the sample period.

We perform both augmented Dickey-Fuller (1979) and Phillips-Perron (1988) unit root tests on the claims rates in Table 1 to establish the order of integration. These traditional tests have a unit root (nonstationarity) as the null hypothesis. While the Dickey-Fuller unit root test seems to be the preferred method in the literature, we also employ the Phillips and Perron unit root test since it is more robust to autocorrelation.[11] The estimated *t*-test statistics, based on a process that includes a constant and trend, are larger (smaller in absolute value) than the critical values at the 5 percent significance level for both unit root tests for each variable. Thus, we are unable to reject the null hypothesis of a unit root with the traditional tests and conclude that each series is an *I(1)*.

The traditional unit root tests discussed above are known to have low power in their ability to reject the null hypothesis of nonstationarity. Kwiatkowski, Phillips, Schmidt, Shin (1992), KPSS, developed a unit root test with stationarity as the null hypothesis. The KPSS test results are presented at the bottom of Table 1. We reject the null hypothesis of stationarity for each claims rates series. Based on the stationarity tests, therefore, we conclude that

[10] Policy-level time series data profiling the individual group policyholders over the 61 quarters were not available to the researchers. While the manufacturing and wholesale/retail sectors represent a significant portion of Unum's portfolio, time series data for other sectors covering the 61-quarter sample period were not available to us.

[11] Compared to the CEX data, the national consumption-to-wealth ratio is relatively smooth and exhibited a substantial amount of autocorrelation, making estimation and inference a challenge.

manufacturing claims rates and wholesale/retail claims rates each are nonstationary.

Growth rates and standard deviations for consumption, income, and the market value of housing series, sorted by income quintiles, are shown in Table 2A. The data are from the Consumer Expenditure Survey (CEX), which is produced by the Bureau of Labor Statistics (BLS) and periodically covers 7,500 households throughout urban and rural areas of the United States.[12] The CEX reports quarterly household average income and expenditure details sorted by household income.[13] The CEX also publishes the average number of individuals in each household by income quintiles. Thus, all CEX data used in this paper are on a per capita basis.

The housing data in the CEX, however, are only compiled on an annual basis. We adjusted this data to capture quarterly variability by multiplying the annual prices by gross quarterly returns computed from a national real estate price index of single family homes published by the Office of Federal Housing and Enterprise Oversight (OFHEO). We deseasoned the consumption, income, and housing data series using SAS's X12 program.[14] Seasonally adjusted national per capita data are also employed in this paper for comparison to the CEX. Additional details on the data are discussed in the Data Appendix.

In terms of growth rate variability, the lower-income groups tend to exhibit the most volatility for all three variables, while the highest-income groups tend to have the lowest volatility. The national data in the last column is quite different from the CEX data. National consumption growth is higher than that of any individual income group, while the growth rate in

[12] Prior to 1999, 5,000 households were sampled.

[13] The BLS stopped publishing the CEX on a quarterly basis to the general public in 1999; however, quarterly reports are prepared internally and are available through our sample period. The income data for our paper comes from the CEX, which does not distinguish between the various types of income. Thus, our measure of income for each group does include capital gains from assets, interest, and dividend income.

[14] SAS's X12 program is adapted from the U.S. Census Bureau's ARIMA model for deseasoning economic time series.

the market value of housing is relatively low. All three variables exhibit substantially lower volatility for their growth rates compared to the CEX data.[15]

In Table 2B, we present the stationarity test results on the consumption-to-wealth ratio across the income groups. In the top of Table 2B we present two traditional unit root tests. We fail to reject the null hypothesis of a unit root for each group under the traditional testing methods. KPSS tests results are presented at the bottom of Table 2B and the null hypothesis of stationarity is rejected for each group.

Augmented Dickey-Fuller (1979) and Phillips-Perron (1988) unit root tests applied to the first differenced series (not shown) of the consumption-to-wealth ratios reject the hypothesis of a unit root. The Kwiatkowski et al. (1992) tests fail to reject the null hypothesis of stationarity. Thus, we conclude that each consumption-to-wealth ratio series is nonstationary in levels and is first-difference stationary.

IV. Cointegration Analysis

i. Background

Since we are dealing with nonstationary data, simply taking first differences and employing ordinary least squares regression analysis on the consumption-to-wealth ratio and

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[15] There are many reasons for the differences between the consumption estimates from the CEX and the consumption estimates from the National Income and Product Accounts (NIPA). According to Garner, et al. (2003), different populations are sampled. The CEX surveys noninstitutional households while the NIPA data covers a wider population. The CEX estimates may reflect under-reporting due to confusion on the part of survey respondents as to the portion of healthcare insurance premiums they pay verses those paid by their employer, and health care services provided by not-for-profit organizations. On an aggregate basis, we are unable to discover a reason why the under-reporting of health insurance costs and healthcare services provided by not-for-profit institutions would significantly impact our results. The inability of survey respondents to know the current market value of their homes, in part, can explain the difference between the CEX data and the national data from the OFHEO on home values. The OFHEO data source is limited in that it comes from conforming mortgage loan transactions supplied by Fannie Mae and Freddie Mac. Conforming loans must meet the underwriting standards set by these organizations and are limited to mortgages under $417,000 at the time of this writing. Thus, luxury home values are included in the CEX data, but not in the national data presented.

claims rates with the appropriate lags would represent a very strong test of equation (6). The relationship is not likely to be precise each period. In addition, with only first-differenced data, we would lose the information content embedded in the *level* of claims rates and in the consumption-to-wealth ratio. The solution to this problem is to employ cointegration analysis to test the long-run relation between LTD claims rates and the consumption-to-wealth ratio. In general, with bivariate cointegrated systems the variables in *levels* evolve over the long run in equilibrium. This equilibrium means that the two series share a common trend that is represented by a stationary linear combination of the variables. Applied to the situation at hand, LTD claims rates and the consumption-to-wealth ratio share a long-run common stochastic trend. Any disequilibria in the data are considered temporary. As such, the short-run dynamics of the system, captured by the first differences in the data, will adjust to the disequilibria to bring the system back onto its long-run common trend.

What could cause temporary disequilibria in the long-run relation between claims rates and the consumption-to-wealth ratio? Timing issues, measurement error, sampling error, and temporary exogenous shocks on each variable will cause slippage in the long-run relationship and prevent equation (6) from holding exactly in each period. Timing problems arise, for example, due to various LTD policy elimination periods, delays in obtaining the economic information needed to make decisions, differing rules for state unemployment benefits, and the presence of short-term disability insurance. Measurement error in claims rates may occur due to quarterly cut-off periods. Consumption and wealth measurement error may arise in surveys due to poor estimates on the part of individuals concerning their actual consumption, their total quarterly income, and the market value of their houses. Sampling error occurs because the data on consumption and wealth (total income and housing values) may not reflect the true population surveyed.

ii. Johansen and Juselius Cointegration Analysis

Johansen and Juselius (1990, 1992) have developed a cointegration technique that employs vector autoregression (VAR) estimation. We follow their procedures using LTD claims rates and the consumption-to-wealth ratio. The results are presented in Table 3 for manufacturing, Table 4 for wholesale/retail, and Table 6 for manufacturing and wholesale/retail claims rates combined with the unemployment rate. We entertained a variety of assumptions regarding lag length and deterministic components in order to obtain well-behaved residuals and results that made economic sense.

We focus first on the middle of Tables 3 and 4 to establish whether or not the data suggest a cointegrating relationship. Based on the trace statistics in the rank statistics section, which reflect a Barlett adjustment for small samples, we reject the null hypothesis of no cointegration at the 5 percent level. In other words, we reject the hypothesis that the rank order of the cointegrating vector is zero ($r = 0$).[16] The residuals are reasonably well behaved and support this conclusion. The normality test results are not significant, so we fail to reject the hypothesis of jointly normally distributed residuals for the system; in addition, the Lagrange Multiplier statistic for fourth-degree autocorrelation for each system is statistically insignificant at the 5 percent level.[17]

We now turn to the normalized cointegrating vector and speed-of-adjustment sections in Tables 3 and 4. Each $\exists_{cw}$ coefficient is positive and statistically significant at the 5 percent level.

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[16] In Table 3 for income quintile one, we reject the hypothesis of no cointegrating vectors at the 6 percent level.

[17] In Table 3 and Table 7, we reject normality for the residuals for income quintile five in the manufacturing section. A single outlier in the third quarter of 1989 is the source of the rejection. We re-estimated the model using the mean of manufacturing claims rates and obtained very similar results to those shown in Tables 3 and 7. Thus, we conclude that quintile five estimates shown in Tables 3 and 7 are relatively unaffected by the outlier.

In the speed-of-adjustment section we see that the estimates for $\forall_{LTD}$ for manufacturing and wholesale/retail claims rates are, respectively, all negative and statistically significant at the 5 percent level.[18] Thus, the estimates show that claims rates adjust to short-run disequilibrium between claims rates and the consumption-to-wealth ratio. The consumption-to-wealth ratio also generally adjusts to disequilibrium, with the exception of the national group in Tables 3 and 4.[19] The speed of adjustment for LTD claims rates generally is faster in groups one, four, and five and the national group. For example, in Table 3 claims rates are restored to equilibrium after about three quarters (1/0.337) for income quintile one, but five quarters (1/0.200) for income quintile two.

Each statistically significant speed-of-adjustment coefficient can be interpreted as a rejection of the null hypothesis of no "Granger-causality," see Granger (1969). Rejection of the hypothesis of no Granger-causality requires statistical significance in either the speed-of-adjustment coefficient or the coefficient ($\ni$ in Johansen and Juselius (1990, 1992)) that captures the change in the short-run dynamics (the first differences) of the variables in the system (not shown in the tables). We examined the corresponding $\ni$s for the national group in the consumption-to-wealth equation since the $\forall_{CW}$ coefficients are not statistically significant. The $\ni$s are statistically insignificant at the 5 percent level for the national group in Tables 3 and 4. Thus, we fail to reject the hypothesis that the consumption-to-wealth ratio for the national

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[18] The coefficients in the cointegrating vector shown in Tables 3, 4, and 6 are estimated within the context of an error correction term and, thus, have the opposite signs from what would normally be estimated outside a cointegrating model.

[19] Tables 3 and 4 show that the consumption-to-wealth ratio adjusts to the disequilibria, but only for the CEX data. In a bivariate system it is not uncommon for both adjustment coefficients to be statistically significant. An economically plausible interpretation, however, is difficult to provide here since it suggests that the consumption-to-wealth ratio for each CEX income group adjusts to the disequilibria between LTD claims rates and the ratio last quarter. The number of consumers represented in the consumption-to-wealth ratio for each quintile dwarfs the number of individuals filing LTD claims. Since the adjustment is isolated to the CEX, one possible explanation for the difference lies in the data gathering process of the CEX.

economy is not Granger caused by LTD claims rates. See Enders (1995) for a discussion of Granger-causality within cointegration models.

We further examine the model used in computing the estimates shown in Tables 3 and 4 by performing out-of-sample forecasts of claims rates and comparing the results to within-sample forecasts. The cointegrating-VAR models for manufacturing and wholesale/retail for each income quintile were estimated over the period 1988:1 - 2001:3. Within-sample forecasts for 1988:1 to 2001:3 (minus the lag effects) and the out-of-sample forecasts covered the last six quarters of the sample, roughly 10 percent, from 2002:4 to 2003:1. The results are shown in Table 5. In the top panel for manufacturing claims rates, the out-of-sample mean forecast errors are well under 1 percent and the root-mean-square errors are actually smaller than the within-sample period. The bottom panel shows similar results for wholesale/retail, although the mean forecast errors are slightly above 1 percent. Thus, we conclude that the cointegrating model used in Table 3 and 4 reasonably represents the claims rate process.

A competing hypothesis is that the unemployment rate is more closely linked to LTD claims rates than is the consumption-to-wealth ratio. Individuals fear unemployment and the negative effect it can have on their income. Table 6 presents cointegrating results for manufacturing and wholesale/retail claims rates combined plus the manufacturing and wholesale/retail unemployment rate included as an endogenous variable to the system. The results for $\exists_{cw}$, $\forall_{LTD}$ and $\forall_{CW}$ are very similar to Tables 3 and 4. The unemployment rate is negative in the cointegrating vectors for income quintile one and the national group, meaning that the variable is positively related to combined claims rates as expected. The unemployment rate coefficients are positive in the cointegrating vector for quintiles two and four, the opposite of what we expected. With the unemployment rate included we see that for the income quintile one, manufacturing claims rates adjusts in about three quarters (1/0.308), while it takes about nine quarters (1/0.109) for group three.

iii. Dynamic Ordinary Least Squares Cointegrating Regressions

We further investigate the cointegration relation between LTD claims rates and the consumption-to-wealth ratio using dynamic ordinary least squares (DOLS) developed by Stock and Watson (1993):

$$LTD_{CR,t} = \beta_0 + \beta_{cw}(cw_t) + \sum_{i=-k}^{k} \beta_{cw,i}\Delta(cw_{t-i}) + \varepsilon_t \quad (7)$$

LTD_{CR} represents log LTD claims rates, *cw* the log consumption-to-wealth ratio, and) a difference operator. Both leads and lags are included in (7) to rid the effects of the short-run dynamics on the $\exists_{cw}$ estimates.[20] The results for the DOLS cointegrating regressions are shown in Table 7. The $\exists_{cw}$ coefficients are negative in accordance with our expectations developed in equation (6). When consumption increases relative to current wealth, for example, claims rates will fall as individuals are more comfortable about maintaining their future consumption levels. Cointegration requires that the residuals *,* be stationary.

At the bottom of each section of the table are Philips-Ouliaris *Z*-statistics for unit root tests on the residuals. The null hypothesis of a unit root is rejected based on the critical values at the 5 percent significance level. Doornik and Hansen (1994) normality statistics are also shown at the bottom of each section in Table 7. We fail to reject the hypothesis that the residuals are

20 The leads and lags in (7) reduce the effects of regressor endogenity on the cointegrating parameter estimates. Furthermore, the cointegrating parameter estimate of $\exists_{cw}$ converges to its true parameter at a rate of T rather than $T^{1/2}$ so that the effects of simultaneous equation bias are eliminated asymptotically. See Stock (1987) and Stock and Watson (1993).

normally distributed at the 5 percent significance level for nearly all regressions.[21] Therefore, from the results in Table 7 it appears that across income groups, LTD claims rates and the consumption-to-wealth ratio share a long-run common trend.[22]

We test the hypothesis that the unemployment rate is positively related to claims rates by augmenting the DOLS cointegrating regressions with the log of the national unemployment rate.[23] The results are shown in Table 8. The unemployment rate is positive, as expected, and statistically significant for income quintile one, two, three, and the national group for manufacturing claims rates and for quintile one and the national group for wholesale/retail. The unemployment rate tends not to be significant for wholesale/retail in the higher-income quintiles.

Comparing the results of Tables 7 and 8 shows that, in general, adding the unemployment rate to the system reduces the magnitude, but does not eliminate the statistical significance, of the consumption-to-wealth ratio in explaining claims rates. Comparing the unemployment estimates by income quintile in Table 8 we obtain mixed results, except for the lowest income and national groups. In other words, we consistently fail to reject the hypothesis that the unemployment rate is cointegrated with claims rates only for the lowest-income quintile and the

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[21] The rejection of the normality hypothesis for the income quintile five manufacturing regression residual is the result of a single outlier in the third quarter of 1989. We re-estimated the regression by substituting the mean of manufacturing claims rates for actual claims rates for that date. The parameter estimate for $\exists_{cw}$ was -1.683 with a t-statistic of -8.953; the E_p normality statistic was 2.033 with significance of 0.362; and Z_p = -36.438 and Z_t = -5.206. Thus, the impact of the outlier on our results is relatively immaterial.

[22] One would expect the national column estimate for the $\exists_{cw}$ coefficient to be in the range of the CEX quintile data, but that is obviously not the case here. The national data, as seen in Table 2A, exhibit very low volatility compared to the CEX data, resulting in large $\exists_{cw}$ coefficients. The apparent smoothness in national consumption data has not gone unnoticed in the financial economic literature. See Cochrane (2001) and Flavin (1993).

23 Dickey-Fuller, Phillips-Perron, and KPSS stationarity tests were employed on each of the manufacturing and wholesale/retail unemployment rates. We were unable to reject the hypothesis of a unit root in each unemployment rate series using the Dickey-Fuller and Phillips-Perron tests and rejected the hypothesis of stationarity in the KPSS tests. Results are not shown.

national group.[24]

Table 9 shows DOLS regression results for manufacturing and wholesale/retail claims rates, combined on an equal weighted basis, plus the unemployment rate in the cointegrating space.[25] The results for income quintile one, three, and the national group show a positive relationship between the unemployment rate claims rates. One possible inference that we can make from Tables 8 and 9 with dynamic ordinary least squares estimates that include the unemployment rates is that the claims rates-unemployment rate relationship on the national level is driven primarily by the lowest income group.

iv. Discussion

The cointegration results provide an important insight into how LTD claims rates are connected to the economy. We may interpret the results as suggesting that claims rates and the consumption-to-wealth ratio (in levels) are in equilibrium in the long run. When the consumption-to-wealth ratio is low, claims rates are high. This occurs when individuals have low expectations about their future wealth and concerns about their ability to maintain consumption habits. The low expectations for future wealth imply a higher expected payoff to exercising their LTD insurance option. When the consumption-to-wealth ratio is high individuals have high expectations for future wealth, are less concerned about their ability to maintain the consumption habit, and the perceived expected payoff to filing a LTD claim decreases. Claims rates are then low. When the two series pull apart (in disequilibrium) temporarily, the short-run dynamics

[24] It is likely that the lowest income group is economically constrained and members are unable to fully manipulate their consumption-savings plan in anticipation of a drop in future wealth. Their consumption is often equal to their income. Thus, their consumption-to-wealth ratio does not fully incorporate all the economic information at hand, allowing the unemployment rate to play a role in explaining claims rates.

[25] Changing the weights to reflect the number of lives covered in each sector does not materially impact our results or our conclusions.

(first-differences) are such that claims rates and the consumption-to-wealth ratio adjust to restore the system. The cointegration results presented in Tables 3, 4, 6, 7, and 8 may be interpreted as reinforcing the idea that individuals use LTD insurance as consumption insurance. This relationship appears robust for both manufacturing and wholesale/retail claims rates when unemployment rates are added to the analysis, across various income groups, and in the national data.

It is important to recognize that while we may often interpret these results at the individual level, our analysis and test results are based on aggregate data. At the individual level, the question of whether to submit a LTD claim or not is a discrete response. For any particular case, the decision to submit a claim primarily reflects an impairment with a small of consideration given to economic factors. That small consideration would be very difficult to detect and measure on an individual basis. On an aggregate basis, however, the weight placed on economic considerations becomes statistically noticeable via trends in claims rates.

V. Conclusion

This paper develops a link between LTD claims rates and the economy using the consumption-to-wealth ratio. The analysis is based on previous financial economic literature that finds that individuals are risk-averse, seek to maintain consumption habits, and prefer smooth consumption over volatile consumption. Their current and expected wealth reflects their ability to maintain smooth consumption in the future. When consumption increases (drops) relative to current wealth, it reflects higher (lower) expectations on the part of individuals about their own personal economic well-being or the economy in aggregate. Consumption tends to increase this quarter relative to today's wealth rather than abruptly increasing next quarter when the increase in wealth is realized.

The U.S. Census Bureau reports that there are more than two million individuals who are impaired by a disability that has lasted at least six months and who are currently "at a job." Provided they are insured, these individuals over a significant period of time have the occasion to consciously or unconsciously evaluate the expected payoff of submitting a LTD claim based, in part, on economic considerations. That expected payoff increases when individuals become concerned about their future economic well-being. We measure that concern using the consumption-to-wealth ratio.

LTD insurance represents an option with the potential to smooth consumption over time. A time series of LTD submitted claims rates aggregated over many people represents a history of people exercising these options. Using this history, we find that when the consumption-to-wealth ratio is low, claims rates are high, and vice versa. We are unable to reject the hypothesis that LTD claims rates evolves over time in equilibrium with the consumption-to-wealth ratio. When there is disruption in the system, claims rates almost always, and the consumption-to-wealth ratio often, adjusts to restore equilibrium.

An important element of this paper is that we derive a financial economic framework and methodology for examining the connection between LTD claims rates and the macro-economy. We find that the connection is fairly strong and robust: it applies to two LTD sectors individually and combined, it applies to consumption-to-wealth ratios sorted by income and national data, and it holds up even when unemployment rates are included in the analysis. While our results are robust, we have examined only two industry sectors, manufacturing and wholesale/retail. Our paper, therefore, opens the door for further research in this area, including the application to other sectors.

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Table 1
Manufacturing and Wholesale/Retail
Long-Term Disability Claims Rates
Unit Root Tests
1988:1 to 2003:1

	Manufacturing LTD Claims rates	Wholesale & Retail LTD Claims rates
ADF unit root *t*-statistic (1)	-0.493	-0.493
PP unit root *t*-statistic (1)	-0.968	-0.956
Critical value at 5%	-3.475	-3.475
KPSS unit root statistic(2)	0.193	0.194
Critical value at 5%	0.146	0.146
Lags	4	4

(1) Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests reject the null hypothesis of a unit root if the *t*-statistic is larger than the critical value. Critical value was simulated assuming a constant, a trend, and 61 observations, using 10,000 repetitions. Lag lengths were selected based on a review of the Akaike and Schwartz's Bayesian criteria in conjunction with the periodicity of the data (quarterly).
(2) Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test rejects the null hypothesis of stationarity if the statistic is larger than the critical value.

Table 2
Panel A
Income, Consumption, and Market Value of Housing
Quarterly Descriptive Statistics in Percent
1988:1 to 2003:1

	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
Consumption:						
Growth Rate	0.003	0.003	0.003	0.004	0.003	0.005
Std Deviation	0.054	0.037	0.030	0.036	0.029	0.005
Income:						
Growth Rate	0.003	0.003	0.004	0.004	0.004	0.004
Std Deviation	0.051	0.028	0.024	0.025	0.020	0.008
Market Value of Housing:						
Growth Rate	0.005	0.007	0.008	0.008	0.009	0.004
Std Deviation	0.057	0.038	0.032	0.031	0.029	0.008

Panel B
Unit Root Tests Consumption-to-Wealth Ratios
1988:1 to 2003:1

	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
ADF unit root *t*-statistic (1)	-2.867	-1.973	-2.601	-0.787	-2.288	-1.119
PP unit root *t*-statistic (1)	-2.817	-2.628	-2.350	-1.783	-2.439	-1.176
Critical value at 5%	-3.475	-3.475	-3.475	-3.475	-3.475	-2.892
KPSS unit root statistic(2)	0.390	0.273	0.257	0.302	0.261	0.351
Critical value at 5%	0.146	0.146	0.146	0.146	0.146	0.146
Lags	4	4	4	4	4	4

(1) Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests reject the null hypothesis of a unit root if the *t*-statistic is larger than the critical value. Critical value was simulated assuming a constant, a trend, and 61 observations, using 10,000 repetitions. Lag lengths were selected after a review of the Akaike and Schwartz's Bayesian criteria in conjunction with the periodicity of the data (quarterly).
(2) Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test rejects the null hypothesis of stationarity if the statistic is larger than the critical value.

Table 3
Johansen & Juselius Cointegration Tests
Manufacturing Claims Rates
1988:1 to 2003:1

	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
Model						
Deterministic component	cidrift	cidrift	cidrift	cidrift	cidrift	cidrift
VAR Lags	2	2	2	2	2	3
Normalized C.I. Vector:						
$\exists_{LTD}$	1.000	1.000	1.000	1.000	1.000	1.000
t-statistic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\exists_{CW}$	1.522	2.798	3.259	2.712	2.097	4.424
t-statistic	(6.475)	(5.706)	(5.799)	(8.847)	(12.225)	(11.357)
Trend	0.001	0.003	0.003	0.003	-0.000	-0.011
t-statistic	(1.347)	(2.193)	(2.086)	(3.380)	(-0.448)	(-12.680)
Speed-of-Adj.Vector:						
$\forall_{LTD}$	-0.337	-0.200	-0.255	-0.458	-0.427	-0.928
t-statistic	(-2.792)	(-2.082)	(-2.914)	(-4.881)	(-4.142)	(-5.882)
$\forall_{CW}$	-0.324	-0.255	-0.237	-0.364	-0.506	0.022
t-statistic	(-3.861)	(-5.687)	(-5.701)	(-7.552)	(-9.877)	(-1.625)
Rank statistics:	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 0$
Eigenvalue	0.315	0.374	0.387	0.543	0.664	0.395
Trace statistic	25.391	29.866	30.759	47.806	65.001	31.667
p-value	0.055	0.013	0.010	0.000	0.000	0.007
	$r = 1$	$r = 1$	$r = 1$	$r = 1$	$r = 1$	$r = 1$
Eigenvalue	0.065	0.055	0.052	0.056	0.054	0.103
Trace statistic	3.865	3.286	3.076	3.387	3.279	5.451
p-value	0.759	0.833	0.857	0.820	0.833	0.542
Residual Analysis:						
Normality test, $\Pi^2(4)$	5.357	4.481	5.496	4.339	11.397	1.846
Significance	(0.253)	(0.345)	(0.240)	(0.362)	(0.022)	(0.764)
Autocorrelation, LM, $\Pi^2(4)$	3.909	11.524	1.581	2.474	4.957	0.537
p-value	(0.418)	(0.028)	(0.812)	(0.649)	(0.292)	(0.970)

The term cidrift indicates a model with linear trends in the variables, a constant, and a trend in the cointegrating space; drift indicates a model with linear trends in the variables and a constant in the cointegrating space. In the cointegrating vector section, the $\exists_{CW}$ estimates roughly correspond (with an opposite sign) to the cointegrating parameter estimates in Table 7. Trace statistics and *p*-values reflect a Barlett correction for small sample size as derived in Johansen (2000) and Johansen (2002). In the speed-of-adjustment section, the alphas estimate the speed at which the variables are restored to their long-run equilibrium. In the rank statistics section, *p*-values smaller than 0.05 reject (with 5 percent significance level) the null hypothesis of no cointegration (r = 0) and suggest that the variables in the system are in a long-run relationship with each other. In the residual analysis section, the normality test is from Doornik and Hansen (1994) and includes a correction for small sample size, and LM represents a Lagrange Multiplier test for at least fourth-degree autocorrelation for the system residuals, where *p*-values that are smaller than 0.05 reject the null hypothesis is of no autocorrelation. The data used in creating this table are in logs and were estimated in CATS in RATS, version 2, by J.G. Dennis, H. Hansen, S. Johansen, and K. Juselius, Estima 2005.

Table 4
Johansen & Juselius Cointegration Tests
Wholesale/Retail Claims Rates
1988:1 to 2003:1

	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
Model						
Deterministic component	cidrift	drift	cidrift	drift	cidrift	cidrift
VAR Lags	2	1	1	2	2	1
Normalized C.I. Vector:						
$\exists_{LTD}$	1.000	1.000	1.000	1.000	1.000	1.000
t-statistic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\exists_{CW}$	1.951	3.414	4.465	3.055	2.704	4.543
t-statistic	(7.570)	(7.135)	(6.455)	(10.004)	(12.829)	(5.761)
Trend	-0.000		0.002		-0.003	-0.012
t-statistic	(-0.288)		(1.136)		(-4.638)	(-8.006)
Speed-of-Adj.Vector:						
$\forall_{LTD}$	-0.277	-0.126	-0.117	-0.280	-0.340	-0.513
t-statistic	(-2.998)	(-1.962)	(-2.067)	(-3.162)	(-3.788)	(-4.840)
$\forall_{CW}$	-0.326	-0.180	-0.164	-0.306	-0.422	-0.010
t-statistic	(-4.866)	(-5.352)	(-6.278)	(-6.636)	(-8.853)	(-1.239)
Rank statistics:	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 0$
Eigenvalue	0.374	0.369	0.419	0.468	0.640	0.294
Trace statistic	29.855	28.688	36.316	36.615	60.857	30.105
p-value	0.013	0.000	0.001	0.000	0.000	0.012
	$r = 1$	$r = 1$	$r = 1$	$r = 0$	$r = 1$	$r = 1$
Eigenvalue	0.056	0.024	0.069	0.013	0.053	0.149
Trace statistic	3.334	1.462	4.285	0.739	3.210	9.621
p-value	0.827	0.227	0.702	0.390	0.842	0.148
Residual Analysis:						
Normality test, $\Pi^2(4)$	2.279	1.054	3.631	2.530	6.349	6.439
Significance	(0.685)	(0.902)	(0.458)	(0.639)	(0.175)	(0.169)
Autocorrelation, LM, $\Pi^2(4)$	2.792	0.401	3.974	1.000	4.472	7.104
p-value	(0.593)	(0.982)	(0.410)	(0.910)	(0.346)	(0.130)

The term cidrift indicates a model with linear trends in the variables, a constant, and a trend in the cointegrating space; drift indicates a model with linear trends in the variables and a constant in the cointegrating space. In the cointegrating vector section, the $\exists_{CW}$ estimates roughly correspond (with an opposite sign) to the cointegrating parameter estimates in Table 7. Trace statistics and *p*-values reflect a Barlett correction for small sample size as derived in Johansen (2000) and Johansen (2002). In the speed-of-adjustment section, the alphas estimate the speed at which the variables are restored to their long-run equilibrium. In the rank statistics section, *p*-values smaller than 0.05 reject (with 5 percent significance level) the null hypothesis of no cointegration (r = 0) and suggest that the variables in the system are in a long-run relationship with each other. In the residual analysis section, the normality test is from Doornik and Hansen (1994) and includes a correction for small sample size, and LM represents a Lagrange Multiplier test for at least fourth-degree autocorrelation for the system residuals, where *p*-values that are smaller than 0.05 reject the null hypothesis is of no autocorrelation. The data used in creating this table are in logs and were estimated in CATS in RATS, version 2, by J.G. Dennis, H. Hansen, S. Johansen, and K. Juselius, Estima 2005.

Table 5

Within-Sample and Out-of-Sample Forecasts
for Manufacturing and Wholesale/Retail LTD Claims Rates

	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
Manufacturing						
Within-sample:						
1988:1 - 2002:3						
mean forecast error as a percentage of LTD claims rates	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
RMSE	0.071	0.076	0.075	0.068	0.069	0.054
Out-of-Sample:						
2002:4 - 2003:1						
mean forecast error as a percentage of LTD claims rates	-0.233%	-0.469%	-0.230%	0.216%	0.114%	-0.052%
RMSE	0.065	0.067	0.064	0.063	0.059	0.060
Wholesale/Retail						
Within-sample:						
1988:1 - 2002:3						
mean forecast error as a percentage of LTD claims rates	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
RMSE	0.070	0.076	0.076	0.073	0.069	0.070
Out-of-Sample:						
2002:4 - 2003:1						
mean forecast error as a percentage of LTD claims rates	1.006%	1.017%	1.169%	1.379%	1.150%	1.036%
RMSE	0.062	0.064	0.064	0.064	0.061	0.064

The cointegration-VAR model for each manufacturing and wholesale/retail claims rates series is based on the equations used to estimate the results in Table 3, except the estimation period is 1988:1 to 2002:3. The out-of-sample forecasts for claims rates cover the six quarters from 2002:4 to 2003:1. The data used in creating this table are in logs and were estimated in CATS in RATS, version 2,by J.G. Dennis, H. Hansen, S. Johansen, and K. Juselius, Estima 2005.

Table 6
Johansen & Juselius Cointegration Tests
Manufacturing and Wholesale/Retail Combined Claims Rates with
the Consumption-to-Wealth Ratio and the Sector's Unemployment Rate
1988:1 to 2003:1

	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
Model						
Deterministic component	cidrift	cidrift	cidrift	cidrift	cidrift	cidrift
VAR Lags	2	2	1	2	4	1
Normalized C.I. Vector:						
$\exists_{LTD}$	1.000	1.000	1.000	1.000	1.000	1.000
t-statistic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\exists_{CW}$	1.834	4.724	4.397	4.698	2.382	2.448
t-statistic	(13.254)	(5.971)	(7.028)	(11.382)	(15.143)	(3.664)
$\exists_{UE}$	-0.286	0.335	-0.098	0.337	0.017	-0.301
t-statistic	(-5.711)	(1.957)	(-0.638)	(3.903)	(0.385)	(-3.872)
Trend	-0.001	0.007	0.003	0.006	-0.001	-0.006
t-statistic	(-1.260)	(2.832)	(1.468)	(5.342)	(-3.141)	(-4.666)
Speed-of-Adj.Vector:						
$\forall_{LTD}$	-0.308	-0.080	-0.109	-0.262	-0.361	-0.254
t-statistic	(-2.621)	(-1.270)	(-2.123)	(-4.405)	(-4.051)	(-2.238)
$\forall_{CW}$	-0.586	-0.200	-0.178	-0.289	-0.538	-0.038
t-statistic	(-7.164)	(-6.007)	(-6.725)	(-8.932)	(-11.761)	(-4.504)
$\forall_{UE}$	-0.221	-0.000	-0.056	-0.096	-0.045	-0.145
t-statistic	(-2.696)	(-0.002)	(-1.589)	(-2.143)	(-0.665)	(-1.839)
Rank statistics:	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 0$	$r = 0$
Eigenvalue	0.572	0.389	0.448	0.651	0.736	0.375
Trace statistic	68.580	44.930	56.430	78.218	91.639	50.248
p-value	0.000	0.029	0.001	0.000	0.000	0.007
	$r = 1$	$r = 1$	$r = 1$	$r = 0$	$r = 1$	$r = 1$
Eigenvalue	0.285	0.245	0.287	0.261	0.249	0.240
Trace statistic	22.502	18.254	21.887	21.302	19.772	22.451
p-value	0.125	0.334	0.146	0.169	0.242	0.126
Residual Analysis:						
Normality test, $\Pi^2(6)$	9.500	4.615	7.377	3.525	8.848	4.660
Significance	(0.147)	(0.594)	(0.287)	(0.741)	(0.182)	(0.588)
Autocorrelation, LM $\Pi^2(9)$	6.433	11.134	7.539	11.300	4.209	10.665
p-value	(0.696)	(0.267)	(0.581)	(0.256)	(0.897)	(0.299)

The term cidrift indicates a model with linear trends in the variables, a constant, and a trend in the cointegrating space; drift indicates a model with linear trends in the variables and a constant in the cointegrating space. In the cointegrating vector section, the $\exists_{CW}$ estimates roughly correspond (with an opposite sign) to the cointegrating parameter estimates in Table 9. Trace statistics and *p*-values reflect a Barlett correction for small sample size as derived in Johansen (2000) and Johansen (2002). In the speed-of-adjustment section, the alphas estimate the speed at which the variables are restored to their long-run equilibrium. In the rank statistics section, *p*-values smaller than 0.05 reject (with 5 percent significance level) the null hypothesis of no cointegration (r = 0) and suggest that the variables in the system are in a long-run relationship with each other. In the residual analysis section, the normality test is from Doornik and Hansen (1994) and includes a correction for small sample size, and LM represents a Lagrange Multiplier test for at least fourth-degree autocorrelation for the system residuals, where *p*-values that are smaller than 0.05 reject the null hypothesis is of no autocorrelation. The data used in creating this table are in logs and were estimated in CATS in RATS, version 2, by J.G. Dennis, H. Hansen, S. Johansen, and K. Juselius, Estima 2005.

Table 7
Dynamic Ordinary Least Squares Cointegrating Regressions
Manufacturing and Wholesale/Retail Claims Rates each with
the Consumption-to-Wealth Ratio
1988:1 to 2003:1

Regressor	Income Quintile	Income Quintile	Income Quintile	Income Quintile	Income Quintile	National

	1	2	3	4	5	
Manufacturing						
Constant	-9.257	-10.134	-11.071	-10.437	-10.236	-13.116
t-statistic	(-51.704)	(-27.931)	(-29.665)	(-29.148)	(-33.120)	(-36556)
$\exists_{CW}$	-1.278	-2.050	-2.884	-2.153	-1.607	-4.498
t-statistic	(-6.774)	(-5.908)	(-8.327)	(-6.716)	(-7.031)	(-14.162)
Leads/Lags	4	4	4	4	4	4
Normality test on residuals:						
E_p statistic	0.030	0.046	3.945	0.390	12.126	1.019
Significance	(0.985)	(0.997)	(0.139)	(0.823)	(0.002)	(0.601)
Philips-Ouliaris unit root test on residuals:						
Z_p statistic	-30.406	-37.059	-37.174	-34.667	-36.108	-45.962
Z_t statistic	-4.674	-5.278	-5.211	-4.949	-5.244	-6.221
Critical values, Z_p	-20.500*	-20.500*	-20.500*	-20.500*	-20.500*	-20.500*
Critical values, Z_t	-3.370*	-3.370*	-3.370*	-3.370*	-3.370*	-3.370*
Wholesale/Retail						
Constant	-9.670	-10.525	-11.034	-10.370	-11.166	-13.479
t-statistic	(-42.412)	(-18.666)	(-12.883)	(-18.903)	(-26.441)	(-11.856)
$\exists_{CW}$	-1.640	-2.361	-2.778	-2.042	-2.208	-4.805
t-statistic	(-6.858)	(-4.589)	(-3.445)	(-4.399)	(-7.137)	(-4.835)
Leads/Lags	4	4	4	4	4	4
Normality test on residuals:						
E_p statistic	1.775	0.845	3.340	0.517	0.951	1.811
Significance	(0.442)	(0.665)	(0.188)	(0.772)	(0.622)	(0.404)
Philips-Ouliaris unit root test on residuals:						
Z_p statistic	-25.536	-25.956	-23.378	-32.412	-35.204	-27.949
Z_t statistic	-4.061	-4.014	-3.716	-4.761	-5.006	-4.300
Critical values, Z_p	-21.500*	-20.500	-21.500*	-20.500	-21.500*	-20.500*
Critical values, Z_t	-3.420*	-3.370	-3.420*	-3.370	-3.420*	-3.370*

This table shows the results for the cointegrating regression equation (7). $\exists_{CW}$ represents the coefficient on the consumption-to-wealth ratio. First-differenced lead/lag terms relate to consumption-to-wealth ratio; their estimated coefficients are not shown. *t*-statistics are in parenthesis and are based on Newey-West standard errors with four lags.

Table 8
Dynamic Ordinary Least Squares Cointegrating Regressions
Manufacturing and Wholesale/Retail Claims Rates each with
the Consumption-to-Wealth Ratio and the Sector's Unemployment Rate
1988:1 to 2003:1

Regressor	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
Manufacturing						
	-9.38	-8.972	-9.850	-10.510	-10.119	-12.393

Constant	(49.015)	(-16.366)	(-14.108)	(-9.751)	(-30.303)	(-27.863)
t-statistic						
	-0.997	-0.615	-1.418	-2.274	-1.390	-3.693
β_{CW}	(-5.270)	(-1.029)	(-2.116)	(-2.060)	(-5.029)	(-8.709)
t-statistic						
β_{UE}	0.196	0.142	0.154	-0.045	0.078	0.087
t-statistic	(3.407)	(1.994)	(3.492)	(-0.443)	(1.453)	(2.222)
Leads/Lags	2	2	2	2	2	2
Normality test on residuals:						
E_p statistic	0.574	0.586	0.850	0.729	3.522	0.348
Significance	(0.750)	(0.746)	(0.654)	(0.694)	(0.172)	(0.840)
Philips-Ouliaris unit root test on residuals:						
Z_p statistic	-44.668	-37.122	-34.511	-37.090	-42.167	-40.462
	-6.119	-5.664	-5.352	-5.320	-6.091	-7.220
Z_t statistic						
Critical values, Z_p	-26.100*	-26.100*	-26.100*	-26.100*	-26.100*	-26.100*
	-3.770*	-3.770*	-3.770*	-3.770*	-3.770*	-3.770*
Critical values, Z_t						
Wholesale/Retail						
	-10.655	-9.831	-10.266	-11.530	-11.557	-12.962
Constant	(-39789)	(-12.610)	(-9.433)	(-17.204)	(-23.274)	(-13.311)
t-statistic						
	-2.032	-2.106	-1.845	-3.531	-2.538	-4.052
β_{CW}	(-9.568)	(-3.298)	(-1.868)	(-4.967)	(-8.063)	(-4.514)
t-statistic						
β_{UE}	0.329	-0.224	0.088	-0.267	-0.045	0.193
t-statistic	(4.765)	(-1.426)	(0.647)	(-1.884)	(-0.666)	(2.162)
Leads/Lags	2	1	1	2	2	2
Normality test on residuals:						
E_p statistic	3.288	3.910	0.154	0.204	0.712	2.822
Significance	(0.193)	(0.141)	(0.992)	(0.903)	(0.700)	(0.244)
Philips-Ouliaris unit root test on residuals:						
Z_p statistic	-30.939	-28.952	-27.614	-29.694	-32.825	-29.650
	-4.666	-4.410	-4.159	-4.376	-4.641	-4.320
Z_t statistic						
Critical values, Z_p	-27.100*	-26.100	-27.100*	-27.100*	-26.100	-27.100*
Critical values, Z_t	-3.800*	-3.770	-3.800*	-3.800*	-3.770	-3.800*

This table shows the results for the cointegrating regression equation (7) plus the sector's unemployment rate as an independent variable. β_{CW} represents the coefficient on the consumption-to-wealth ratio and β_{UE} the coefficient on the unemployment rate. *t*-statistics are in parenthesis and are based on Newey-West standard errors with four lags. First-differenced lead/lag terms relate to the consumption-to-wealth ratio and the unemployment rate; their estimated coefficients are not shown. The critical values are at the 5 percent significance level for Z_p and Z_t and "*" indicates that the regression also includes a trend. See Hamilton (1994) Tables B.8 and B.9. The data used in creating this table are in logs.

Table 9
Dynamic Ordinary Least Squares Cointegrating Regressions
Manufacturing and Wholesale/Retail Combined Claims Rates with
the Consumption-to-Wealth Ratio and the Sector's Unemployment Rate
1988:1 to 2003:1

Regressor	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	National
Manufacturing						
	-9.239	-8.785	-9.954	-10.321	-10.075	-11.913
Constant	(-71.777)	(-17.288)	(-10.163)	(-20.668)	(-36.364)	(-20.659)
t-statistic						

	-1.462	-1.350	-1.223	-2.895	-1.897	-3.796
β_{CW}	(-11.576)	(-2.905)	(-1.517)	(-5.116)	(-8.910)	(-7.225)
t-statistic						
β_{UE}	0.252	-0.003	0.132	-0.157	0.027	0.18
t-statistic	(5.935)	(-0.032)	(1.959)	(-1.645)	(0.605)	(2.808)
Leads/Lags	2	2	2	2	2	2
Normality test on residuals:						
E_p statistic	0.512	1.052	0.170	1.085	1.923	1.337
Significance	(0.774)	(0.591)	(0.853)	(0.581)	(0.382)	(0.512)
Philips-Ouliaris unit root test on residuals:						
Z_p statistic	-41.681	-30.776	-27.576	-35.009	-43.612	-43.244
Z_t statistic	-6.158	-4.828	-4.289	-5.152	-6.252	-5.770
Critical values, Z_p	-27.100*	-27.100*	-27.100*	-27.100*	-27.100*	-27.100*
Critical values, Z_t	-3.800*	-3.800*	-3.800*	-3.800*	-3.800*	-3.800*

This table shows the results for the cointegrating regression equation (7) plus the sector's unemployment rate as an independent variable. β_{CW} represents the coefficient on the consumption-to-wealth ratio and β_{UE} the coefficient on the unemployment rate. *t*-statistics are in parenthesis and are based on Newey-West standard errors with four lags. First-differenced lead/lag terms relate to the consumption-to-wealth ratio and the unemployment rate; their estimated coefficients are not shown. The critical values are at the 5 percent significance level for Z_p and Z_t and "*" indicates that the regression also includes a trend. See Hamilton (1994) Tables B.8 and B.9. The data used in creating this table are in logs.

Data Appendix

LTD Claims Rates

Claims rates are the sum of the number of individuals submitting long-term disability claims during a quarter divided by the number of individuals covered in that quarter. Both manufacturing and wholesale/retail claims rates were deseasoned using SAS's X12 procedure. Further details are mentioned in the body of the paper.

Consumption from the CEX

The CEX also publishes the average number of individuals in each household by income quintiles, thus all CEX data used in this paper are on a per capita basis. We deseasoned the consumption, income, and housing data series using SAS's X12 procedure.[26] Seasonally adjusted national per capita data are also employed in this paper for comparison to the CEX.

Aggregate National Consumption

Aggregate per capita U.S. consumption represents total consumption, durables plus nondurables, from the National Income and Product Accounts.

Unemployment Rates

The manufacturing, wholesale, and retail unemployment rates used in this study are the seasonally adjusted national unemployment rates for individuals 16 years and older, published by the Bureau of Labor Statistics. Wholesale/retail and combined manufacturing/wholesale/retail unemployment rates were computed as the employment weighted average of each unemployment series.

Real Estate Prices

The market value for housing by income group is from the CEX. Data are by household and are converted into per capita figures based on the number of individuals living in a household. Data are annual and are converted to quarterly by multiplying the annual prices by gross quarterly returns computed from national real estate prices. National real estate prices are based on an index of single-family housing prices covering all 50 states and the District of Columbia. Data are from the Office of Federal Housing and Enterprise Oversight. Prices are quarterly. SAS's X12 procedure was used to deseason each series.

Inflation

Inflation rates are based on the CPI, employ the index for "Urban/All Items," and are annualized. Data are from the Bureau of Labor Statistics. Inflation rates are based on durables, nondurables, and services deflators that are from the U.S. Department of Commerce, Bureau of Economic Analysis.

[26] SAS's X12 program is adapted from the U.S. Census Bureau's ARIMA model for deseasoning economic time series.