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Firm Profitability:

Mean-Reverting or Random-Walk Behavior?

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Abstract: We analyze the stochastic properties of three measures of profitability, return on assets (*ROA*), return on equity (*ROE*), and return on investment (*ROI*), using a balanced panel of US firms during the period 2001-2010. We employ a panel unit-root approach, which assists in identifying competitive outcomes versus situations that require regulatory intervention to achieve more competitive outcomes. Based upon conventional panel unit-root tests, we find substantial evidence supporting mean-reversion, which, in turn, lends support to the long-standing "competitive environment" hypothesis originally set forward by Mueller (1976). These results, however, prove contaminated by the assumption of cross-section independence. After controlling for cross-section dependence, we find that profitability evolves as a non-stationary process in some sectors in the US economy. Our findings, especially taken as a whole, remain fairly robust to various assumptions regarding the underlying data generation process.

Key words: Cross-section dependence, unit roots, panel data, hysteresis, firm profitability

JEL codes: C23, D22, L25

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1. Introduction

Theoretical microeconomic models use a representative firm to describe an industry, assuming firm homogeneity. Empirical evidence, however, facilitated by the more-recent availability of firm-level data, shows that firms exhibit heterogeneity, even for a narrowly defined industry. That is, industries display substantial and persistent differences in productivity (Nelson and Winter, 1982), innovation (Griliches, 1986), skill compositions and wages (Haltiwanger *et al.*, 2007), profitability (Mueller, 1977, 1986), and so on.[1]

The extent of profit persistence, in particular, remains an open question in empirical micro-econometrics. That is, important issues relate to the stochastic behavior of firm profits. Do firm profits exhibit mean-reverting or random-walk behavior? If firm profits revert to the mean (i.e., stationary process), then shocks that affect the series prove transitory, implying that profits eventually return to their equilibrium level.[2] Researchers call the mean-reversion (stationarity) of profit as the "competitive environment" hypothesis (Mueller, 1986).[3] The "competitive

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[1] The persistence of differences in productivity, skills, wages, and profits may reflect a common source. That is, productive firms employ skilled workers and pay high wages (e.g., Haltiwanger *et al*., 1999). In addition, worker skills positively correlate with the market value of the firm (Abowd *et al*., 2005). As suggested by Haltiwanger *et al.* (2007), the assignment model provides a potential explanation for the coexistence of persistent differences in several variables. If a quasi-fixed firm-specific resource and workers skills complement each other, a firm endowed with large resources may willingly pay high wages to attract skilled workers. Such a firm achieves high productivity and earns large profits.

[2] Marshall thought that this assumption did not hold in actual market processes. Using the shock to the supply of cotton during the American Civil War as an example, he argued that " ... if the normal production of a commodity increases and afterwards diminishes to its old amount, the demand price and the supply price are not likely to return, as the pure theory assumes that they will, to their old positions for that amount" (Marshall, 1890, 426).

[3] Essentially two distinct views exist at the core of the "competitive environment" hypothesis, static and dynamic views of competition (Gschwandtner, 2012). The static view's long history in empirical economics begins with the seminal analysis of Bain (1951, 1956) and extends through the work of Schwartzman (1959), Levinson (1960), Fuchs (1961), Weiss (1963), Comanor and Wilson (1967), Collins and Preston (1969), and Kamerschen (1969), among others. In the static view, persistent differences across firms reflect the characteristics of the industry, such as industry concentration and industry elasticity of demand. Profits persist because significant barriers to entry exist. Conversely, the dynamic view, which links to the work of Schumpeter (1934, 1950), focuses on the characteristics of the firms, in particular their innovative capacities. Innovations create monopoly power. Firms benefit from their "first mover" advantages (e.g., Spence, 1981; Lieberman and Montgomery, 1988) and increase their market power over time. In theory, entry and the threat of entry eliminates such abnormally high profits, while firms that make abnormally low profits restructure or exit the industry. Although the process of "creative destruction" should drive

environment" hypothesis characterizes the dynamics of firm profits as a stationary, mean-reverting, stochastic process.[4] The hypothesis implies that economic profits and losses disappear in the long-run equilibrium to which the markets adjust. Excess profits attract competitors, absent significant barriers to entry, reducing the profit margin of existing firms. This process persists until the profit rate returns to its competitive level. The existing literature on profit persistence generally follows the mean-reverting view of firm profits. Conversely, if firm profits exhibit random-walk or hysteretic behavior (i.e., profits evolve as a unit-root, non-stationary, integrated process), shocks affecting the series exhibit permanent effects, shifting equilibrium profit from one level to another.

A unit-root process imposes no bounds on how a variable moves. If firm profits really conform to random-walk processes, then these profits are also non-predictable. This, in turn, suggests, from an antitrust and regulatory perspective, that policy recommendations based on profitability may prove advisable, as current profitability no longer is a transitory phenomenon and competition fails to control the adjustment or mean-reversion of firm profits toward some long-run equilibrium value. Thus, evidence on the stochastic properties of profitability can assist in differentiating between instances of a "competitive environment", and instances which may require regulatory intervention to achieve a "competitive environment".

Evidence on the stochastic properties of profitability also possesses well-defined implications for econometric modeling and forecasting. Failure to reject the unit-root hypothesis potentially implies that profitability exhibits a long-run cointegrating relationship with other

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all firms' economic profits toward zero, the "first-mover" advantages and other entry and exit barriers may impede firms reaching this point. Therefore, the dynamic view is consistent with non-zero economic profits at different points in time.

[4] The speed of mean reversion also plays a role. For example, if it takes 50 years for the return to the competitive profit rate, where entry and exit of firms disappears, then as a practical matter the industry does not effectively conform to a competitive environment.

firm-level data, while rejecting the unit-root hypothesis implies that profitability exhibits only a short-term relationship with other corporate series. Rejecting or not rejecting the unit-root hypothesis, in turn, profoundly affects the forecasting process, since forecasting based on a mean-reverting process proves quite different from forecasting based on a random walk process.

Tippett (1990) models financial ratios in terms of stochastic processes, and Tippett and Whittington (1995) and Whittington and Tippett (1999) report empirical evidence that the majority of financial ratios exhibit random-walk behavior. Siddique and Sweeney (2000) present panel evidence that the return on equity (*ROE*) and return on investment (*ROI*) are integrated, *I*(1), processes. *ROE* provides a crucial component to the Edwards-Bell-Ohlson (Ohlson, 1995) accounting valuation model; *ROI* proves a crucial variable in the Free-Cash-Flow (*FCF*) finance valuation model. These models typically assume that *ROE* and *ROI* are mean-reverting, stationary, stochastic processes (Dechow, *et al*. 1999), because if competition eliminates economic profits over time, these financial ratios must revert to their required rates of return.

Profit hysteresis should not be confused with profit persistence. Profit persistence entails a slow process of adjustment to the equilibrium level, while profit hysteresis implies that firm profits may deviate from their normal level and never return to it. Thus, hysteresis implies that firm profits exhibit a unit root, while persistence suggests that firm profits exhibit significant autocorrelation with a near unit root.[5]

The methodology typically applied to analyze persistence of firm profits uses a firm-level first-order autoregressive model.[6] Since the seminal contributions of Mueller (1977, 1986), many

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[5] The literature on hysteresis in unemployment and international trade uses a similar approach. See, for example, Gordon (1989) and Franz (1990).

[6] The *AR*(1) model incorporates the idea that competitive mechanisms need some time to erode the excess profits generated by short-run rents (Mueller, 1986). Geroski (1990) justifies the autoregressive specification theoretically as a reduced form of a two-equation system, where firm profits depend on the threat of entry into the market, and the threat, in turn, depends on the profits observed in the last period.

others, such as Geroski and Jacquemin (1988), Schwalbach, *et al*. (1989), Cubbin and Geroski (1990), Mueller (1990), Jenny and Weber (1990), Odagiri and Yamawaki (1986, 1990), Schohl (1990), Khemani and Shapiro (1990), Waring (1996), and Glen, *et al*. (2001), find evidence of persistence of firm profits. Lipczinsky and Wilson (2001) summarize these studies and their findings.

All studies specify a common empirical model -- a univariate *AR*(1) process as follows:

$$\pi_{it} = \alpha_i + \lambda_i \pi_{it-1} + \mu_{it} \tag{1}$$

where π_{it} is the (normalized) profit of firm *i* in period t, α_i is a firm specific constant, λ_i is the parameter that indicates the speed of convergence of profit to a mean value (equilibrium rate of return), and μ_{it} is an error term distributed $N(0,\sigma^2)$. The *AR*(1) structure implies that the maximum speed of mean-reversion occurs when $\lambda_i = 0$. The model is estimated by *OLS* for each firm *i* and an estimate of the long-run profit ($\bar{\pi}_i = \pi_{it} = \pi_{it-1}$) of each firm is given as follows:[7]

$$\bar{\pi}_i = \frac{\alpha_i}{1-\lambda_i} \tag{2}$$

If all firms earn the competitive rate of profit, then $\bar{\pi}_i$ should equalize for all firms (ignoring differences in risk).[8] This long-run profit captures the static notion of the "competitive environment". The dynamic notion of the "competitive environment", however, focuses on the parameter estimate of λ_i. If λ_i is close to zero, then firm profits display minimal persistence: profits at time *t*-1 do not exert much effect on profits at time *t*. On the other hand, if λ_i is close to 1, then firm profits exhibit high persistence: profits at time *t*-1 exert a substantial effect on

[7] The parameter α_i includes a competitive profit and a firm-specific permanent rent over and above the competitive return. See Gschwandtner (2012).

[8] Any firm-specific permanent rent must equal zero.

profits at time *t*.

This approach, however, experiences severe limitations, since the methodology assumes stationary processes. That is, $\overline{\pi}_i$ does not exist for unit-root processes where λ_i=1, the degenerate case of adjustment dynamics. Kambhampati (1995), Goddard and Wilson (1999), Gschwandtner (2005), among others, using univariate tests, and Yurtoglu (2004), Bentzen, *et al.* (2005), Resende (2006), Aslan, *et al.* (2010), and Aslan, *et al.* (2011), using panel unit-root tests, report partial evidence that supports unit-root processes.

More recent research, such as Gschwandtner (2012), Gschwandtner and Hauser (2008), Stephan and Tsapin (2008), Crespo Cuaresma and Gschwandtner (2008), McMillan and Wohar (2011), and Goddard, *et al.* (2004), among others, departs from the *OLS* autoregressive method. Gschwandtner (2012), using a state space *AR*(1) model, finds time-varying profit persistence. Gschwandtner and Hauser (2008), using a fractional integration method, report evidence of non-stationarity. Stephan and Tsapin (2008), employing Markov chain analysis and Generalized Methods of Moments (*GMM*) estimation, find that Ukrainian firms do not significantly differ from the findings for firms in more advanced economies. Crespo Cuaresma and Gschwandtner (2008) report low levels of persistence, using a non-linear threshold model that allows for non-stationary behavior over sub-samples. McMillan and Wohar (2011), applying an asymmetric autoregressive model, find that firm profits above normal persist longer than firm profits below normal. Goddard, *et al.* (2004) use the Arellano and Bond (1991) approach to estimate a dynamic panel model of profitability of European banks and find that profits exhibit significant persistence despite the presence of substantially increased competition in the industry.

In this paper, we depart from the firm-level autoregressive approach and focus on testing for the existence of a unit root in a linear process.[9] Specifically, we test for the validity of the hysteresis hypothesis, using panel unit-root tests. By using such tests rather than univariate tests, we combine information from time series with information from cross-section units, improving estimation efficiency and potentially producing more precise parameter estimates. Furthermore, panel unit-root tests possess asymptotically standard normal distributions. This contrasts with conventional time-series unit-root tests, which possess non-standard normal asymptotic distributions. On the other hand, the advantages of micro-econometric panels are often overstated, since such data exhibit many cross-section and temporal dependencies. That is, "*NT* correlated observations have less information than *NT* independent observations" (Cameron and Trivedi, 2005, p. 702). Finally, most previous studies do not consider disaggregating the analysis to the industry level. Our analysis performs the panel unit-root tests on 10 individual industries, rather than across all firms in our sample.

Conventional panel unit-root tests, such as Levin, *et al.* (2002), Harris and Tzavalis (1999), and Im, *et al.* (2003) receive criticism (O'Connell, 1998; Jönsson, 2005; and Pesaran, 2007, among others) for assuming cross-section independence. Cross-section dependence can arise due to unobservable common stochastic trends, unobservable common factors, common macroeconomic shocks, spatial effects, and spillover effects, which are common characteristics

[9] Pérez-Alonso and Di Sanzo (2011) acknowledge that a unit root provides the necessary, but not sufficient, condition for the existence of hysteresis, since the unit-root process could reflect the accumulation of natural shocks and not depend on whether hysteresis exists. Following the vast majority of the empirical literature in this area, we adopt linear hysteresis as described by the presence of unit roots. We recognize, however, that this adopts a potentially narrow definition, since the linear hysteretic hypothesis is a special case of a more general hysteresis case. Cross, *et al.* (2009) note that a general hysteretic process contains two features -- eminence (i.e., positive and negative shocks of equal size do not cancel each other) and selective memory of past shocks (i.e., only the "non-dominated extreme values" of the shocks are retained in the memory). The linear hysteretic hypothesis, in contrast, does not have "non-dominated extreme values" and two consecutive shocks of equal magnitude and opposite direction will cancel each other. As Leon-Ledesma and McAdam (2004) point out, however, we can use hysteresis interpreted as a unit root as a local approximation to the underlying data generating process (*DGP*) of profits during a sample period. Consequently, unit-root tests for the presence of the linear version of the hysteresis hypothesis supplies an upper-bound test of the hypothesis, given that this is an extreme case of path-dependence, where any shock, large or small, matters.

of the datasets employed in industry studies. For example, business cycle movements will affect all industries, albeit with different magnitudes. To the extent that firms rely on borrowed funds to operate, then adjustments of economy-wide interest rates, say through changes in monetary policy, will affect firms across industries. Such common macroeconomic shocks can create cross-section dependence. Baltagi and Pesaran (2007) and Pesaran (2007) argue that ignoring the presence of cross-section dependence in panel unit-root tests leads to considerable size distortions and can cause adverse effects on the properties of tests, leading to invalid and misleading conclusions.

This paper contributes to the existing profit persistence literature in three ways. First, we deal with the low-power and size-distortion problems (Luintel, 2001; Strauss and Yogit, 2003; Pesaran, 2007) of conventional panel unit-root tests by employing the methodology developed by Pesaran (2004, 2007) to perform a formal test of cross-section independence in panels, and to implement a test which explicitly models and corrects for cross-section dependence. Second, we use a large panel data of public firms in the US from 2001 to 2010.[10] Most empirical literature on profit persistence does not include data after 2000. This may prove important, since the financial crisis and the Great Recession took a heavy macroeconomic toll on the US industry. In addition, we further partition the panel into ten sectors of the economy (using the classification by Standard and Poor's Compustat) and examine the stochastic properties of profitability in each

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[10] We recognize that the time dimension of our sample does not provide a long period over which the profit rate can return to its competitive level. Our test, however, considers whether our measures of the profit rate exhibit mean reversion, or not. In that sense, we do not require that the firms actually reach long-run equilibrium. The existence of a unit root tells us that no tendency exists for mean reversion. The use of a small time dimension is common in the empirical literature on profit persistence. For example, Bou and Satorra (2007) analyze the persistence of abnormal returns in a group of Spanish industries using annual data from 1995 to 2000. Bentzen, *et al.*, (2005) report panel unit-root results using annual data from Danish firms covering 1990 to 2001. Goddard, *et al*., (2011) provide evidence for the persistence of annual profits in banking from 65 countries covering 1997 to 2007, and Goddard, *et al.*, (2004) investigate the determinants of annual profitability in six major European banking sectors from 1992 to 1998. Furthermore, the use of panel data partly remedies the potential problem of a small time dimension, as the power of panel tests usually exceeds that of univariate tests. Nonetheless, some caution is warranted in interpreting our findings.

sector. By stratifying by sector, our profit persistence tests use the average industry profit as the benchmark rather than economy-wide average profit. In other words, we measure firm profit as a deviation from the average industry profit. Since each sector may exhibit a different level of competitive profit, our measure of profit makes it more likely that our tests will support the "competitive environment" hypothesis. Third, we measure profitability with three of the most extensively used measures: return on assets (*ROA*), return on equity (*ROE*), and return on investment (*ROI*). Most research in this field uses only data on returns on assets (*ROA*).

Application of conventional panel unit-root tests finds strong evidence that favors the mean-reverting hypothesis in each of the three measures of profitability. These tests, however, assume cross-section independence. We strongly reject this assumption with the *CD* test (Pesaran, 2004). Moreover, the application of the Pesaran (2007) unit-root test uncovers substantial evidence of linear hysteretic behavior in each of the three measures of profitability, which refutes the "competitive environment" hypothesis.

The rest of the paper is organized as follows. After a brief review of panel unit-root tests that assume cross-section independence, Section 2 outlines some of the conventional testing procedures and describes the approach developed by Pesaran (2004, 2007) to test for cross-section independence (*CD* test) and to test for panel unit roots with cross-section dependence (*CIPS* test). Section 3 reports the empirical results from the application of the panel unit-root test procedures discussed in the previous section. We apply the panel data unit-root test proposed by Pesaran (2007) and compare the results with those obtained with conventional panel data unit-roots tests such as Im, *et al.* (1997, 2003) and Harris and Tzavalis (1999). Section 4 performs two sets of robustness checks. First, we consider whether the unit-root test results are sensitive to the selection of the sample period. Recent events may indeed play a crucial role in our understanding of the dynamics of profits. We construct a “pre-Lehman” sub-sample and investigate whether the global financial crisis and the Great Recession affected our findings. Second, we consider whether the unit-root results are sensitive to outliers. Sample statistics suggest that outliers exist and we winsorize our data series to replicate our analysis without the effects of outliers. Section 5 presents the conclusions.

2. Empirical methodology

We can examine the linear hysteretic hypothesis by means of panel unit-root tests, where the null hypothesis implies a unit root. Assume that, for a panel of *N* firms observed over *T* time periods, r_{it} exhibits the following augmented Dickey-Fuller (*ADF*) representation:

$$\Delta r_{it} = \alpha_i + \rho_i r_{it-1} + \sum_{j=1}^{p_i} \gamma_{ij} \Delta r_{it-j} + \varepsilon_{it}, \quad i = 1, \ldots, N; \ t = 1, \ldots, T \tag{3}$$

where r_{it} denotes the profit series (*ROA*, *ROE*, or *ROI*), $\Delta r_{it} = r_{it} - r_{it-1}$, α_i is the intercept term that captures the firm-specific effects, and $\varepsilon_{it} \sim N\left(0, \sigma_{ij}^2\right)$. To incorporate the time-specific effects, we add a trend component to equation (3) as follows:

$$\Delta r_{it} = \alpha_i + \rho_i r_{it-1} + \delta_i t + \sum_{j=1}^{p_i} \gamma_{ij} \Delta r_{it-j} + \varepsilon_{it}. \tag{4}$$

When $\rho_i < 0$, the processes for r_{it} defined by equations (3) and (4) are stationary, and firm profits are mean-reverting. On the other hand, when $\rho_i = 0$, the processes for r_{it} contain a unit root, and firm profits follow a random walk and display path-dependence.[11]

In recent years, the econometric literature developed a number of unit-root tests in panel

[11] Madsen (2010) observes that equations (3) and (4) contain two sources of persistence -- the autoregressive mechanism described by ρ_i and the unobserved individual-specific effects described by α_i. A lower ρ_i means that more persistence associates with the autoregressive mechanism and less persistence associates with the unobserved individual-specific effects. The case with $\rho_i = 0$ is the extreme case where all persistence falls on the autoregressive mechanism.

data.[12] Two groups of tests exist, depending on the alternative hypothesis. The first group (e.g., Levin, *et al.*, 2002; Harris and Tzavalis, 1999) assumes homogeneity of autoregressive coefficients (i.e., $\rho_1 = \rho_2 = ... = \rho_N = \rho$) and tests the null hypothesis $H_0 : \rho_i = \rho = 0$ against the alternative hypothesis $H_1 : \rho_i = \rho < 0$ for all *i*. The second group (e.g., Im, *et al.*, 1997, 2003) does not assume a common unit-root process. Rather, it allows for heterogeneity in all parameters and tests the null hypothesis $H_0 : \rho_i = 0$ against the alternative hypothesis $H_1 : \rho_i < 0$ for $i = 1,..., N_1$ and $\rho_i = 0$ for $i = N_1 + 1,..., N$. We confine our attention to those tests, which are more appropriate for small *T* and large *N*.

Consider the Harris and Tzavalis (1999, *HT*) test. This test is based on bias correction of the within-group (*WG*) estimator under the null. The *HT* test assumes that the number of panels *N* tends to infinity for a fixed number of time periods *T* and allows for non-normality but requires homoskedasticity. The normalized distribution of the *HT* test statistic depends on the assumptions made about the deterministic constant and trend. When the data generating process (*DGP*) includes only heterogeneous fixed effects and no trend,[13] the test statistic equals $\sqrt{N}(\hat{\rho}_{WG} - 1 - B_2)$, which is asymptotically normally distributed with $\mu = 0$ and $\sigma^2 = C_2$. The parameters are defined as follows: $\hat{\rho}_{WG}$ equals the *WG* estimator, $B_2 = -3(T+1)^{-1}$, and $C_2 = 3(17T^2 - 20T + 17)\left(5(T-1)(T+1)^3\right)^{-1}$. When the *DGP* includes heterogeneous fixed effects and individual trends, the test statistic equals $\sqrt{N}(\hat{\rho}_{WG} - 1 - B_3)$, which is asymptotically

[12] For a general survey of the literature about unit root tests, see Breitung and Pesaran (2008).

[13] Harris and Tzavalis (1999) consider three models when testing for the unit-root hypothesis. They differ on the deterministic component specified under the alternative. The first model excludes both the constant and the individual trend, the second model includes the constant only, and the third model includes both constant and trend.[14] Im, *et al.* (2003) offer different methods of standardization. We choose the procedure in equation (7), since it provides, according to Im, *et al.* (2003), the most accurate statistic for small samples based on Monte Carlo simulation.

normally distributed with $\mu = 0$ and $\sigma^2 = C_3$. The parameters are now defined as follows: $B_3 = -15\left(2\left(T+2\right)\right)^{-1}$ and $C_3 = 15\left(193T^2 - 728T + 1147\right)\left(112\left(T-2\right)\left(T+2\right)^3\right)^{-1}$. In the first case, the null hypothesis is a non-stationary process while the alternative is a stationary process, where both hypotheses include heterogeneous intercepts (drift parameters). In the second case, the null hypothesis is a non-stationary process while the alternative is a stationary process, where both hypotheses include heterogeneous constants and individual trends.

The Levin, *et al.* (2002) test, which requires that the ratio of the number of panels to time periods tends to zero asymptotically, performs poorly for a large number of panels and relatively few time periods. Thus, our sample with a relatively large number of panels to time periods precludes us from considering this test.

Now, consider the Im, *et al.* (1997, 2003, *IPS*) test. This test takes a different approach from the *HT* test, in that it views the panel-data regression as a system of *N* individual regressions and the test combines independent Dickey-Fuller tests for these *N* regressions. The test allows the ρ_i values to differ over cross-sections, but assumes that N_1 of the *N* panels are stationary with individual specific autoregressive coefficients. Following the estimation of individual *ADF* regressions, the test adjusts the average of the *t* statistics for ρ_i to obtain the test statistic:

$$\overline{t_N} = N^{-1}\sum_{i=1}^{N} t_i , \qquad (5)$$

where t_{iT} equals the individual Dickey-Fuller test statistic for testing $\rho_i = 0$. Im, *et al.* (1997, 2003) show that the standardized test statistic:

$$\overline{Z} = \sqrt{N}\,\frac{\left(\overline{t_N} - E\left(\overline{t_N}\right)\right)}{\sqrt{var(\overline{t_N})}}, \qquad (6)$$

where the values of $E\left(\bar{t}_N\right)$ and $\sqrt{var(\bar{t}_N)}$ come from Monte Carlo experiments. When the lag order is non-zero for some cross-sections, Im, *et al.* (1997, 2003) compute the $W_{\bar{t}_N}$ statistic as follows:

$$W_{\bar{t}_N} = \frac{\sqrt{N}\left(\bar{t}_N - N^{-1}\sum_{i=1}^{N} E(\bar{t}_i)\right)}{\sqrt{N^{-1}\sum_{i=1}^{N} \mathrm{var}(\bar{t}_i)}}, \qquad (7)$$

which converges asymptotically to the standard normal distribution. [14]

In both the *HT* and the *IPS* tests, the error term ε_{it} is independent across *i*. Assuming that the individual time series in the panel are independently distributed over cross sections faces criticism. Specifically, the *HT* and *IPS* tests are only valid under the assumption of cross-section independence. This assumption, however, seldom proves realistic, since it ignores the possibility of short-run co-movements (common cycles caused by the business cycle, interest rates, and so on) and long-run co-movements (common trends caused by technological change, and so on) that characterize each industry's dynamics. For example, a large literature provides evidence of technological interdependencies and co-movements across firms in the same industry. Panel unit-root tests can lead to spurious results, if they fail to account for significant degrees of cross-section dependence. Pesaran (2004) shows that considerable size distortions emerge[15] in panel-data analysis, when the hypothesis of cross-section independence is violated. To overcome this difficulty, the econometric literature developed various tests that permit cross-section dependence. If *N* is small and *T* is sufficiently large, then we can model the cross-section

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[14] Im, *et al.* (2003) offer different methods of standardization. We choose the procedure in equation (7), since it provides, according to Im, *et al.* (2003), the most accurate statistic for small samples based on Monte Carlo simulation.

[15] Panel unit-root tests will tend to over-reject the null hypothesis of a unit root (i.e., to reject the null whether it is true or not).

correlation using the Seemingly Unrelated Regression (*SUR*) approach. The Lagrange Multiplier (*LM*) statistic proposed by Breusch and Pagan (1980) tests the diagonality of the error-covariance matrix of a *SUR* equation system. If N is large, however, we cannot implement the *SUR* estimation because the error-covariance matrix is rank deficient ($N > T$). This characterizes our samples.

Pesaran (2004) proposes a cross-section dependence (*CD*) test, which uses the simple average of all pair-wise correlation coefficients. The *CD* test provides a general test for cross-section dependence, which, as shown in Pesaran (2004), applies to a large variety of panel data models, including stationary and non-stationary dynamic heterogeneous panel with T small and N large, as is the case for our panel data. The test applies to both balanced and unbalanced panels and is robust to parameter heterogeneity and/or structural breaks, and performs well even in small samples. Under the null hypothesis $H_0 : \rho_{it} = \rho_{jt} = \text{corr}(\varepsilon_{it}, \varepsilon_{jt}) = 0$ for $i \neq j$, ε_{it} is independent and identically distributed over time periods and across cross-section units. Under the alternative hypothesis $H_1 : \rho_{it} = \rho_{jt} \neq 0$ for some $i \neq j$, ε_{it} is correlated across cross-sections, but uncorrelated over time periods. Under the null hypothesis of cross-section independence, the *CD* test statistics are distributed as standard normal for N sufficiently large. The test averages the pair-wise correlation coefficients of the residuals obtained from the individual Augmented Dickey-Fuller (*ADF*) regression equations. We compute the *CD* test statistics for a balanced panel as follows:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\text{corr}(\hat{\varepsilon}_i, \hat{\varepsilon}_j)\right) \text{ and} \tag{8}$$

$$\text{corr}(\hat{\varepsilon}_i, \hat{\varepsilon}_j) = \frac{\sum_{t=1}^{T} \hat{\varepsilon}_{it} \hat{\varepsilon}_{jt}}{\left(\sum_{t=1}^{T} \hat{\varepsilon}_{it}^2 \right)^{1/2} \left(\sum_{t=1}^{T} \hat{\varepsilon}_{jt}^2 \right)^{1/2}}, \quad (9)$$

where $\hat{\varepsilon}_{it}$ are estimated residuals from the Augmented Dickey-Fuller (*ADF*) regression equations.

Under the null hypothesis of cross-section independence, the *CD* test statistic converges asymptotically to the standardized normal distribution. The *CD* test also applies to unbalanced panels. In this case, we compute the test statistic as follows:

$$CD = \sqrt{\frac{2}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \sqrt{T_{i,j}} \, \text{corr}(\hat{\varepsilon}_i, \hat{\varepsilon}_j) \right), \quad (10)$$

where $T_{i,j}$ equals the number of common time-series observations between units *i* and *j*.

Pesaran (2007) proposes a panel unit-root test based on a single common factor specification for the cross-correlation structure. The test augments the *ADF* equations (3) and (4) with the cross-section averages of lagged levels and first-differences of the individual series. This controls for the contemporaneous correlation among r_{it} and filters out the effect of the unobserved common factor. The augmentation of lagged first-differences of the series controls for any residual serial correlation. Then, the cross-section augmented Dickey-Fuller (*CADF*) test equations are as follows:

$$\Delta r_{it} = a_i + \rho_i r_{it-1} + \sum_{j=1}^{p} \gamma_{ij} \Delta r_{it-j} + b_i \bar{r}_{t-1} + c_i \Delta \bar{r}_i + \sum_{j=1}^{p} d_{ij} \Delta \bar{r}_{t-j} + \varepsilon_{it}, \text{ and} \quad (11)$$

$$\Delta r_{it} = a_i + \rho_i r_{it-1} + \delta_i t + \sum_{j=1}^{p} \gamma_{ij} \Delta r_{it-j} + b_i \bar{r}_{t-1} + c_i \Delta \bar{r}_i + \sum_{j=1}^{p} d_j \Delta \bar{r}_{t-j} + \varepsilon_{it}, \quad (12)$$

respectively, where $\bar{r}_t = N^{-1} \sum_{i=1}^{N} r_{it}$ is the cross-section mean of r_{it}, $\Delta \bar{r}_t = N^{-1} \sum_{i=1}^{N} \Delta r_{it}$, and *p* is the lag order of the model.

The individual-specific test statistic for the hypothesis $H_0 : \rho_i = 0$ for a given *i* equals the *t*-value for $\rho_i = 0$, $t_i(N,T)$, in the *CADF* regressions defined by equations (11) and (12). The panel unit-root test for the hypothesis $H_0 : \rho_i = 0$ for all *i* against the heterogeneous alternative $H_1 : \rho_i < 0$ for some *i* equals the average of the individual $t_i(N,T)$ tests. That is,

$$CIPS(N,T) = N^{-1} \sum_{i=1}^{N} t_i(N,T) \tag{13}$$

In addition, to ensure the existence of the first and second moments of the distribution of $t_i(N,T)$, Pesaran (2007) constructs a truncated version of the $CIPS(N,T)$ test, denoted $CIPS^*(N,T)$, to avoid using extreme statistics caused by a small number of sample observations.

$$CIPS^*(N,T) = \frac{1}{N} \sum_{i=1}^{N} t_i^*(N,T), \tag{14}$$

where

$$t_i^*(N,T) = \begin{cases} t_i(N,T) & -K_1 < t_i(N,T) < K_2 \\ -K_1 & t_i(N,T) < K_1 \\ K_2 & t_i(N,T) \geq K_2 \end{cases} \tag{15}$$

K_1 and K_2 depend upon the deterministic component of the models. Pesaran (2007) provides values for K_1 and K_2 obtained by simulations for models with intercept and no trend (K_1 = 6.19 and K_2 = 2.61) and models with intercept and trend (K_1 = 6.42 and K_2 = 1.70) for various combinations of *N* and *T*. [16]

3. Empirical results

We use annual data on 1,092 US public firms belonging to all sectors of the economy over the period 2001 through 2010. The total number of firm-years equals 10,920, and includes 132 industry groups, based on Compustat Industry Sector Code (SECTOR). The data are obtained from Standard and Poor's Compustat database. We use accounting return series in the analysis. We measure profitability with three of the most extensively used measures -- return on assets (*ROA*), return on equity (*ROE*), and return on investment (*ROI*) (Combs *et al.*, 2005).[17] We decompose the sample into ten sectors of the economy, according to Compustat Economic Sector Code (*ECNSEC*). The ten sectors include (number of firms in parenthesis; Compustat Economic Sector Code in brackets): a) Materials (57)[1000]; b) Consumer Discretionary (208)[2000]; c) Consumer Staples (67)[3000]; d) Health Care (102)[3500]; e) Energy (32)[4000]; f) Financials (148)[5000]; g) Industrials (166)[6000]; h) Information Technology (285)[8000]; i) Telecommunication Services (6)[8600]; and j) Utilities (21)[9000]. The Appendix below provides a general description of the firms within each sector.[18]

Tables A1 and A2 in the Appendix report the pooled mean, the pooled median, and the

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[16] Pesaran (2007) investigates the small-sample properties of the tests under various specifications of the *DGP*. The Monte Carlo experiments show that the tests exhibit satisfactory size and power properties even for small time dimensions (e.g., $T = 10$).

[17] These measures are computed as follows: Return on Assets: Income before extraordinary items available for common shareholders (IBCOM[item 237]), which equals income before extraordinary items and discontinued operations less preferred dividend requirements, but before adding savings due to common stock equivalents, divided by total assets (AT[item 6]), which equals the sum of current assets, net property, plant, and equipment, and other noncurrent assets. Return on Equity: Income before extraordinary items available for common shareholders (IBCOM[item 237]) divided by common equity as reported (CEQ[item 60]), which equals the common shareholders' interest in the company. Return on Investment: Income before extraordinary items available for common shareholders (IBCOM[item 237]) divided by total invested capital (ICAPT[item 37]), which equals the sum of total long-term debt, preferred stock, minority interest, and total common equity. All returns are multiplied by 100.

[18] All computations use Stata, version 12.

pooled standard deviation of each of three measures of profitability by sector and year, respectively. Comparing profitability by sector, the energy sector achieves the highest average return, but also the highest variability; in contrast, health care, information technology and telecommunication services post negative averages for *ROA*, *ROE* and *ROI*, although the large standard deviations of these series indicate an extremely wide range of values. Conversely, comparing profitability by year, each of the three measures of profitability reach their highest levels in 2007, and their lowest levels in 2002 and 2009. Tables A1 and A2 clearly illustrates the potential problems of aggregating all observations as opposed to partitioning them by industry. Not only do the empirical distributions vary substantially from sector to sector, and from year to year, but the four largest industries, in terms of number of firms in the sample (information technology, consumer discretionary, financials and industrials), account for approximately 74 percent of the total number of firms. The remaining six sectors may exert little, if any influence, on the results based on the entire sample.

Tables A1 and A2 also show issues related to outliers in the distributions across industries and across years. That is, the median values prove much more stable across industries and years than do the mean values. Moreover, the standard deviations suggest significant variability in the distributions, especially for *ROE* and *ROI*.

Tables 1 through 4 summarize the results of examining all ten sectors of the economy for unit roots using the *HT* and *IPS* panel unit-root tests. In each test, we permit two different configurations of the deterministic terms (intercept only and intercept and trend[19]) and, in case of the *IPS* test, different lag lengths for each series. For the *IPS* tests, we report the robust version,

[19] With a time trend, mean-reversion implies convergence toward a time-varying mean. For completeness, we also computed the *HT* panel unit-root test without a time trend or an intercept. The rejection of the unit-root null hypothesis proves even stronger in this case. The results are available from the authors on request.

the $W_{\bar{t}}$ test statistic. The appropriate lag length is selected using the Akaike information criterion (*AIC*) with a maximum lag $p = 2$.[20] We also implement the suggestion of Im, *et al.* (1997, 2003). That is, we assume that in addition to a series-specific intercept and/or trend as given in Equations (3) and (4), a time-specific intercept may exist as well. We control for this possibility by removing for each industry the cross-section means from each series. This normalization, by extracting common time-specific or aggregate effects, removes the effect of the business cycle and other macroeconomic shocks. [21] This correction will not remove the potential effect of correlation between the series, but may reduce it considerably (O'Connell, 1998; Luintel, 2001).

The results (almost) uniformly do not indicate linear hysteretic behavior for any of the three profitability measures. Rather, ample evidence emerges that firm profits exhibit mean-reverting stationary processes, whose fluctuations are largely temporary. Only a few significant discrepancies exist in the results provided by both tests. More specifically, the *HT* test rejects the null hypothesis of a unit-root process for *ROA*, *ROE*, and *ROI* at the 1-percent significance level for each of the ten sectors of the economy. This conclusion holds regardless of the inclusion or exclusion of deterministic constants and linear trend. On the other hand, for the intercept only specification, the *IPS* test rejects the unit-root hypothesis at the 1-percent level for *ROE* for all sectors; but, for *ROA* and *ROI*, the test rejects the null at the 1-percent level in all sectors except utilities, for which the test rejects the null of unit root at the 5-percent level. For the intercept and trend specification, the test rejects the unit root hypothesis at the 1-percent level for all sectors

[20] Given the short time-series dimension of our panel, a limit exists to the number of lags that can be added in the *IPS* tests without consuming too many degrees of freedom. The average number of lags ranges from 0 to 0.30, which for most of the individual *ADF* regressions results in no lags or at most a single lag.

[21] This approach differs from the conventional methodology, where researchers normalize profit as a deviation from an economy-wide measure of profitability in year *t*. Using the economy-wide sample mean may produce misleading implications. That is, the profit of a firm in a given industry may not exhibit abnormal behavior with respect to its own sample average, but may exhibit well above- or below-average behavior with respect to the economy-wide average profit. Table A1 illustrates this point.

except utilities, where the test cannot reject the unit root for *ROA* and *ROI*, but does reject the unit root for *ROE*.

These findings, however, may not serve as strong evidence for the mean-reversion hypothesis because the *HT* and the *IPS* tests assume cross-section independence. Thus, the restrictive nature of these tests does not discriminate between stationarity with cross-section independence and non-stationarity with cross-section dependence. These tests experience well-known large size distortions when cross-section independence does not hold. To test whether cross-section independence holds in our data, we employ the *CD* test proposed by Pesaran (2004). For each of the ten sectors, the *CD* test draws on two specifications: residuals from a fixed effects *ADF* model with intercept and trend and residuals from a fixed effects *ADF* model with intercept only.[22] Tables 5 and 6 report the findings of the *CD* test.[23] We reject the null hypothesis of no cross-section dependence in all cases in both Tables at the 1-percent level, except for the intercept-only findings for health care (*ROA*, *ROE*, and *ROI*) as well as telecommunication services (*ROE*). As the tests clearly indicate, overwhelming evidence of cross-section dependence exists in all sectors considered. This plausible result reflects the high degree of cross-section dependence induced by intra-sectoral links and common shocks.

A potential drawback of the *CD* test, however, lies in the pair-wise construction of the test, which cannot prevent the possibility that the computed correlations alternate in sign, canceling out each other. In such case, the test would fail to reject the null hypothesis in the presence of cross-section dependence. De Hoyos and Sarafidis (2006) suggest computing the average absolute value of the off-diagonal elements of the cross-section correlation matrix of residuals, which would help identify cases of cross-section dependence when the signs of the

[22] These regressions use the raw profitability series that are not adjusted for the mean at each point in time.

[23] We use the XTCSD Stata module coded by De Hoyos and Sarafidis (2006).

correlations alternate. For economy of space, we do not report[24] these statistics, but note that in the intercept only case, the average absolute correlation ranges from a minimum of 0.309 (consumer staples) to a maximum of 0.463 (financials), while in the intercept and trend case, the average absolute correlation ranges from a minimum of 0.309 (consumer discretionary) to a maximum of 0.898 (industrials). These results clearly indicate that more than enough evidence exists to support the presence of cross-section dependence. In addition, the variability of these estimates suggests that the cross-section correlation is heterogeneous rather than homogeneous. This, in turn, may justify the disaggregation of the data to the industry level.

The rejection of the hypothesis of cross-section independence implies that the previous panel unit-root tests generate contaminated findings and that we should consider the possible cross-section dependence in our panel unit-root tests. Tables 7 and 8 report the results of the $CIPS^*$ tests.[25] Table 7 presents the results of the intercept only specification, while Table 8 presents the results for the intercept and trend specification. In both cases, we augment the *CADF* regressions with 1 lag to account for the possibility of serial correlation. In Table 7, we can reject the null hypothesis that *ROA* contains a unit root at the 5-percent significance level for only 2 sectors − industrials and information technology. Similarly, we can reject the null hypothesis that *ROE* contains a unit root at the 5-percent level for 0 sectors. Finally, we can reject the null hypothesis that *ROI* contains a unit root at the 5-percent level for only 1 sector − financials. In Table 8, we can reject the null hypothesis that *ROA* contains a unit root at the 5-percent significance level for 1 sector − consumer staples. Similarly, we can reject the null hypothesis that *ROE* contains a unit root at the 5-percent level for 3 sectors − materials, health care, and financials. Finally, we can reject the null hypothesis that *ROI* contains a unit root at the

[24] These results, as well as the full cross-section correlation matrices, are available from the authors on request.

[25] The PESCADF (version 1.0.3) Stata module (Lewandowski, 2006) computes the test statistics.

5-percent level for 1 sector − materials.

In sum, using the *CIPS** test, we find evidence of non-stationary behavior of profits in all 10 sectors, at least for one measure of firm profitability in one of the two Tables. These results reverse our initial findings as detailed by the *HT* and the *IPS* tests. The failure to reject the unit root hypothesis provides *prima facie* evidence that is inconsistent with the "competitive environment" hypothesis. The mean-reversion (stationarity) of firm profitability is an important, but only necessary, condition to validate the neoclassical theory of the firm. In contrast, the absence of mean-reversion (non-stationarity) of firm profitability represents strong evidence suggesting that differences in profitability can persist indefinitely.

4. Additional Empirical Results and Robustness Checks.

This section considers robustness checks that address two particularly important concerns that could understate the strength of the findings in the previous section. First, the summary statistics suggest that outliers may create a problem because of their potential effect on statistical inferences. Thus, we winsorize the original data series for the top and bottom 10-percent of the observations. That is, we adjust 20 percent of the observations in our sample: all observations below the 10th percentile are set to the 10th percentile, and all observations above the 90th percentile are set to the 90th percentile.[26] Then, we replicate the analysis for the two-sided winsorized data.

The findings for the *IPS,* but not the *HT,* tests exhibit modest changes using the winsorized data in three sectors – materials, energy, and telecommunication services.[27] The

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[26] Winsorization gives the empirical distribution of the series more desirable statistical properties. It reduces the standard deviation, skewness, and kurtosis in the series, and brings the means closer to the medians. For more discussion and references, see Barnett and Lewis (1994).

[27] We omit the *HT*, *IPS*, and *CD* test results to conserve space. These findings are available from the authors on request.

results of the *HT* tests reject the null hypothesis of a unit root for all measures of profit in both the intercept, and the intercept and trend specifications. The results of the *IPS* tests do not reject the null hypothesis of a unit root for all three measures of profit in the intercept specifications for the telecommunication services sector and for the intercept and trend specifications for the energy sector. Finally, the results of the *IPS* tests do not reject the null hypothesis of a unit root for *ROA* and *ROI* in the materials and telecommunication services sectors in the intercept and trend specifications.

In sum, we now find evidence of non-stationary profitability using the *IPS* tests in the materials, energy, and telecommunication services sectors. We found no such evidence for this in the original sample. That is, these changes in the *IPS* test results reduce the acceptance of the "competitive environment" hypothesis at the margin.

The findings of the *CD* test, instead, remain robust to the use of winsorized data that adjusts for outliers in the data series. That is, we find strong evidence of cross-section dependence in each sector for all three measures of profitability for both the intercept only and intercept and trend specifications.

A few of our findings for the $CIPS^*$ test are sensitive to the winsorization of the data series. We find slightly more evidence of stationarity in the sample using the winsorized data than in the sample with the original data. In Table 9, the $CIPS^*$ test rejects the null hypothesis of a unit root for *ROA* in industrials and information technology; for *ROE* in consumer discretionary and industrials; and for *ROI* in industrials. In Table 10, we reject the null hypothesis of a unit root for *ROA* in industrials, information technology, and utilities; for *ROE* in industrials and information technology; and for *ROI* in industrials and utilities.

In sum we find evidence of stationarity ("competitive environment") across all three measures of profitability for industrials in the intercept only and the intercept and trend models. We cannot reject the null hypothesis of a unit root across all three profitability measures for materials, consumer staples, health care, energy, financials, and telecommunications services in both the intercept and intercept and trend models, for utilities in the intercept only model, and for consumer discretionary in the intercept and trend models.

Second, as previously noted, one needs to exercise caution in interpreting our findings of cross-section dependence and non-stationarity because of the short time dimension of our panel. That caution, however, runs counter to the fact that our sample also includes the financial crisis and Great Recession. Do our findings occur because of the time period? That is, the structural change caused by the financial crisis and Great Recession may potentially drive our findings. So far, we implicitly assume that throughout the sample period, the data generating process does not exhibit structural change. When this assumption is not valid, however, the tests can be misleading, since they are biased toward the non-rejection of the unit-root hypothesis. In the presence of a known structural break, one can intuitively test for a unit root twice, before and after the break. In our case, however, splitting the sample into two is practically impossible. Consequently, we provide a second robustness check by applying the same unit-root methodology to a sub-sample that ends in 2007, the period prior to the Lehman bankruptcy filing in September 2008, and the beginning of the Great Recession.

The findings for the *HT* and *IPS* tests change, using the "pre-Lehman" sample, in two sectors – materials and energy.[28] The results of the *HT* tests do not reject the null hypothesis of a unit root for *ROE* and *ROI* in energy (intercept only and intercept and trend specifications). Similarly, the results of the *IPS* tests do not reject the null hypothesis of a unit root for *ROE* and

[28] Once again, we omit the *HT*, *IPS*, and *CD* test results to conserve space. These findings are available from the authors on request.

ROI in materials and energy (intercept only and intercept and trend specifications).

In sum, we now find evidence of non-stationary profitability using the *HT* and *IPS* tests in the materials and energy sectors. We found no such evidence for this in the full sample. From above, we also find similar results when we used the winsorized data, adding the telecommunication services sector. That is, these changes in the *IPS* test results reduce the acceptance of the "competitive environment" hypothesis at the margin.

The findings of the *CD* test, instead, remain robust to the sample reduction. That is, we find strong evidence of cross-section dependence in each sector for all three measures of profitability for both the intercept only and intercept and trend specifications.

Some of the findings for the $CIPS^*$ test are also sensitive to the time period. We find more evidence of stationarity in the "pre-Lehman" sample than in the original sample. In Table 11, the $CIPS^*$ test rejects the null hypothesis of a unit root for *ROA* in consumer staples, health care, industrials, and information technology; for *ROE* in materials, consumer staples, and information technology; and for *ROI* in consumer staples, health care, and information technology. In Table 12, we reject the null hypothesis of a unit root for *ROA* in health care, energy, financials, industrials, information technology, and telecommunications services; for *ROE* in materials, consumer staples, health care, energy, and information technology; and for *ROI* in materials, health care, energy, information technology, and utilities.

In sum we find evidence of stationarity ("competitive environment") across all three measures of profitability for consumer staples and information technology in the intercept only models and for health care, energy, and information technology in the intercept and trend models. We cannot reject the null hypothesis of a unit root across all three profitability measures for consumer discretionary in both the intercept and intercept and trend models, and for energy, financials, telecommunications services, and utilities in the intercept only model.

5. Conclusions

Firms display pervasive differences in profitability. Some firms earn profits above the equilibrium level while other firms earn profits below the equilibrium level. Do such differences disappear over time? Are such differences transitory or permanent? We assess these questions empirically by applying a variety of unit-root tests. If we can reject the unit-root null hypothesis in favor of the alternative hypothesis of stationarity, then such differences in firm profit eventually dissipate and the series revert to their equilibrium levels. Conversely, if we cannot reject the unit-root null hypothesis, then such differences in firm profit are permanent and the series never return to their original values.

In the standard autoregressive approach, the researcher implicitly assumes that profit (loss) reverts to the mean. It remains to determine how quickly the reversion occurs and whether reversion proceeds to no economic profit. That is, the autoregressive model assumes that firms operate in a "competitive environment", where slow reversion and reversion to a non-zero economic profit implies insufficient competition. Persistent profit can come from two different sources – market power and more efficient operation. Such persistence in profit continues only if sufficient barriers insulate firms from competitive forces.

In the unit-root approach, the researcher permits the profit to follow a hysteretic process that does not revert to the mean. Firms do not face a "competitive environment". Other factors may affect profit, but these factors must also exhibit hysteretic processes and cointegrate with profit itself. That is, the driving forces behind hysteretic profit, if they exist, must also exhibit a unit-root process. We note in the introduction that industries display substantial and persistent differences in productivity (Nelson and Winter, 1982), innovation (Griliches, 1986), skill compositions and wages (Haltiwanger *et al.*, 2007), profitability (Mueller, 1977, 1986), and so on. In sum, profitability may cointegrate with productivity, innovation, skill composition, wages, and so on, where each variable exhibits a hysteretic process.

We apply conventional methodologies (Harris and Tzavalis, 1999 and Im, *et al.*, 1997, 2003) for unit roots in panel data. These tests reject the unit-root hypothesis in firm profits and support the long-standing "competitive environment" (Mueller, 1986) hypothesis for all sectors, except utilities.[29] These tests, however, encounter a potential problem, which is now widely recognized in the econometric literature. To wit, the assumption of cross-section independence in panel data tests is rarely observed in industry data. Cross-section dependence reflects a mixture of factors, such as unobservable common stochastic trends, unobservable common factors, common macroeconomic shocks, spatial effects, and spillover effects. Thus, assuming cross-section independence proves unrealistic in industry studies. In fact, the *CD* test (Pesaran, 2004) confirms the existence of cross-section dependence in the original, winsorized, and "pre-Lehman" data sets.

Cross-section dependence does matter and affect substantially the outcome of the tests. Thus, while conventional panel unit-root tests suggest that profitability exhibits mean-reverting (stationary) behavior, tests that account for cross-section dependence (Pesaran, 2007) no longer consistently rejects the null hypothesis on non-mean-reverting (non-stationary) behavior for many sectors of the US economy. Thus, in those sectors, we cannot describe the dynamics of firm profits by mean-reverting dynamics. Rather, in contrast to previous research which suggests persistent, but stationary firm profitability, we uncover evidence of hysteretic features in the dynamics of profits in many sectors. This is inconsistent with the "competitive environment"

[29] In the "pre-Lehman" sample, we cannot reject the null hypothesis of a unit root for the materials and energy sectors.

hypothesis. Furthermore, the inability to reject the unit-root hypothesis for all sectors of the US economy indicates that some sectors of the US economy see persistence differences in profitability, where competitive pressures never erode such differences.

In addition, we consider two robustness checks on our findings – winsorized data series to reduce the influence of outliers and using the "pre-Lehman" sample that excludes the financial crisis and Great Recession at the end of our full sample. The findings for the winsorized data exhibit marginal adjustments with slightly more evidence of stationary ("competitive environment") behavior. The results for the "pre-Lehman" sample generate more evidence of stationary ("competitive environment") behavior.

In sum, the "competitive environment" hypothesis becomes, in our findings, a less-compelling concept. Considering the original data set, we strongly reject the "competitive environment" hypothesis in all sectors. That is, we do not reject the null hypothesis of a unit root for all three measures of profitability in any sector and for either the intercept and the intercept and trend models. When we winsorize the data series, we strongly support the "competitive environment" hypothesis for industrials. That is, we reject the null hypothesis of a unit root only for industrials across all three measures of profitability and across the intercept and the intercept and trend models. Finally, when we employ the "pre-Lehman" data set, we strongly support the "competitive environment" hypothesis only for information technology. That is, we reject the null hypothesis of a unit root for information technology across all three measures of profitability and across the intercept and the intercept and trend models.

This mixed evidence is not surprising. Our data encompass a short time span: only one decade. A robust and powerful rejection of the null of unit root with slowly reverting series may require a span of data covering more than one decade. Thus, we regard our findings as suggestive, but not conclusive. This paper can only offer preliminary indications of the dynamics of profits in the US industries. To discover the factors driving our results requires more work. A multiplicity of factors may simultaneously affect our analysis, including economies of scales, merger and acquisition activities, and regulation. Nevertheless, the use of panel unit-root tests remains a valuable approach that offers some interesting insight into the industry competitive process.

We offer one final caution on our findings. To wit, although we disaggregated our analysis to industry sector levels, we may not have disaggregated enough to reach the truly industry level required to test the "competitive environment" hypothesis.

References:

Abowd, J. M., Haltiwanger, J., Jarmin, R., Lane, J. I., Lengermann, P., McCue, K., McKinney, K., and Sandusky, K., (2005). The Relation among Human Capital, Productivity, and Market Value: Building Up from Micro Evidence. In *Measuring Capital in the New Economy, Studies in Income and Wealth,* C. Corrado, J. Haltiwanger, and D. Sichel (Eds), 65, 153–204, University of Chicago Press, Chicago, 2005.

Arellano, M., and Bond, S., (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, *Review of Economic Studies*, 58, 277-297.

Aslan, A, Kula, F. and Kaplan, M., (2010). New Evidence on The Persistence of Profit in Turkey with First and Second Generation Panel Unit Root Test. *METU Studies in Development* 37, 25-40.

Aslan, A., Koksal, K, and Ocal, O, (2011). Competitive Environment Hypothesis in Turkish Banking System. *International Journal of Economics and Financial Issues* 1, 74-77.

Bain, J. S., (1951). Relation of Profit Rate to Industry Concentration: American Manufacturing 1936-1940. *Quarterly Journal of Economics* 65, 293-324.

Bain, J. S., (1956). *Barriers to New Competition*, Cambridge, MA, Harvard University Press.

Barnett, V. and Lewis, T., (1994). *Outliers in statistical data*. Third edition, John Wiley.

Bentzen, J., Madsen, E., Smith, V., and Dilling-Hansen, M., (2005). Persistence in Corporate Performance? Empirical Evidence from Panel Unit Root Tests. *Empirica* 32, 217-230.

Bou, J.C., and Satorra, A., (2007). The Persistence of Abnormal Returns at Industry and Firm Levels: Evidence from Spain. *Strategic Management Journal* 28, 707-722.

Breitung, J., and Pesaran, M. H. (2008). Unit roots and cointegration in panels. In *The Econometrics of Panel Data,* L. Matyas and P. Sevestre (Eds.), Third edition, Ch. 9, 279-322. Kluwer Academic Publishers.

Breusch, T. S., and Pagan, A. R., (1980). The Lagrange Multiplier Test and Its Applications to Model Specification in Econometrics. *Review of Economic Studies* 47, 239-254.

Cameron, A. C., and Trivedi, P. K., (2005). *Microeconometrics: Methods and Applications*. Cambridge University Press.

Collins, N. R., and Preston, L. E., (1969). Price-Cost Margins and Industry Structure. *Review of Economics and Statistics* 51, 271-286.

Comanor, W. S., and Wilson, T. A., (1967). Advertising, Markets Structure and Performance. *Review of Economics and Statistics* 49, 423-440.

Combs, J., Crook, T., and Shook, C., (2005). The Dimensionality of Organizational Performance and its Implications for Strategic Management Research. In *Research Methodology in Strategy and Management*, Vol. 2, D. J. Ketchen and D. D. Bergh (Eds.). Emerald Group Publishing Limited, Elsevier, 259-286.

Crispo Cuaresma, J., and Gschwandtner, A., (2006). The Competitive Environment Hypothesis Revisited: Nonlinearity, Nonstationarity and Profit Persistence. *Applied Economics* 38, 465–472.

Crispo-Cuaresma, J., and Gschwandtner, A., (2008). Tracing the Dynamics of Competition: Evidence from Company Profits. *Economic Inquiry* 46, 208-213.

Cubbin, J. and Geroski, P. A., (1990). The Persistence of Profits in the United Kingdom. In *The Dynamics of Company Profits: An International Comparison,* D. C. Mueller (Ed.). Cambridge University Press, Cambridge, 147–67.

Cross, R., Grinfeld, M. and Lamba, H. (2009). Hysteresis and Economics. *IEEE Control Systems Magazine* 29, 30–43.

Dechow, P. M., Hutton, A. P., and Sloan, R. G., (1999). An Empirical Assessment of the Residual Income Valuation Model. *Journal of Accounting and Economics* 26, 1-34.

De Hoyos, R. E., and Sarafidis, V., (2006). Testing for Cross-sectional Dependence in Panel Data Models. *The Stata Journal* 6, 482-496.

Franz, W., (1990). Special Issue on Hysteresis Effects in Economic Models. *Empirical Economics* 15, 109-125.

Fuchs, V. R., (1961). Integration, Concentration and Profits in Manufacturing Industry. *Quarterly Journal of Economics* 75, 278-291.

Geroski, P., and Jacquemin, A., (June 1988). The Persistence of Profits: A European Perspective, *Economic Journal* 98, 375-389.

Geroski, P., (1990). Modelling Persistent Profitability. In *The Dynamics of Company Profits: An International Comparison*, D. C. Mueller (Ed.). Cambridge: Cambridge University Press, 15-34.

Glen, J., Lee, K., and Singh, A., (2001). Persistence of Profitability and Competition in Emerging Markets. *Economics Letters* 72, 247–253.

Goddard, J. A., and Wilson, J. O. S., (1999). The Persistence of Profit: A New Empirical Interpretation. *International Journal of Industrial Organization* 17, 663-687.

Goddard, J. A., Molyneux, P., and Wilson, J. O. S., (2004). The Profitability of European Banks: A Cross-Sectional and Dynamic Panel Analysis, *The Manchester School* 72, 363-381.

Goddard, J. A., Molyneux, P., and Wilson, J. O. S., (2011). The Persistence of Bank Profit. *Journal of Banking and Finance* 35, 2881-2890.

Gordon, R. J., (1989). Hysteresis in History: Was there Ever a Phillips Curve? *American Economic Review* 79, 220-225.

Griliches, Z., (1986). Productivity, R&D and Basic Research at the Firm Level in 1970's. *American Economic Review* 76, 141-154.

Gschwandtner, A., (2005). Profit Persistence in the 'Very' Long Run: Evidence from Survivors and Exiters. *Applied Economics* 37, 793-806.

Gschwandtner, A., (2012). Evolution of Profit Persistence in the US: Evidence from Three Periods. *The Manchester School* 80, 172-209.

Gschwandtner, A. and Hauser, M., (2008). Modelling Profit Series: Nonstationarity and long Memory. *Applied Economics* 40, 1475-1482.

Haltiwanger, J. C., Lane, J. I., and Spletzer, J. R., (1999). Productivity Differences across Employers: The Roles of Employer Size, Age and Human Capital. *American Economic Review* 89, 94-98.

Haltiwanger, J. C., Lane, J. I., and Spletzer, J. R., (2007). Wages, Productivity and the Dynamic Interaction of Businesses and Workers. *Labor Economics* 14, 575-602.

Harris, R. D. F., and Tzavalis, E., (1999). Inference for Unit Roots in Dynamic Panels where the Time Dimension Is Fixed. *Journal of Econometrics* 91, 201-226.

Im, K. S., Pesaran, M. H., and Shin, Y., (1997). Testing for Unit Roots in Heterogeneous Panels. Cambridge Working Papers in Economics, Department of Applied Economics, University of Cambridge.

Im, K. S., Pesaran, M. H., and Shin, Y., (2003). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics* 115, 53-74.

Jenny, F. Y., and Weber, A. P., (1990). The Persistence of Profits in France. In *The Dynamics of Company Profits,* D. C. Mueller (Ed.). Cambridge: Cambridge University Press, 123-128.

Jönsson, K., (2005). Cross-sectional Dependency and Size Distortion in a Small-sample Homogeneous Panel Data Unit Root Test. *Oxford Bulletin of Economics and Statistics* 67, 369-392.

Kambhampati, U. S., (1995). The Persistence of Profit Differentials in Indian Industry. *Applied Economics* 27, 353-361

Kamerschen, D. R., (1969). The Determination of Profit Rates in "Oligopolistic" Industries. *Journal of Business* 42, 293-301.

Khemani, R. S., and Shapiro, D. M., (1990). The Persistence of Predictability in Canada. In *The Dynamics of Company Profits: An International Comparison*, D. C. Mueller (Ed.). Cambridge University Press, Cambridge, 77-104.

León-Ledesma, M. A., and McAdam, P., (2004). Unemployment, Hysteresis and Transition. *Scottish Journal of Political Economy* 51, 377-401.

Levin, A., Lin, C. F., and Chu, C. S. J., (2002). Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties. *Journal of Econometrics* 108, 1-24

Levinson, H., (1960). Post War Movements in Prices and Wages in Manufacturing Industries, Joint Economic Committee, Study of Income, Employment, and Prices. Study Paper No. 21, Washington, Government Printing Office.

Lewandowski, P., (2006). PESCADF: Stata module to perform Pesaran's CADF panel unit root test in presence of cross section dependence, Statistical Software Components S456732, Boston College Department of Economics, revised 08 Oct 2007.

Lieberman, M. B., and Montgomery, D. B., (1988). First-mover Advantages. *Strategic Management Journal* 9, 41-58.

Lipczinsky, J., and Wilson, J., (2001). *Industrial Organization: An Analysis of Competitive Markets*. Prentice Hall, UK.

Luintel, K. B., (2001). Heterogeneous Panel Unit Root Tests and Purchasing Power Parity. *The*

Manchester School (Supplement) 69, 42-56.

Madsen, E., (2010). Unit Root Inference in Panel Data Models where the Time-series Dimension Is Fixed: A Comparison of Different Tests. *Econometrics Journal* 13, 63-94.

Marshall, A., (1890). *Principles of Economics*, Macmillan: London.

McMillan, D. G., and Wohar, M. E., (2011). Profit Persistence Revisited: The Case of the UK. *The Manchester School* 79, 510-527.

Mueller, D. C., (1977). The Persistence of Profits Above the Norm. *Economica* 44, 369-380.

Mueller, D. C., (1986). *Profits in the Long Run.* Cambridge University Press, Cambridge.

Mueller, D. C., (Ed.), (1990). *The Dynamics of Company Profits.* Cambridge, England: Cambridge University Press.

Mueller, D. C., (1997). Merger Policy in the United States: A Reconsideration. *Review of Industrial Organization* 12, 655-685.

Nelson, R., and Winter, S., (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: The Bellknap Press of Harvard University Press.

O'Connell, P. G. J., (1998). The Overvaluation of Purchasing Power Parity. *Journal of International Economics* 44, 1-19.

Odagiri, H., and Yamawaki, H., (1986). A Study of Company Profit-Rate Time Series: Japan and the United States. *International Journal of Industrial Organization* 4, 1-23.

Odagiri, H., and Yamawaki, H., (1990). The Persistence of Profits in Japan. In *The Dynamics of Company Profits*, D. C. Mueller (Ed.). Cambridge: Cambridge University Press, 129-146.

Ohlson, J., (1995). Earnings, Book Values, and Dividends in Equity Valuation. *Contemporary Accounting Research* 11, 661-687.

Pérez-Alonso, A., and Di Sanzo, S., (2011). Unemployment and Hysteresis: A Nonlinear Unobserved Components Approach. *Studies in Nonlinear Dynamics & Econometrics* 15 http://www.bepress.com/snde/vol15/iss1/art2.

Pesaran, M. H., (2004). General Diagnostic Tests for Cross Section Dependence in Panels. Cambridge Working Papers in Economics, Department of Applied Economics, University of Cambridge.

Pesaran, M. H., (2007). A Simple Panel Unit Root Test in the Presence of Cross-section Dependence. *Journal of Applied Econometrics* 22, 265–312.

Resende, M., (2006). Profit Persistence in Brazil: A Panel Data Study. *Estudos Economicos* 36, 115-126.

Schohl, F., (1990). Persistence of Profits in the Long Run. *International Journal of Industrial Organization* 8, 385-404.

Schumpeter, J. A., (1934). *The Theory of Economic Development.* Cambridge, MA: Harvard University Press.

Schumpeter, J. A., (1950). *Capitalism, Socialism and Democracy*. New York: Harper and Row.

Schwalbach, J., Grasshoff, U., and Mahmood, T., (1989). The Dynamics of Corporate Profits. *European Economic Review* 33, 1625-1639.

Schwartzman, D., (1959). The Effects of Monopoly on Price. *Journal of Political Economy* 67, 352-362.

Siddique, A., and Sweeney, R. J., (2000). Earnings, Book Value and Residual Income: Implications of Time Series Properties. Georgetown University: Working Paper, McDonough School of Business.

Spence, M., (1981). The Learning Curve and Competition. *The Bell Journal of Economics* 12, 49-70.

Stephan, A., and Tsapin, A., (2008). Persistence and Determinants of Firm Profit in Emerging Markets. *Applied Economics Quarterly* 54, 231-253.

Strauss, J., and Yogit, R., (2003). Shortfalls of Panel Unit Root Testing. *Economics Letters* 81, 309-313.

Tippett, M., (1990). An Induced Theory of Financial Ratios. *Accounting and Business Research* 21, 77-85.

Tippet, M., and Whittington, G., (1995). An Empirical Evaluation of an Induced Theory of Financial Ratios. *Accounting and Business Research* 25, 209–238.

Waring, G., (1996). Industry Differences in the Persistence of Firm-specific Returns. *American Economic Review* 86, 1253-1265.

Weiss, L. W., (1963). Average Concentration Ratios and Industry Performance. *Journal of Industrial Economics* 11, 237-254.

Whittington, G., and Tippett, M., (1999). The Components of Accounting Ratios as Co-integrated Variables. *Journal of Business Finance and Accounting* 26, 1245–1273.

Yurtoglu, B. B., (2004). Persistence of Firm-Level Profitability in Turkey. *Applied Economics* 36, 615–625.

Table 1: Harris and Tzavalis panel unit-root test results (intercept only)

Economic Sector	*ROA*	*ROE*	*ROI*
Materials	-19.863*	-13.377*	-11.894*
Consumer Discretionary	-26.966*	-37.355*	-34.385*
Consumer Staples	-12.590*	-16.595*	-10.755*
Health Care	-18.252*	-28.776*	-23.791*
Energy	-17.154*	-4.681*	-4.679*
Financials	-24.369*	-23.792*	-23.012*
Industrials	-16.518*	-39.698*	-36.642*
Information Technology	-42.697*	-47.004*	-46.413*
Telecommunication Services	-6.127*	-7.848*	-7.784*
Utilities	-8.403*	-12.340*	-8.802*

Note: The ten sectors include (number of firms in parenthesis): Materials (57); Consumer Discretionary (208); Consumer Staples (67); Health Care (102); Energy (32); Financials (148); Industrials (166); Information Technology (285); Telecommunication Services (6); and Utilities (21). The profit measures include return on assets (*ROA*), return on equity (*ROE*), and return on investment (*ROI*). The *DGP* includes heterogeneous fixed effects and no trend. The test statistic equals $\sqrt{N}(\hat{\rho}_{WG} - 1 - B_2)$, which is asymptotically normally distributed with $\mu = 0$ and $\sigma^2 = C_2$, where $\hat{\rho}_{WG}$ equals the *WG* estimator, $B_2 = -3(T+1)^{-1}$, and $C_2 = 3(17T^2 - 20T + 17)\left(5(T-1)(T+1)^3\right)^{-1}$.

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 2: Harris and Tzavalis panel unit-root test results (intercept and trend)

Economic Sector	*ROA*	*ROE*	*ROI*
Materials	-17.291*	-10.847*	-10.076*
Consumer Discretionary	-15.678*	-24.136*	-20.449*
Consumer Staples	-9.547*	-6.593*	-9.096*
Health Care	-9.051*	-15.380*	-11.376*
Energy	-12.111*	-4.468*	-4.468*
Financials	-11.154*	-14.292*	-10.056*
Industrials	-7.832*	-31.4768*	-28.773*
Information Technology	-29.473*	-32.055*	-33.512*
Telecommunication Services	-13.698*	-13.607*	-15.034*
Utilities	-4.550*	-7.658*	-4.639*

Note: See Table 1. The data generating process includes heterogeneous fixed effects and individual linear trends. The test statistic equals $\sqrt{N}(\hat{\rho}_{WG} - 1 - B_3)$, which is asymptotically normally distributed with $\mu = 0$ and $\sigma^2 = C_3$, where $B_3 = -15(2(T+2))^{-1}$ and $C_3 = 15(193T^2 - 728T = 1147)\left(112(T-2)(T+2)^3\right)^{-1}$.

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 3: Im, Pesaran, and Shin panel unit-root test results (intercept only)

Economic Sector	***ROA***	***ROE***	***ROI***
Materials	-6.656*	-2.974*	-2.260*
Consumer Discretionary	-9.908*	-12.781*	-12.129*
Consumer Staples	-8.213*	-23.179*	-8.745*
Health Care	-10.562*	-10.491*	-12.240*
Energy	-7.556*	-4.809*	-4.981*
Financials	-3.847*	-3.475*	-2.880*
Industrials	-8.991*	-4.619*	-12.311*
Information Technology	-20.835*	-27.639*	-27.822*
Telecommunication Services	-9.017*	-8.3236*	-13.733*
Utilities	-1.855**	-4.216*	-1.769**

Note: See Table 1. The data generating process includes heterogeneous fixed effects and no trend. The Table reports the $W_{\bar{t}_{NT}}$ statistic, $W_{\bar{t}_{NT}} = \frac{\sqrt{N}\left(\bar{t}_{NT} - N^{-1}\sum_{i=1}^{N} E(\bar{t}_{iT})\right)}{\sqrt{N^{-1}\sum_{i=1}^{N}\text{var}(\bar{t}_{iT})}}$, which converges asymptotically to the standard normal distribution.

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 4: Im, Pesaran, and Shin panel unit-root test results (intercept and trend)

Economic Sector	***ROA***	***ROE***	***ROI***
Materials	-4.418*	-4.489*	-3.396*
Consumer Discretionary	-10.146*	-13.807*	-11.178*
Consumer Staples	-6.620*	-15.038*	-12.584*
Health Care	-5.544*	-12.546*	-8.948*
Energy	-8.899*	-3.381*	-3.176*
Financials	-7.894*	-3.785*	-3.977*
Industrials	-4.329*	-2.904*	-10.830*
Information Technology	-15.733*	-21.183*	-24.209*
Telecommunication Services	-12.778*	-8.902*	-10.361*
Utilities	-1.157	-3.242*	-0.621

Note: See Tables 1 and 3. The data generating process includes heterogeneous fixed effects and trend.

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 5: Pesaran's cross-section dependence (*CD*) test results (intercept only)

Economic Sector	***ROA***	***ROE***	***ROI***
Materials	9.591*	9.584*	9.325*
Consumer Discretionary	73.403*	70.573*	75.292*
Consumer Staples	4.578*	2.341**	4.858*
Health Care	1.271	1.938	2.491**
Energy	6.759*	7.730*	7.716*
Financials	85.080*	89.438*	87.729*
Industrials	38.142*	41.953*	44.906*
Information Technology	67.150*	66.637*	71.769*
Telecommunication Services	4.118*	1.688	6.740*
Utilities	4.067*	3.916*	4.771*

Note: See Table 1 The *CD* test statistic for a balanced panel equals $\sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\mathrm{corr}(\hat{\varepsilon}_i,\hat{\varepsilon}_j)\right)$, where $\mathrm{corr}(\hat{\varepsilon}_i,\hat{\varepsilon}_j)=\frac{\sum_{t=1}^{T}\hat{\varepsilon}_{it}\hat{\varepsilon}_{jt}}{\left(\sum_{t=1}^{T}\hat{\varepsilon}_{it}^2\right)^{1/2}\left(\sum_{t=1}^{T}\hat{\varepsilon}_{jt}^2\right)^{1/2}}$ and $\hat{\varepsilon}_{it}$ are estimated residuals from the Augmented Dickey-Fuller (*ADF*) regression equations. Under the null hypothesis of cross-section independence, the *CD* test statistic converges asymptotically to the standardized normal distribution.

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 6: Pesaran's cross-section dependence (*CD*) test results (intercept and trend)

Economic Sector	***ROA***	***ROE***	***ROI***
Materials	36.959*	17.925*	24.962*
Consumer Discretionary	54.248*	92.254*	57.556*
Consumer Staples	7.039*	9.854*	19.195*
Health Care	2.890*	47.111*	5.979*
Energy	7.605*	10.524*	10.104*
Financials	173.858*	68.889*	67.504*
Industrials	44.144*	285.832*	135.446*
Information Technology	113.840*	128.192*	137.954*
Telecommunication Services	11.326*	21.995*	20.630*
Utilities	5.910*	27.706*	3.599*

Note: See Tables 1 and 5

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 7: Pesaran's unit-root test (*CIPS) results (intercept only)**

Economic Sector	*ROA*	*ROE*	*ROI*	*CV5*	*CV1*
Materials	-1.908	-1.956	-1.866	-2.13	-2.32
Consumer Discretionary	-1.723	-1.650	-1.425	-2.08	-2.25
Consumer Staples	-1.934	-1.959	-2.120	-2.13	-2.32
Health Care	-1.626	-1.913	-1.755	-2.08	-2.25
Energy	-1.525	-2.143	-1.678	-2.16	-2.36
Financials	-1.904	-2.074	-2.209**	-2.08	-2.25
Industrials	-2.154**	-1.826	-1.818	-2.08	-2.25
Information Technology	-2.084**	-2.029	-2.003	-2.08	-2.25
Telecommunication Services	-0.779	-1.461	-1.119	-2.47	-2.85
Utilities	-1.690	-2.061	-1.627	-2.22	-2.44

Note: The truncated $CIPS^*(N,T)$ test equals $\frac{1}{N}\sum_{i=1}^{N} t_i^*(N,T)$, where

$$t_i^*(N,T) = \begin{cases} t_i(N,T) & -K_1 < t_i(N,T) < K_2 \\ -K_1 & t_i(N,T) < K_1 \\ -K_2 & t_i(N,T) \geq K_2 \end{cases}$$

K_1 and K_2 depend upon the deterministic component of the models. The cross-section average in the first period is extracted and extreme *t*-values truncated. Pesaran (2007) simulates results in models with intercept and no trend (K_1 = 6.19 and K_2 = 2.61) and in models with intercept and trend (K_1 = 6.42 and K_2 = 1.70).

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 8: Pesaran's unit-root test (*CIPS) results (intercept and trend)**

Economic Sector	*ROA*	*ROE*	*ROI*	*CV5*	*CV1*
Materials	-1.939	-3.065*	-2.864**	-2.73	-2.96
Consumer Discretionary	-2.389	-2.251	-2.177	-2.67	-2.88
Consumer Staples	-3.128*	-2.251	-2.596	-2.73	-2.96
Health Care	-2.231	-2.92*	-2.525	-2.67	-2.88
Energy	-1.107	-1.916	-1.799	-2.75	-3.00
Financials	-2.221	-2.781**	-2.326	-2.67	-2.88
Industrials	-2.393	-2.399	-2.515	-2.67	-2.88
Information Technology	-2.64	-2.507	-2.472	-2.67	-2.88
Telecommunication Services	-0.672	-1.553	-2.489	-3.10	-3.51
Utilities	-2.793	-2.372	-2.717	-2.82	-3.10

Note: See Table 7.

* means significant at the 1-percent level.

** means significant at the 5-percent level.

Table 9: Pesaran's unit-root test (*CIPS) results (intercept only) (Winsorized Sample)**

Economic Sector	*ROA*	*ROE*	*ROI*	*CV5*	*CV1*
Materials	-1.614	-1.756	-1.750	-2.13	-2.32
Consumer Discretionary	-1.660	-2.182**	-1.506	-2.08	-2.25
Consumer Staples	-1.646	-1.696	-1.687	-2.13	-2.32
Health Care	-1.363	-1.472	-1.457	-2.08	-2.25
Energy	-1.651	-1.673	-1.821	-2.16	-2.36
Financials	-1.694	-1.705	-1.976	-2.08	-2.25
Industrials	-2.137**	-2.166**	-2.161**	-2.08	-2.25
Information Technology	-2.183**	-2.057	-2.123	-2.08	-2.25
Telecommunication Services	-1.009	-2.011	-2.039	-2.47	-2.85
Utilities	-1.793	-1.835	-2.013	-2.22	-2.44

Note: See Table 7.
* means significant at the 1-percent level.
** means significant at the 5-percent level.

Table 10: Pesaran's unit-root test (*CIPS) results (intercept and trend) (Winsorized Sample)**

Economic Sector	*ROA*	*ROE*	*ROI*	*CV5*	*CV1*
Materials	-2.401	-2.410	-2.446	-2.73	-2.96
Consumer Discretionary	-2.309	-2.327	-2.338	-2.67	-2.88
Consumer Staples	-2.547	-2.101	-2.450	-2.73	-2.96
Health Care	-1.921	-1.915	-1.941	-2.67	-2.88
Energy	-2.300	-2.343	-2.475	-2.75	-3.00
Financials	-2.396	-2.410	-2.419	-2.67	-2.88
Industrials	-2.753**	-2.889*	-2.795**	-2.67	-2.88
Information Technology	-2.735**	-2.669**	-2.469	-2.67	-2.88
Telecommunication Services	-0.216	-1.775	-1.351	-3.10	-3.51
Utilities	-3.356*	-2.540	-2.886**	-2.82	-3.10

Note: See Table 7.
* means significant at the 1-percent level.
** means significant at the 5-percent level.

Table 11: Pesaran's unit-root test (*CIPS) results (intercept only) ("Pre-Lehman" Sample)**

Economic Sector	*ROA*	*ROE*	*ROI*	*CV5*	*CV1*
Materials	-1.907	-2.423*	-1.916	-2.13	-2.32
Consumer Discretionary	-1.599	-1.231	-1.255	-2.08	-2.25
Consumer Staples	-2.881*	-2.221**	-2.168**	-2.13	-2.32
Health Care	-2.167**	-2.075	-2.369*	-2.08	-2.25
Energy	-2.000	-1.810	-1.754	-2.16	-2.36
Financials	-1.939	-1.843	-1.797	-2.08	-2.25
Industrials	-2.509*	-2.015	-1.857	-2.08	-2.25
Information Technology	-2.601*	-2.550*	-2.548*	-2.08	-2.25
Telecommunication Services	-2.467	-2.119	-2.393	-2.47	-2.85
Utilities	-1.974	-1.798	-2.197	-2.22	-2.44

Note: See Table 7.
* means significant at the 1-percent level.
** means significant at the 5-percent level.

Table 12: Pesaran's unit-root test (*CIPS) results (intercept and trend) ("Pre-Lehman" Sample)**

Economic Sector	*ROA*	*ROE*	*ROI*	*CV5*	*CV1*
Materials	-2.522	-3.062*	-3.075*	-2.73	-2.96
Consumer Discretionary	-2.385	-1.679	-2.187	-2.67	-2.88
Consumer Staples	-2.718	-3.351*	-2.663	-2.73	-2.96
Health Care	-3.148*	-2.850**	-2.947*	-2.67	-2.88
Energy	-3.846*	-2.975**	-3.369*	-2.75	-3.00
Financials	-3.030*	-1.760	-2.570	-2.67	-2.88
Industrials	-2.760**	-1.688	-1.554	-2.67	-2.88
Information Technology	-3.189*	-3.063*	-3.116*	-2.67	-2.88
Telecommunication Services	-3.112**	-2.311	-2.908	-3.10	-3.51
Utilities	-2.743	-2.181	-3.180*	-2.82	-3.10

Note: See Table 7.
* means significant at the 1-percent level.
** means significant at the 5-percent level.

Appendix:

Description of producers in each of the 10 sectors used in our analysis. Compustat economic sector codes in parenthesis

Materials (1000) include all construction materials, chemicals, paper products, and commodity firms.

Consumer Discretionary (2000) includes automobile manufacturers, homebuilders, hotels, gaming, retail, and textile firms.

Consumer Staples (3000) include food, beverages, tobacco, and drug retail and personal care firms.

Health Care (3500) includes health care, pharmaceutical, and biotechnology firms.

Energy (4000) includes all types of oil and gas firms.

Financials (5000) include insurance, banking, and investment brokerage firms.

Industrials (6000) include conglomerates, construction, aerospace/defense, heavy machinery, manufacturing,, trucking, and office services and supplies firms.

Information technology (8000) includes information technology, software, hardware, electronics and semiconductor firms.

Telecommunication Services (8600) include network providers, broadband services, radio, television, and voice communication.

Utilities (9000) include electric companies, natural gas, and water utilities.

Table A1: Summary Statistics by Sector

	Mean	Median	Std.Dev
Return on Assets (ROA)			
Materials	4.51	4.06	52.75
Consumer Discretionary	3.64	5.38	14.41
Consumer Staples	4.67	5.51	9.69
Health Care	-5.38	4.10	33.70
Energy	21.90	5.02	93.18
Financials	0.54	0.97	28.14
Industrials	3.48	5.25	13.57
Information Technology	-4.03	3.04	37.75
Telecommunication Services	-9.23	0.75	36.01
Utilities	3.18	3.37	4.07
Return on Equity (ROE)			
Materials	11.14	9.28	172.35
Consumer Discretionary	3.91	10.57	63.37
Consumer Staples	6.49	6.43	130.53
Health Care	-23.34	6.97	207.67
Energy	1382.91	9.98	8670.15
Financials	6.77	10.20	42.76
Industrials	-85.90	10.49	2959.26
Information Technology	-9.36	4.88	85.22
Telecommunication Services	-20.07	4.09	87.99
Utilities	25.82	11.79	143.69
Return on Investment (ROI)			
Materials	9.18	6.02	166.35
Consumer Discretionary	4.77	8.01	28.18
Consumer Staples	5.94	8.35	25.64
Health Care	-9.11	6.24	55.40
Energy	1386.55	7.27	8669.20
Financials	5.34	7.65	33.83
Industrials	2.13	7.96	86.83
Information Technology	-6.82	4.22	73.08
Telecommunication Services	-17.71	1.26	69.08
Utilities	5.10	5.74	6.51

Table A2: Summary Statistics by Year

	Mean	Median	Std.Dev
Return on Assets (ROA)			
2001	-1.26	2.89	36.56
2002	-3.47	2.41	48.38
2003	0.09	2.95	26.80
2004	3.09	4.29	27.33
2005	3.44	4.70	22.76
2006	3.55	0.97	28.14
2007	3.90	4.70	22.10
2008	1.32	3.86	30.18
2009	-3.09	1.23	47.01
2010	1.55	3.50	32.46
Return on Equity (ROE)			
2001	29.87	8.95	1131.02
2002	15.21	7.63	794.91
2003	37.38	8.81	1172.60
2004	22.55	10.37	666.46
2005	34.31	10.65	956.94
2006	84.21	10.88	2543.54
2007	85.83	10.38	2610.97
2008	52.57	9.20	1761.82
2009	-92.95	4.31	3600.81
2010	-10.28	7.87	1391.69
Return on Investment (ROI)			
2001	32.58	6.15	1124.78
2002	16.13	5.40	793.42
2003	35.39	6.45	1170.71
2004	24.44	7.97	657.19
2005	33.54	8.10	956.71
2006	82.72	8.02	2543.54
2007	85.63	8.08	2610.58
2008	54.99	6.85	1757.17
2009	15.96	3.08	899.64
2010	26.58	6.11	876.81