Cashing In or Paying Out?
Analysis of the Relation Between Corporate Earnings and Cash

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This paper examines the relation between corporate earnings and cash in the US on annual basis in the period 2002 to 2022. We document that both earnings and cash holdings are non-stationary and therefore we use the Granger representation theorem and the methods of cointegration analysis and make an attempt to model the relation between these company variables. We document a negative sign of the cointegration coefficient estimate that is statistically significant. The statistical significance confirms that cash and earnings are cointegrated, and depend on each other. However, the significance of the models with earnings as the dependent variable is larger, and the coefficient estimates are more reliably negative. These results indicate that earnings depend on cash to a larger degree than cash depends on earnings.

Keywords: earnings, EPS, EBITDA, cash, cointegration, VECM

INTRODUCTION

In this paper, we examine the relation between corporate earnings and cash in the US on annual basis in the period 2002 to 2022. Martikainen and Puttonen (1993) study the role that accounting variables, such as earnings and cash play in stock returns formation in Finland using cointegration methodology. They conclude their study by writing:

> "For further research, a similar kind of analysis as reported here based on cash flow information should be extended to larger capital markets."

We extend their study by focusing on the US market. To the best of our knowledge no study has examined the relation of cash and earnings in a cointegration setting in the US. This extension is important, as the US financial markets have ripple effects all over the world.

We document that both earnings and cash holdings are non-stationary and therefore we use the Granger representation theorem and the methods of cointegration analysis and make an attempt to model the relation between these company variables. We document a negative sign of the cointegration coefficient estimate that is statistically significant. The statistical significance confirms that cash and EBITDA are cointegrated, and depend on each other. However, the significance of the models with EBITDA as the dependent variable is larger, and the coefficient estimates are more reliably negative. These results indicate that EBITDA

depends on cash to a larger degree than cash depends on EBITDA. Additionally, we find that cash is impacted by a two- to three-year lag of EBITDA. These results reveal that as EBTIDA increases (decreases), cash increases (decreases) as well, two to three years later. Another year after that, EBITDA increases (decreases) as a result of the increase (decrease) in cash.

Thus, we contribute to the literature by demonstrating that companies do not immediately increase their liquidity when given the opportunity. Instead, companies appear to have a pipeline of worthwhile investment opportunities for approximately two to three years.

LITERATURE REVIEW

There is an extant literature in the area of corporate earnings. Swaminathan and Weintrop (1991), Lee (1996), Kothari (2001), Ertimur et al. (2003) and Beyer et al. (2010) are just of few in the vast literature but those studies are relevant to the ideas developed in this study. Kothari (2001) and Beyer et al. (2010) develop summary studies in the area of financial reporting concerning firm value, such as voluntary firm disclosures, mandatory firm disclosures, and disclosures by independent information intermediaries. Swaminathan and Weintrop (1991) and Ertimur et al. (2003) examine the role of revenues, expenses and earnings surprises in investors' reactions. They show that investors appreciate revenue surprises more than earnings surprises. Lee (1996) examines stock returns, earnings and dividends and their comovement and documents that returns, earnings and dividends are cointegrated. This last study motivated us in exploring further the use cointegration analysis in the context of accounting variables.

The topic of corporate cash and its dynamics has been the subject of many important studies in corporate finance. Opler, et al. (1999), Harford (1999), Dittmar, et al. (2003), Harford, Mansi, Maxwell (2008), Fresard (2010) and Liu and Mauer (2011) are just a few in that area of the finance literature. Opler, et al. (1999) examine the information asymmetry in the context of cash, Harford (1999) examines the influence of cash holdings on the corporate acquisition activity, Dittmar, et al. (2003) study the impact of cash on agency conflicts, Harford, Mansi, Maxwell (2008) examine the role of cash in corporate governance, Fresard (2010) studies cash and its effects on product market competition and Liu and Mauer (2011) examine cash and compensation incentives. Theoretically, there is a strong foundation and reason for the relation of cash to earnings. Corporate earnings can be used as cash for dividends and share repurchases or be held as cash on hand and reinvested in the company as retained earnings:

$$\text{Net Income} = \text{Dividends} + \text{Retained Earnings} \tag{1}$$

Therefore, there is a direct theoretical link between corporate earnings and cash. Considering the randomness in business operations an empirical study of this theoretical link is necessary, therefore our null hypothesis is:

H0: *Earnings and cash are not related.*

We proceed to test this null hypothesis by using the tools of cointegration analysis.

METHODOLOGY

We rely on the Granger representation theorem (Engle and Granger, 1987) to perform the analysis in this study. The Granger representation theorem states that when two series are non-stationary, i.e. integrated of order one, a cointegration of order 'k' can be established for their relation. The Johansen Cointegration Test helps determine the rank of the cointegration relation. Once the rank is determined a vector error correction model VECM(p) can be estimated to determine the most fitting model of the relation. A VECM(p) with a cointegration rank r<=k can be expressed as follows:

$$\Delta y_t = \delta + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Phi_i^* \Delta y_{t-i} + \varepsilon_t, \quad (2)$$

where $\Delta$is the difference operator, $\Pi = \alpha\beta'$, with α being the adjustment coefficient and β - the long-run parameter.

DATA AND ANALYSIS

We use earnings before interest, tax, depreciation and amortization (EBITDA) and cash on annual basis for the period 2002 to 2022. We use EBITDA instead of, for example EBIT, since it reflects the true operating cash flows better than EBITDA, which only reflects the operating cash flow in an accounting sense.

TABLE 1
SUMMARY STATISTICS

Variable	N	Mean	Std. Dev.	25th Perc.	Median	75th Perc.
cash	1449	704.1221	2261.435	34.773	145.273	547.189
EBITDA	1449	1037.324	2196.953	57.66	221.836	970

The adjusted *t*-statistic of Levin, Lin, and Chu (2002) tests the null hypothesis of a unit root, so insignificant results confirm y_{it} being non-stationary. The *z*-statistic of Hadri (2000) has the opposite null hypothesis to minimize type II errors resulting from insufficient power. Thus, significant results confirm y_{it} being non-stationary. ***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

Since our tests require a strongly balanced panel, only observations are included in our sample from firms for which complete data on both cash and EBITDA are available from Compustat over the sample period without gaps. 69 firms meet this requirement, for a total sample size of 1,449 firm-year observations. Table 1 reports the summary statistics of our sample.

TABLE 2
UNIT ROOT TESTS

Variable	Number of Observations	Adjusted *t*-Statistic Levin, Lin, and Chu (2002)	*z*-Statistic Hadri (2000)
cash	1449	-0.741	71.290***
EBITDA	1449	2.824	56.757***

The adjusted *t*-statistic of Levin, Lin, and Chu (2002) tests the null hypothesis of a unit root, so insignificant results confirm y_{it} being non-stationary. The *z*-statistic of Hadri (2000) has the opposite null hypothesis to minimize type II errors resulting from insufficient power. Thus, significant results confirm y_{it} being non-stationary. ***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

We first formally test for the presence of unit roots in both the cash holdings and earnings series. We employ the unit root tests of Levin, Lin, and Chu (2002), and Hadri (2000). The unit root test of Levin, Lin, and Chu (2002) has the null hypothesis of non-stationarity in differences, and is recommended for panels of moderate size, similar to our panel. Additionally, this test overcomes the problem reported by Nickell (1981) that including a fixed-effect term in a dynamic model introduces bias into the asymptotic distribution, by producing a bias-adjusted *t*-statistic which is asymptotically normally distributed.

The Hadri (2000) test is based on the premise that tests with a null hypothesis of an existing unit root can lead to higher Type II errors, and thus incorrect assumptions of unit roots which might really due to

insufficient statistical power. Thus, the Hadri (2000) test has the null hypothesis of no unit root, so statistically significant results are required to confirm non-stationarity in differences.

As the results show, unit root is confirmed for both variables with both test statistics.

TABLE 3
COINTEGRATION TEST RESULTS

Kao (1999)						
Number of Periods	**Number of Observa-tions**	**Modified Dickey-Fuller *t***	**Dickey-Fuller *t***	**Augment. Dickey-Fuller *t***	**Unadjust. Modified Dickey-Fuller *t***	**Unadjust. Dickey-Fuller *t***
21	1449	4.122***	3.839***	9.379***	-8.344***	-5.873***
Pedroni (1999, 2004)						
Number of Periods	**Number of Observa-tions**	**Modified Philips-Perron *t***	**Phillips-Perron *t***	**Augment. Dickey-Fuller *t***		
20	1380	-4.027***	-9.209***	-9.802***		
Westerlund (2005)						
Number of Periods	**Number of Observa-tions**	**Variance Ratio**				
19	1311	-2.684***				

The different test statistics use different regression frameworks to model serial correlation. All tests have the null hypothesis that no cointegration is present in the data. ***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

Next, we formally test for cointegration between the two series, using the cointegration tests of Kao (1999), Pedroni (1999, 2004), and Westerlund (2005). The Kao (1999) cointegration tests assume no time trend, and test the null hypothesis that no cointegration exists. As shown in Table 3, over five different test statistics, the significant results confirm cointegration across the panel series with the same cointegration vector.

Pedroni (1999, 2004) cointegration tests extend the Kao (1999) tests by allowing for panel-specific cointegration vectors and autocorrelations. Over three different test statistics, the significant results confirm cointegration of cash and EBITDA.

The Westerlund (2005) cointegration tests also allow for panel-specific cointegration vectors and autocorrelation. However, the Westerlund (2005) tests extend the Pedroni (1999, 2004) tests by including the panel-specific means into the tests, and do not require modeling accommodating serial correlation (Breitung, 2002; Phillips and Ouliaris, 1990). The significant variance ratio confirms cointegration of cash and EBITDA.

After establishing cointegration the next step in the analysis is to estimate a VECM as expressed in equation (1). We use the AIC, SBIC, and HQIC information criteria for the selection of the most parsimonious model. All three information criteria confirm that five lags of each variable should enter the vector error-correction models. The coefficients are estimated for each firm individually and then averaged to get the results reported in Table 4. In the first and the third column, the average is simply the arithmetic average, similar to Fama-MacBeth panel regressions. In the second and fourth column, the average is formed by weighting the individual coefficient estimates of each panel by their standard errors, extending the idea of appropriate weighting of Fama and MacBeth (1973).

TABLE 4
MODEL ESTIMATES

Variable	Dependent Variable: EBITDA		Dependent Variable: cash	
	Arithmetic Average	Standard Error Weighted Average	Arithmetic Average	Standard Error Weighted Average
Intercept	**50.425**	**1069.063**	**83.508**	**2772.169**
	(-1.116)	(-0.614)	(-0.692)	(-0.441)
Cointegration Coefficient	**-0.913*** **	**-10.557*** **	**-0.211** **	**44.228** **
	(-4.626)	(-4.087)	(-2.178)	(1.767)
EBITDA lag 1	**0.011*** **	**-19.240**	**0.240* **	**12.064**
	(-3.577)	(0.145)	(-1.729)	(-0.331)
EBITDA lag 2	**-0.128*** **	**-18.061* **	**-0.166* **	**-236.003*** **
	(-3.147)	(-1.419)	(-1.698)	(-4.997)
EBITDA lag 3	**-0.050*** **	**-10.052**	**-0.512* **	**-64.889*** **
	(-3.046)	(-0.410)	(-1.599)	(-2.697)
EBITDA lag 4	**0.031*** **	**-62.442** **	**-0.484* **	**-11.486**
	(-3.275)	(1.810)	(-1.504)	(-0.839)
EBITDA lag 5	**-0.293*** **	**-2.989**	**-0.117* **	**47.242* **
	(-3.153)	(-1.145)	(-1.733)	(1.575)
cash lag 1	**-0.162*** **	**40.509**	**-1.596* **	**-29.230** **
	(-3.646)	(0.471)	(-1.566)	(-1.910)
cash lag 2	**0.191*** **	**23.533**	**-1.362* **	**-24.465* **
	(-4.059)	(-0.339)	(-1.582)	(-1.747)
cash lag 3	**0.201*** **	**32.985**	**-1.105* **	**-23.341** **
	(-3.859)	(-0.828)	(-1.591)	(-2.520)
cash lag 4	**0.056*** **	**19.644**	**-0.756* **	**-12.623** **
	(-3.541)	(-0.288)	(-1.612)	(-1.956)
cash lag 5	**0.330*** **	**6.388**	**-0.480* **	**-11.327** **
	(-3.261)	(-0.917)	(-1.393)	(-2.323)
N	15	15	15	15

***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

The negative sign of the cointegration coefficient estimate as well as its significance confirm that cash and EBITDA are cointegrated, and depend on each other. However, the significance of the models with EBITDA as the dependent variable is larger, and the coefficient estimates are more reliably negative and, if they are, larger. These results indicate that EBITDA depends on cash to a larger degree than cash depends on EBITDA. Additionally, the results in Table 4 show that cash is impacted by a two- to three-year lag of EBITDA. Thus, the results reveal that as EBTIDA increases (decreases), cash increases (decreases) as well, two to three years later. Another year after that, EBITDA increases (decreases) as a result of the increase (decrease) in cash.

To get a better estimation of the actual effect size that cash has on EBITDA, the Johansen (1995) normalization restriction is applied. Hence, the coefficient estimate for EBITDA is normalized to 1, and does not have a standard error. The reduced number of elements in the vector-error correction matrix also does not allow for the computation of the standard error, and thus the significance level of the coefficient estimate of the intercept. The coefficient estimate of cash is again averaged across panels by using the arithmetic average and the standard error weighted average, similar to Table 4. The results show that cash and EBITDA are cointegrated, with cash significantly impacting EBITDA.

TABLE 5
LONG-RUN AND ADJUSTMENT COEFFICIENTS TABLE

Variable	Arithmetic Average	Standard Error Weighted Average
Intercept	**0.358**	**0.358**
	(.)	(.)
EBITDA	**1**	**1**
	(.)	(.)
cash	**-1.277*** **	**-3.172*** **
	(-8.445)	(-3.810)

The coefficient estimate of EBITDA is normalized to 1 as the Johansen (1995) normalization restriction is implemented. As a result of the Johansen (1995) normalization restriction, not enough elements in the vector-error correction matrix are available to determine the standard error and thus the significance level of the adjusted coefficient estimate for the intercept. Hence, this coefficient estimate could not be computed by using the standard error weighted average. ***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

ROBUSTNESS

To assess the impact of the Great Recession of 2008 and the robustness of the results of our main analyses, we split the sample in before and after 2008.

TABLE R2
UNIT ROOT TESTS

Before 2008			
Variable	**Number of Observations**	**Adjusted *t*-Statistic Levin, Lin, and Chu (2002)**	***z*-Statistic Hadri (2000)**
cash	408	-28.158***	4.788***
EBITDA	408	-9.088***	15.553***
After 2008			
Variable	**Number of Observations**	**Adjusted *t*-Statistic Levin, Lin, and Chu (2002)**	***z*-Statistic Hadri (2000)**
cash	952	-2.239**	34.835***
EBITDA	952	1.719	44.833***

The adjusted *t*-statistic of Levin, Lin, and Chu (2002) tests the null hypothesis of a unit root, so insignificant results confirm y_{it} being non-stationary. The *z*-statistic of Hadri (2000) has the opposite null hypothesis to minimize type II errors resulting from insufficient power. Thus, significant results confirm y_{it} being non-stationary. ***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

We first formally test for the presence of unit roots in both the cash holdings and earnings series, similar to the tests described in Table 2. The results confirm unit root is generally confirmed for both time periods, although to a lesser degree for cash after 2008 with the Leven, Lin, and Chu (2002) test statistic. The same test statistic is insignificant for EBITDA after 2008.

TABLE R3
COINTEGRATION TEST RESULTS

Before 2008						
Kao (1999)						
Number of Periods	**Number of Observations**	**Modified Dickey-Fuller *t***	**Dickey-Fuller *t***	**Augment. Dickey-Fuller *t***	**Unadjust. Modified Dickey-Fuller *t***	**Unadjust. Dickey-Fuller *t***
4	272	0.493	-4.462***	-6.759***	-2.310**	-6.367***
Pedroni (1999, 2004)						
Number of Periods	**Number of Observations**	**Modified Philips-Perron *t***	**Phillips-Perron *t***	**Augment. Dickey-Fuller *t***		
5	340	5.349***	-31.198***	-29.887***		
Westerlund (2005)						
Number of Periods	**Number of Observations**	**Variance Ratio**				
6	408	-0.756				
After 2008						
Kao (1999)						
Number of Periods	**Number of Observations**	**Modified Dickey-Fuller *t***	**Dickey-Fuller *t***	**Augment. Dickey-Fuller *t***	**Unadjust. Modified Dickey-Fuller *t***	**Unadjust. Dickey-Fuller *t***
13	884	4.898***	3.555***	8.560***	-11.464***	-9.616***
Pedroni (1999, 2004)						
Number of Periods	**Number of Observations**	**Modified Philips-Perron *t***	**Phillips-Perron *t***	**Augment. Dickey-Fuller *t***		
13	884	-0.604	-9.132***	-8.842***		
Westerlund (2005)						
Number of Periods	**Number of Observations**	**Variance Ratio**				
14	952	-2.100**				

The different test statistics use different regression frameworks to model serial correlation. All tests have the null hypothesis that no cointegration is present in the data. ***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

We repeat the analyses of Table 3 and test for cointegration between the two series for each subperiod, using the cointegration tests of Kao (1999), Pedroni (1999, 2004), and Westerlund (2005). As in the main analyses, cointegration is confirmed for both subperiods, although the power of the statistical tests is smaller, due to fewer observations in each subsample.

TABLE R4
MODEL ESTIMATES

	Dependent Variable: EBITDA		Dependent Variable: cash	
Variable	**Arithmetic Average**	**Standard Error Weighted Average**	**Arithmetic Average**	**Standard Error Weighted Average**
Intercept	**-1.128*** **	**-4.930*** **	**95.279** **	**102101.816*** **
	(20.508)	(15.589)	(-2.350)	(128928.631)
Cointegration Coefficient	**0.369*** **	**2.080*** **	**0.148**	**0.809*** **
	(-4.097)	(9.364)	(-1.185)	(10.763)
EBITDA lag 1	**0.138*** **	**1.021*** **	**-0.043**	**-0.256*** **
	(5.901)	(5.617)	(1.269)	(13.364)
EBITDA lag 2	**0.432*** **	**1.402*** **	**-0.059**	**0.199*** **
	(-12.155)	(6.432)	(-0.971)	(11.350)
EBITDA lag 3	**0.636*** **	**2.606*** **	**0.387**	**2.760*** **
	(-18.871)	(9.647)	(0.358)	(13.619)
EBITDA lag 4	**0.680*** **	**2.283*** **	**0.826***	**2.290*** **
	(-17.425)	(6.260)	(2.082)	(13.401)
EBITDA lag 5	**0.031*** **	**-0.806** **	**0.566***	**1.346*** **
	(-13.725)	(2.745)	(1.836)	(8.289)
cash lag 1	**-1.128*** **	**-4.930*** **	**0.263**	**0.357*** **
	(20.508)	(15.589)	(1.138)	(3.544)
cash lag 2	**0.369*** **	**2.080*** **	**31.856**	**138987.741*** **
	(-4.097)	(9.364)	(-0.148)	(57588.108)
cash lag 3	**0.138*** **	**1.021*** **	**95.279** **	**102101.816*** **
	(5.901)	(5.617)	(-2.350)	(128928.631)
cash lag 4	**0.432*** **	**1.402*** **	**0.148**	**0.809*** **
	(-12.155)	(6.432)	(-1.185)	(10.763)
cash lag 5	**0.636*** **	**2.606*** **	**-0.043**	**-0.256*** **
	(-18.871)	(9.647)	(1.269)	(13.364)
N	10	10	10	10

***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

We also attempt to repeat the analyses of Table 4 for both subperiods. Unfortunately, the period before 2008 does not have enough observations, and thus not enough degrees of freedoms to perform the analyses. However, the results for the period after 2008 reveal that EBITDA depends on cash, while cash does not depend on EBITDA. This not only supports the findings from the main analyses, but strengthens their interpretation and thus adds further support to our hypothesis.

The analyses of Table 5 could also only be performed for the post-2008 period due to insufficient degrees of freedoms. The results show that cash and EBITDA are still cointegrated, but the sign is reversed, relative to the results from our main analyses.

TABLE R5
LONG-RUN AND ADJUSTMENT COEFFICIENTS TABLE

Variable	Arithmetic Average	Standard Error Weighted Average
Intercept	**-2567.07**	**-2567.07**
	(.)	(.)
EBITDA	**1**	**1**
	(.)	(.)
cash	**3.023*** **	**-36894.2**
	(16.843)	(0.180)

The coefficient estimate of EBITDA is normalized to 1 as the Johansen (1995) normalization restriction is implemented. As a result of the Johansen (1995) normalization restriction, not enough elements in the vector-error correction matrix are available to determine the standard error and thus the significance level of the adjusted coefficient estimate for the intercept Hence, this coefficient estimate could not be computed by using the standard error weighted average. ***, **, * represent statistical significance at the 1, 5 and 10% confidence level.

CONCLUSION

This paper examines the relation between corporate earnings and cash in the US on annual basis in the period 2002 to 2022. We document that both earnings and cash holdings are non-stationary and therefore we use the Granger representation theorem and the methods of cointegration analysis and make an attempt to model the relation between these company variables.

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