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THE MISHKIN TEST: AN ANALYSIS OF MODEL EXTENSIONS

Literature
review

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Abstract

This paper reviews empirical research that apply Mishkin test for the examination of the existence of accruals anomaly using alternative approaches. Mishkin test is a test used in macro-econometrics for rational hypothesis, which test for the market efficiency. Starting with Sloan (1996) the model has been applied to accruals anomaly literature. Since Sloan (1996), the model has known various improvements and it has been the subject to many debates in the literature regarding its efficacy. Nevertheless, the current evidence strengthens the pervasiveness of the model. The analyses realized on the extended studies on Mishkin test highlights that adding additional variables enhances the results, providing insightful information about the occurrence of accruals anomaly.

Introduction

The literature of accruals anomaly has known a culminating expansion since the work of Sloan (1996). The author demonstrates that investors are not able to understand the different persistence of accruals and cash flow components of earnings. Sloan (1996) is the first who uses the Mishkin Test in order to test for the capacity of stock prices to reflect different properties of accrual and cash flow components of earnings. Mishkin test is used in macro-econometrics for rational hypothesis, which test for the market efficiency.

The evolution of the accruals anomaly research was based primarily on the new perspectives that researchers offered to the estimation of Mishkin test. Most of the studies have extended Mishkin test by developing different approaches. Although, the Mishkin test has been applied with success in different contexts the conflicting evidence (Kraft et al., 2007) has determined model improving through the inclusion of new variables, by dividing the firms in smaller groups or by following other estimations.

This paper analyzes the most relevant studies in this field that apply Mishkin test and follow a different approach than the initial one. This critical examination of the extended studies on Mishkin test highlights that adding additional variables in the model enhances the results, providing insightful information about the occurrence of accruals anomaly.

The rest of the paper discusses the basic research model, the econometric estimation, the current debates and the new extensions of the model. The last section presents the main conclusions.

The basic model

Mishkin test implies the estimation of two equations: a rational forecasting equation and a market equilibrium pricing equation. The estimated parameters from the forecasting equation are compared with the estimated parameters from the pricing equation. This comparison helps testing for investors' fixation on earnings hypothesis (Dechow et al., 2011). In Xie (2001) approach, Mishkin test is a statistical comparison between the forecasting coefficient of abnormal accruals and the valuation coefficient of abnormal accruals. If the valuation coefficient is significantly smaller (larger) than the forecasting coefficient, it signals an underpricing (overpricing) of abnormal accruals (Xie, 2001). The forecasting coefficient can also be interpreted as a measure of the persistence of abnormal accruals.

Mishkin test is a test used in macro-econometrics testing for the market efficiency. In general, the studies that apply Mishkin test reject market efficiency. Mishkin test tests whether market's objective expectation of earnings is the

same with the objective expectation of earnings based on previous information.

In accruals anomaly literature it is combined the persistence model with the rational pricing model. It results the following system:

$$\begin{aligned} Earnings_{t+1} &= \alpha_0 + \alpha_1 Earnings_t + v_{t+1} \\ \text{Abnormal returns} &= \beta(Earnings_{t+1} - \alpha_0 \\ &\quad - \alpha_1^* Earnings_t) + \varepsilon_{t+1} \end{aligned} \quad [1]$$

In the above equation, the compulsory constraint of market efficiency is that $\alpha_1 = \alpha_1^*$, which enforces correct anticipated stock prices for earnings performance (Sloan, 1996).

Applying the different persistence for the accrual and cash flow components of earnings proposed by Sloan (1996), the model transforms itself in one of the most used versions of the Mishkin Test.

$$\begin{aligned} Earnings_{t+1} &= \gamma_0 + \gamma_1 Accrual_t \\ &\quad + \gamma_2 Cash Flow_t + v_{t+1} \\ \text{Abnormal returns}_{t+1} &= \beta(Earnings_{t+1} - \gamma_0 \\ &\quad - \gamma_1^* Accrual_t - \gamma_2^* Cash Flow_t) \\ &\quad + \varepsilon_{t+1} \end{aligned} \quad [2]$$

Now, the market efficiency demands for the model two constraints $\gamma_1 = \gamma_1^*$ and $\gamma_2 = \gamma_2^*$, which requires that market anticipates rationally the impact of current accrual and cash flow on future earnings. As the different earnings persistence implies that $\gamma_1 < \gamma_2$, the market efficiency imposes that $\gamma_1^* < \gamma_2^*$. These two coefficients may be equal if investors are not able to distinguish between accrual and cash flow components of earnings (Sloan, 1996).

The second equation implies that the returns from year t+1 are responding to the unexpected earnings in year t+1. β represents the earnings response coefficient or the valuation multiplier. Unexpected earnings are comprised in the parenthesis.

Econometric estimation

a. Iterative weighted non-linear least squares

Equations are estimated by an iterative weighted non-linear least square in two stages (Sloan, 1996) which is asymptotically equivalent with OLS (Dechow et al., 2011). The first stage imposes the estimation of the equations without constraints on coefficients, while in the second stage, equations are estimated with the rational pricing constraints.

The estimation of 2SLS is a technique used for over-identified systems done in 2 stages (Brooks, 2008):

- Estimation of a reduced form equations using OLS; saving the fitted values for the dependent values.

- Estimation of the structural equation using OLS and replacing any RHS endogenous variables with the fitted values from the first stage.

Following 2SLS, the 3SLS offers a third step in the estimation process with non-zero covariance between the error terms. This estimation is more efficient than 2SLS because the last one does not take into account information about error covariance.

b. Likelihood ratio statistic

For the test of market efficiency is used a likelihood ratio statistic, distributed asymptotically $\chi^2(q)$. The likelihood ratio statistic compares the values of the restricted and unrestricted cases. Consequently, it will show whether the data are more likely under a model than another, or to reject the null model in favour of the alternative model. This statistical test helps in taking a decision when are 2 hypotheses. If the test has a high value, then the null hypothesis cannot be rejected. If it has a low value the null hypothesis is likely to be rejected (Brooks, 2008). The null hypothesis is that market rationally prices one or more earnings components regarding the forecasting of future earnings.

$$2n \ln (SSR^c / SSR^u) \quad [3]$$

q - number of constraints imposed by market efficiency

n - the number of observations

SSR^c - the sum of squared residuals from the constrained weighted system

SSR^u - the sum of the squared residuals from the unconstrained weighted system

The results of the likelihood ratio statistic in Sloan's study indicate the investors fail in anticipating the persistence of earnings components. The results reject the market efficiency because prices are overweighting accruals and underweighting cash flows.

Debates of Mishkin test

Existing research in this area has used the Mishkin test to confirm the existence of accruals anomaly. However, many papers have found limits to the Mishkin test. The most conflicting evidence is brought by Kraft et al. (2007) paper. Their study indicates that Mishkin test is not able to identify whether the market is efficient regarding accruals in forecasting equation. They recommend the utilization of an OLS function instead of Mishkin TEST. Specifically they demonstrate that accruals anomaly disappears when are incorporated additional variables in Mishkin test. Another aspect is that ordinary least squares may be equivalent to Mishkin test for large samples, providing similar coefficients and inferences.

Kraft et al. (2007) doubt whether the results of Mishkin test in the accounting literature enhance market inefficiency or are just a

misspecification of Mishkin test. Authors consider that Mishkin is in fact thinking to market efficiency tests in general, and not to specific variables that may be included in forecasting equation. Thus, Kraft et al. (2007) assume the fact that forecasting equations can be estimated with omitted variables in order to test for the market efficiency, even if cannot found which variable is the source of information. Thus, the use of Mishkin test leads to wrong inferences regarding rationally market pricing. Also, the Mishkin test is not applied the same as in economics literature, as the economists apply the test on time-series data with a single equation for both the forecasting and pricing model. Authors recommend the inclusion of other variables in the estimation, to avoid an incorrect supposition that mispricing is determined by different variables when is in fact determined by an omitted variable. Lewellen (2010) also emphasizes the possibility that earnings could be forecasted correctly and another variable may be interpreted wrong. Thus, Mishkin test could be repeated by replacing earnings with other variables correlated with returns.

In a recent paper of Dechow et al. (2011) which reviews the accruals anomaly, authors accept that indeed the equations could be estimated by an OLS, but this could bring a lack of direct estimated and associated errors for γ_1^* , γ_2^* . Further, they highlight that although the Mishkin test involves a non-linear least square, this is asymptotically equivalent to OLS. Regarding the criticism about the omitted variables from Kraft et al. (2007) and Lewellen (2010), Dechow et al. (2011) replicate that as long as it cannot be identified that something that can possible influence accruals and future stock returns, and a "compelling reason" why something should preserve a correlation, this is an empty affirmation.

Another critical discussion about Mishkin test is summarized by Kothari et al. (2005) which shows that Mishkin test's results are sensitive to extreme observations and determination of annual returns originates more extreme values than monthly returns. Because of sensitivity of Mishkin test to extreme observations, LaFond (2005) uses an alternative statistical technique to test for the relation between returns and accruals around the globe. Thus, he employs monthly calendar time portfolio regression to investigate the existence of accruals anomaly.

Extensions of Mishkin test

Much previous research has tried to extend Mishkin test by developing other contextual issues not taken into account by the original model. Thus, while various studies described above have used successfully the original Mishkin test, the conflicting evidence in the literature has enforced model improving by including new variables, by

dividing the firms in smaller groups or by following other estimations (see Table).

We have analyzed the most relevant studies that apply extended versions for the Mishkin test in Table 1. Studies with similar approaches were excluded from the analyses for a better focus. The objective of this examination is to observe improvements made to the test and the achieved validation of the hypotheses.

The most used approach after Sloan (1996) is the one of Xie (2001) which splits accruals in normal and abnormal accruals. The market mispricing of abnormal accruals occurs because the market is not able to understand the persistence of abnormal accruals (Xie, 2001). The results of Mishkintest applied on normal and abnormal accruals reveal that abnormal accruals are less persistent than normal accruals. The hedge portfolio test strengthens these results, although does not show an overpricing of normal accruals. Consistent with this approach, Dechow et al. (2008) split the cash flows in three subcomponents: change in cash balance, issuances/distributions to debt and issuances/distributions to equity. The results suggest that the subcomponent related to equity determines the higher persistence of cash flows. The estimations performed allow the separation of accruals anomaly from external financing anomaly, suggesting that accruals anomaly subsumes the external financing anomaly.

Collins and Hribar (2000) apply an adapted Mishkin test to test for accruals anomaly in order to investigate quarterly the market anticipations for future earnings. Results reveal the same conclusions as the annual estimations. Further, Pincus et al. (2007) apply a similar model with Sloan (1996) for examining the occurrence of accruals anomaly, outside US, on a larger sample of 20 countries arranged by their legal system. Significant accruals overweighting is observed in Australia, Canada, U.K. and US. Thus, the presence of accruals anomaly is confirmed such as on smaller frequency of data (quarterly data) as well as on larger samples (countries data).

Subsequent research divides the companies in different groups in order to improve de original Mishkin test and applies the test on these groups. The criterions used are related to the type of news, earnings quality, accounting information quality, institutional ownership or consistent signals. Thus, Jiang (2007) applies Mishkin test using a differential in persistence between the bad-news and neutral-news groups. He complements this test with a hedge portfolio test, which helps establishing whether the mispricing is economically significant. Author supports that the market does not perceive better the lower persistence in bad-news groups than for the neutral-news group. The results emphasize that market does not misestimate accruals persistence more for

good-news group than for neutral news group. Moreover, Beneish and Vargus (2002) divide the firms in high and low earnings quality groups. Earnings quality is the likelihood that a firm can sustain current earnings in the future. The study intends to investigate whether insider trading illustrates proper earnings quality and accruals influences. They apply five versions of Mishkin test including different variations for total accruals. Results infer that market mispricing occurs due to the mispricing of income-increasing accruals.

Next, Chan et al. (2009) employ the Mishkin test separately for groups with low and high accounting information quality. The results from the Mishkin test highlight that UK market is mispricing accruals in the pre-FRS3 period in companies with a poor accounting information quality. The conclusion is that the quality of accounting information is improved after FRS3 and investors are more capable to correctly understand accruals. Also, it suggests that FRS3 reduces the effect of managerial discretion in reported earnings. Kothari et al. (2006) also apply the Mishkin test separately for companies with income increasing accruals and income decreasing accruals. The results support the agency hypothesis that investors over-estimate accruals persistence in firms with higher accruals. Hence, the results do not hold up investors` fixation hypothesis. Next, Li et al. (2011) test for accruals anomaly in China`s stock market between 1998-2002 and split the companies in loss and profitable firms. They observe that firms are taking a big-bath to avoid delisting from the stock market, recognizing large income-decreasing abnormal accruals in loss years. After this separation of companies, authors find significant evidence for the presence of accruals anomaly in profitable firms. Kaserer and Klinger (2008) apply the original Mishkin test to German capital market (Datastream Global Market Index for Germany) in 1995-2002 years separating firms in German GAAP and IFRS/IAS or US-GAAP. Results show that market reacts efficiently to German GAAP sample and confirm the accruals anomaly for firms that present their financial statement according to IFRS or US-GAAP. They apply dummy variables to the model.

Furthermore, Collins et al. (2003) use the level of institutional ownership (IO) to split the companies. They include interaction terms for accrual and cash flow to test whether their persistence differ between HIO and LIO subsamples. Authors observe that firms with LIO firms have a higher accruals anomaly comparative with HIO. And, Barth and Hutton (2004) estimate the sample differently for firms with consistent signals and without consistent signals to control for the variation across these groups. Consistent signals are reflected by opposite signs of accruals and analyst forecast revisions while inconsistent

signals reflect ambiguous information about accruals persistence. Results confirm that accruals anomaly is higher in the firms with more consistent signals.

In the context of previous examples, we notice that studies that apply modified versions of Mishkin test include new variables to enhance its power or to highlight other factors that could interact with accruals anomaly such as insider trading (Beneish and Vargus, 2002), growth in long-term net operating assets (Fairfield et al., 2003), NOA (Hirshleifer et al., 2004), Pre SI operating accruals and special items (Dechow and Ge, 2006). The papers have included in general dummy variables in order to divide the companies in the above mentioned categories.

Conclusions

The analyses realized on the extended studies on Mishkin test reveal that additional variables enhance the results, providing insightful information about the occurrence of accruals anomaly.

As a general conclusion, we observe that all the studies that apply Mishkin test, either in the original or in the modified form, confirm the presence of accruals anomaly on different samples, strengthening the power of the Mishkin test. Thus, Mishkin test is not only the most used model, but also the most indicated model to confirm the existence of accruals anomaly. Given its appliance on large and different samples and its capability to adapt to different constraints, is no doubt that Mishkin test is the most necessary test in accruals anomaly studies.

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Table no. 1
Analysis of the main studies that propose new extensions for the Mishkin Test

Study	Research question	Adapted model	Specification	Estimation sample	Results
Collins & Hribar (2000)	Does accruals anomaly hold for quarterly data?	$AR_{t+1} = \beta_0 + \beta_1 [E_{t+1} - E_t - \gamma_0 - \gamma_1 ACC_t - \gamma_2 CFO_t] + \varepsilon_{t+1}$	Use quarterly data; After controlling for post-announcement earnings drift	US: 1988-1997	Investor fail to anticipate the lower persistence of accruals compared with cash flows
Xie (2001)	Do stock prices reflect earnings implications of abnormal accruals?	$AR_{t+1} = \alpha + \beta(E_{t+1} - \gamma_0 - \gamma_1 NACC_t - \gamma_2 APACC_t - \gamma_3 CFO_t) + \varepsilon_{t+1}$	Split total accruals in normal and abnormal accruals	US: 1971-1992	Market significantly overprices abnormal accruals more than normal accruals
Beneish & Vargus (2002)	Is insider trading informative about earnings quality and accruals?	$AR_{t+1} = \beta(E_{t+1} - \gamma_0 - \gamma_1 CFO_t - \gamma_2 SA_{acc,t} - \gamma_3 N_{acc,t}) + \varepsilon_{t+1}$	Include insider trading main variables (sell, buy) and market to book ratio; Firms are divided in high vs. low earnings quality	US: 1985-1996	Accruals persistence is lower/higher when is accompanied by abnormal insider selling/buying
Collins et al. (2003)	Do stock prices reflect differentially investor sophistication?	$AR_{t+1} = \beta_0 + \beta_1 (E_{t+1} - \gamma_0 - \gamma_1 ACC_t - \gamma_{1H} H_{acc,t} - \gamma_2 CFO_t - \gamma_{2H} H_{CFO,t}) + \varepsilon_{t+1}$	Split firms in high and low levels of institutional ownership	US: 1988-1997	Accruals anomaly is smaller for firms with high IO relative to low IO firms
Fairfield et al. (2003)	Is overvaluation of accruals a case of investors' difficulty in valuing growth in net operating assets?	$AR_{t+1} = \alpha + \beta(E_{t+1} - \gamma_0 - \gamma_1 G_{LTNOA,t} - \gamma_2 Acc_t - \gamma_3 E_t) + \varepsilon_{t+1}$	Divide growth in net operating assets (accruals) and growth in long-term net operating assets	US: 1964-1993	Market overvalues accruals and growth in long-term net operating assets
Barth & Hutton (2004)	Do revisions of analyst earnings forecasts reflect earnings persistence?	$AR_{t+1} = \beta_0 + \beta_1 (E_{t+1} - \gamma_0 - \gamma_1 Acc_t - \gamma_2 CFO_t) + \varepsilon_{t+1}$	Split the sample in firms with and without consistent signals	US: 1981-1996	Market overestimates the persistence of accruals for all samples, substantially larger for firms with consistent signals
Hirshleifer et al. (2004)	How investors employ the information in NOA?	$AR_{t+1} = \beta(E_{t+1} - \gamma_0 - \gamma_1 Acc_t - \gamma_2 NOA_t - \gamma_3 CFO_t) + \varepsilon_{t+1}$	Include NOA because of NOA ability to forecast future returns due to investors misperceptions	US: 1965-2002	Market is overpricing NOA because it not capable to discount the unsustainability of earnings growth

<p>Dechow&Ge (2006)</p>	<p>How investors perceive the implication of special items in low accrual firms?</p>	$E_{t+1} = \gamma_0 + \gamma_1 \Delta E_t + \gamma_2 \Delta \text{Pre-SI operating accr}_t + \gamma_3 \text{Special items}_t + v_{t+1}$ $AR_{t+1} = \beta(E_{t+1} - \gamma_0 - \gamma_1 \Delta E_t - \gamma_2 \Delta \text{Pre-SI operating accr}_t - \gamma_3 \text{Special items}_t) + \varepsilon_{t+1}$	<p>Include Pre-Special Items operating accruals and special items in the model Observations after the release of SFAS 95</p>	<p>US: 1988-2005</p>	<p>Investors seem capable to recognize that special items are less persistent than other components of accruals. They also overweight accruals and special items and underweight cash flows</p>
<p>Jiang (2007)</p>	<p>Are the levels of accruals mispricing related to the levels of accruals persistence?</p>	$E_{t+1} = a_0 + a_1 ID_t + b_0 CFO_t + b_1 CFO_t * ID_t + c_0 Accr_t + c_1 Accr_t * ID_t + v_{t+1}$ $AR_{t+1} = \alpha + \beta * (E_{t+1} - a_0 - a_1 ID_t - b_0 CFO_t - b_1 CFO_t * ID_t - c_0 Accr_t - c_1 Accr_t * ID_t)$	<p>Include dummy variables for bad-news and good-news firms and neutral - news group</p>	<p>US: 1965-1997</p>	<p>The market does not perceive the lower persistence of the accrued earnings for the bad-news group better than for the neutral-news group and misprices bad-news group to a greater extent.</p>
<p>Dechow et al. (2008)</p>	<p>Do investors understand the implications of differential persistence of cash components?</p>	$E_{t+1} = \gamma_0 + \gamma_1 \Delta E_t + \gamma_2 \Delta CFO_t + \gamma_3 \text{Dist}_{EQ_t} + \gamma_4 \text{Dist}_{D_t} + v_{t+1}$ $AR_{t+1} = \beta(E_{t+1} - \gamma_0 - \gamma_1 \Delta E_t - \gamma_2 \Delta CFO_t - \gamma_3 \text{Dist}_{EQ_t} - \gamma_4 \text{Dist}_{D_t}) + \varepsilon_{t+1}$	<p>Split cash in three components: change in cash balance, issuances/distributions to debt and issuances/ distributions to equity</p>	<p>US: 1950-2003</p>	<p>Investors estimate correctly the persistence of profitability associated with distributed capital and overestimate the persistence of reinvested capital</p>
<p>Chan et al. (2009)</p>	<p>How accounting information quality impacts accruals anomaly?</p>	$E_{t+1} = \lambda_0 + \lambda_{1PRE} PRE_t + \lambda_{2PRE} PRE_t * CFO_t + \lambda_{3PRE} PRE_t * Accr_t + \lambda_{4PRE} PRE_t * CFO_t * Accr_t + v_{t+1}$ $AR_{t+1} = \beta_1 [E_{t+1} - \lambda_0 - \lambda_{1PRE} PRE_t - \lambda_{2PRE} PRE_t * CFO_t - \lambda_{3PRE} PRE_t * Accr_t - \lambda_{4PRE} PRE_t * CFO_t * Accr_t] + \varepsilon_{t+1}$	<p>Include dummy variables for PRE- FRS 3 period; 1995-2002 Separate companies in high and low accounting information quality groups</p>	<p>UK: 1986-1992, 1995-2002</p>	<p>Accruals are mispriced in the period before the implementation of FRS3, thus in low accounting quality group too</p>

Note: E - earnings; Acc- accruals; CFO- cash flow from operation; AR- cumulative size and risk adjusted return; E(Q) – quarterly earnings; N.Acc- normal accruals; Ab.Acc- abnormal accruals; PosAcc /NegAcc - total accruals if total accruals are positive (negative), and 0 otherwise; H_Acc/H_CFO - interaction terms used to test whether the persistence properties of accrual and cash flow components of earnings differ between HIO and LIO subsamples; GrLTNOA- one year growth in long-term net operating