Dissecting Profitability: Evidence from International Stock Markets

Daniel Huber, Matthias Hanauer*‡

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Recent findings for the U.S. stock market indicate that profitability is a priced factor in the cross-section of expected stock returns. We demonstrate that this result also holds for international markets. In a horserace of different profitability definitions, we find that gross profitability adjusted for accounting accruals (i.e. cash-based gross profitability) outperforms other measures of profitability in the prediction of the cross-section of expected stock returns. Furthermore, cash-based gross profitability weakens the accrual anomaly.

Keywords: Anomalies, Profitability, Return Prediction, International Markets, Market Dynamics, Factor models

JEL Classifications: G11, G12, G15

*Department of Financial Management and Capital Markets, Technische Universität München, Arcisstr. 21, 80333 Munich, Germany.
Email: daniel.huber@tum.de, matthias.hanauer@tum.de

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‡Matthias Hanauer is also affiliated with Robeco Asset Management.

I. Introduction

In this paper, we investigate the relation between various prominent profitability measures internationally. We document that profitability is also priced outside the U.S. In contrast to previous results, we find that internationally, a cash-based variant of gross profitability seems to have the highest marginal power in the explanation of the cross-section of expected stock returns.

Novy-Marx (2013) shows that gross-profitability, which is defined as gross profit deflated by the book value of total assets, predicts the cross-section of expected stock returns and also has a higher predictive power than net income deflated by the book value of equity. Ball et al. (2015) confirm these results and point out that the difference in the marginal predictive power is mainly due to the deflator in the measures. Furthermore, they develop a new measure, operating profitability, and claim that this measure reflects more closely the actual expenses incurred in order to generate the revenue for a given period. Operating profitability is defined as gross profit less selling, general and administrative expenses (SG&A), excluding research and development (R&D) expenditures, deflated by the book value of total assets. In a comparison with net income, the authors find that operating profitability is better suited for the prediction of the cross-section of expected stock returns. There is also another definition of operating profitability by Fama and French (2015), which was introduced in the context of the Fama-French five-factor model: Gross profit less SG&A less interest expenses, deflated by the book value of equity.

The three[1] measures of profitability introduced so far have something in common: They include accruals, which are accounting adjustments of operating cash flows in order to measure periodic firm performance more precisely (Ball et al. 2016). Accruals, however, are negatively correlated with the cross-section of expected returns (e.g. Sloan 1996); this phenomenon which is also reffered to as the 'accrual anomaly' was shown by numerous studies (e.g. Fama and French 2006, Hirshleifer, Hou, and Teoh 2009 and Polk and Sapienza 2009). Ball et al. (2016) account for this issue by correcting any accounting accruals adjustments that were made to operating profitability;[2] the result is cash-based operating profitability. They find that it dominates operating profitability in the explanation of the cross-section of expected returns and it even subsumes the accrual anomaly. Furthermore, Fama and French (2016a) acknowledge that cash-based operating profitability also dominates operating profitability as defined in Fama and French (2015). Appropriately, Fama and French (2016b) hint at the possibility, that their definition of operating profitability could be redefined in the future.

The goal of this study is to investigate if these findings can be extended to international markets and thus, to verify, if the 'profitability anomaly' can be seen as a market inefficiency of global scope, that poses wide-spread challenges to asset pricing theory, or if it is only a regional phenomenon, attributable to certain market characteristics. To be more precise, we aim to investigate which of the approaches to measure profitability is best placed for the prediction

[1] If we count the two definitions for operating profitability separetely, it would be four.

[2] These adjustments are changes in accounts receivable, inventory, prepaid expenses, deferred revenue, accounts payable, and accrued expenses.

of the cross-section of expected returns: (i) return on equity (ROE), (ii) gross profitability by Novy-Marx (2013), (iii) operating profitability by Ball et al. (2015) and defined in an alternative way (iv) by Fama and French (2015) and (v) cash-based operating profitability by Ball et al. (2016). The forecasting potential of each of the profitability measures is evaluated in the context of several other well-known and proven return predictors. In this regard, we also try to investigate if there is any room for further improvement in the definition of profitability in international markets. For the purpose of consistency and comparison, we use the (non-lagged) book value of total assets as a deflator for all profitability measures besides ROE and operating profitability by Fama and French (2015), which by definition are deflated by book equity, as they are profitability measures after interest expenses.

We can confirm that the profitability anomaly is globally prevalent. In particular, we show that besides ROE, all four profitability definitions are robustly priced outside the U.S. In comparison with the U.S., however, we find that subtracting SG&A (excluding R&D expenditures) from gross profitability induces a loss in forecasting power, whereas correcting accounting accruals adjustments leads to the same positive effect as in the U.S. Thus, we abstain from the SG&E correction and propose a new profitability measure, that only adjusts for accounting accruals; we name it 'cash-based gross profitability' (vi) within this study. Consequently, we test in total six profilitability measures with regard to their return forecasting ability.

In a horserace of the previously mentioned profitability measures in international markets (ex U.S.), we find that cash-based gross profitability has the highest marginal power to explain future stock returns, and it even beats cash-based operating profitability, as defined by Ball et al. (2016).

In a final step, we also plan to explore the determinants of the profitability anomaly.

II. Empirical Analysis

A. Data

We collect monthly equity market data from Datastream and yearly accounting data from Worldscope from 07/1989 to 06/2016 on firm-level for the following 49 countries: Argentina, Australia, Austria, Belgium, Brazil, Canada, Switzerland, Chile, China,[3] Colombia, Czech, Germany, Denmark, Egypt, Spain, Finland, France, Great Britain, Greece, Hong Kong, Hungary, Indonesia, India, Ireland, Israel, Italy, Jordan, Japan, Korea, Sri Lanka, Morocco, Mexico, Malaysia, Netherlands, Norway, New Zealand, Pakistan, Peru, Philippines, Poland, Portugal, Russia, Singapore, Sweden, Thailand, Turkey, Taiwan, Venezuela, South Africa. We generally include all countries which, at least at some point during the sample period, are classified by MSCI as a developed or an emerging market.

[3] Chinese 'A' shares are excluded from the sample because they are not available for public investors.

Table 1: Descriptive statistics

The table presents summary statistics for the 49 countries of our Datastream and Worldscope sample. Column 2 states the market affiliation according to MSCI, with DM as Developed Markets and EM as Emerging Markets. Columns 3, 4 and 5 report the total, minimum, and maximum number of firms per country, respectively. Columns 6 and 7 state the average mean and median size per country-month, respectively. Column 8 shows the average total size per country-month and column 9 reports these values in percentage of the respective total across countries. Size is measured as market capitalization in million USD. The last two columns report the start and end date of data availability for each country. Following Ball et al. (2016), we require that firms have non-missing values for the following items: market value of equity, book-to-market, gross profit, book value of total assets, current month return and momentum. Financial firms are excluded.

Country	Market	Total no. firms	Min no. firms	Max no. firms	Mean size	Median size	Average total size	Average total size in %	Start date	End date
Argentina	EM	84	2	64	654	166	20,930	0.17	1990-07-31	2009-06-30
Australia	DM	2,210	117	1,334	594	91	368,176	2.91	1990-07-31	2016-06-30
Austria	DM	121	30	61	787	223	38,680	0.31	1990-07-31	2016-06-30
Belgium	DM	165	49	97	1,561	164	114,567	0.91	1990-07-31	2016-06-30
Brazil	EM	183	19	132	2,126	445	194,168	1.53	1995-08-31	2016-06-30
Canada	DM	3,156	198	1,880	632	90	511,635	4.04	1990-07-31	2016-06-30
Switzerland	DM	259	93	177	3,468	288	520,917	4.12	1990-07-31	2016-06-30
Chile	EM	183	18	136	855	209	86,278	0.68	1990-08-31	2016-06-30
China	EM	10	1	10	403	340	2,649	0.02	2000-07-31	2016-06-30
Colombia	EM	57	14	37	1,530	200	44,745	0.35	1994-07-29	2016-06-30
Czech	EM	79	9	59	1,484	129	23,468	0.19	1997-07-31	2016-06-30
Germany	DM	1,052	231	607	1,642	104	769,303	6.08	1990-07-31	2016-06-30
Denmark	DM	202	73	112	922	75	91,368	0.72	1990-07-31	2016-06-30
Egypt	EM	94	11	85	564	138	34,489	0.27	2001-07-31	2016-06-30
Spain	DM	199	54	106	3,053	483	287,837	2.28	1990-07-31	2016-06-30
Finland	DM	167	19	110	1,376	190	124,546	0.98	1990-07-31	2016-06-30
France	DM	1,223	289	624	1,972	105	974,721	7.71	1990-07-31	2016-06-30
Great Britain	DM	2,992	883	1,198	1,517	75	1,524,622	12.05	1990-07-31	2016-06-30
Greece	DM/EM	325	16	253	228	58	37,306	0.29	1990-07-31	2016-06-30
Hong Kong	DM	1,288	47	1,114	999	128	565,014	4.47	1990-07-31	2016-06-30
Hungary	EM	54	16	33	576	46	14,806	0.12	1997-07-31	2016-06-30

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Country	Market	Total no. firms	Min no. firms	Max no. firms	Mean size	Median size	Average total size	Average total size in %	Start date	End date
Indonesia	EM	405	5	323	445	62	98,349	0.78	1991-07-31	2016-06-30
India	EM	2,532	161	2,068	476	57	505,294	3.99	1994-07-29	2016-06-30
Ireland	DM	61	20	35	959	213	24,577	0.19	1993-07-30	2016-06-30
Israel	DM/EM	349	15	279	546	135	64,868	0.51	1995-07-31	2016-06-30
Italy	DM	371	97	203	1,672	198	257,658	2.04	1990-07-31	2016-06-30
Jordan	EM	85	67	82	153	22	12,055	0.10	2006-11-30	2009-06-30
Japan	DM	4,488	994	3,418	1,084	192	2,738,132	21.64	1990-07-31	2016-06-30
Korea	EM	2,025	90	1,650	501	90	441,796	3.49	1992-07-31	2016-06-30
Sri Lanka	EM	12	6	12	31	21	278	0.00	1994-07-29	2001-06-29
Morocco	EM	50	9	48	643	192	20,999	0.17	2001-07-31	2014-06-30
Mexico	EM	27	4	14	1,366	394	11,326	0.09	1990-07-31	2016-06-30
Malaysia	EM	1,061	51	791	368	108	152,542	1.21	1990-07-31	2016-06-30
Netherlands	DM	200	65	122	2,141	260	190,785	1.51	1990-07-31	2016-06-30
Norway	DM	299	49	144	941	129	103,129	0.82	1990-07-31	2016-06-30
New Zealand	DM	172	15	101	430	100	25,161	0.20	1990-07-31	2016-06-30
Pakistan	EM	145	39	129	158	55	12,121	0.10	1994-07-29	2009-06-30
Peru	EM	114	14	87	321	41	18,869	0.15	1994-07-29	2016-06-30
Philippines	EM	177	3	143	465	60	47,686	0.38	1990-07-31	2016-06-30
Poland	EM	501	9	375	253	52	46,142	0.36	1995-07-31	2016-06-30
Portugal	DM/EM	104	28	53	939	130	39,109	0.31	1990-07-31	2016-06-30
Russia	EM	424	5	311	3,406	442	358,320	2.83	1998-07-31	2016-06-30
Singapore	DM	717	31	498	447	93	121,374	0.96	1990-07-31	2016-06-30
Sweden	DM	622	60	362	942	79	200,249	1.58	1990-07-31	2016-06-30
Thailand	EM	571	10	464	300	51	95,952	0.76	1990-07-31	2016-06-30
Turkey	EM	301	10	242	418	106	63,713	0.50	1990-07-31	2016-06-30
Taiwan	EM	1,859	199	1,594	536	126	456,096	3.61	1997-07-31	2016-06-30
Venezuela	EM	22	7	15	259	83	2,680	0.02	1994-07-29	2006-06-30
South Africa	EM	444	105	234	1,049	157	190,992	1.51	1995-07-31	2016-06-30

The result is a comprehensive, international sample, that contains more than 23 million firm-months. Currently, we do not include the U.S., because the analysis of profitability for this region is already available and evidently, including the U.S. would have a considerable effect on any findings that we make; at a later point, however, we plan to add them for the purpose of verification and comparison. Table 1 provides an overview of the sample.

The sample start date 07/1990 was chosen specifically, because this is the time when data availability increases a lot cross-sectionally. Moreover, there is evidence that data quality in Datastream is better for some countries after 1990 (e.g. Brückner 2014).

As we want to restrict our sample to common stocks, exclusively, and in order to ensure high data quality, we conduct the recommended static and dynamic screens proposed by Ince and Porter (2006), Griffin, Kelly, and Nardari (2010) and Schmidt et al. (2016). Mores specifically, (i) we demand that companies are located and securities are listed in the respective domestic country; (ii) only primary quotations of a security are analyzed; (iii) for firms with more than one equity security, only the one with the biggest market capitalization and liquidity is chosen; (iv) securities with quoted currency or with ISIN country code different from those of the associated countries are disregarded; (v) following Karolyi, Lee, and Dijk (2012), Schmidt et al. (2016) and Griffin, Kelly, and Nardari (2010), we also apply name filters in order to exclude any non-common equity like ADRs, investment trusts, REITs, mutual funds, preferred stocks and warrants from our sample. We finally perform a manual check of all removed stocks in order to make sure that none of them was deleted by error.

Moreover, we take into account both, active and dead stocks, in order to obviate survivorship bias. Following Fama and French (1992), Novy-Marx (2013), Ball et al. (2015) and Ball et al. (2016) among others, all financial firms are dropped.

B. Profitability Measures

For the remaining firms, we calculate accruals and cash-based operating profitability according to Ball et al. (2016), operating profitability according to Fama and French (2015) and Ball et al. (2015) and gross profitability according to Novy-Marx (2013). We also calculate cash-based gross profitability, which is defined in a similar way to cash-based operating profitability; the only difference is that the starting point is gross profitability instead of operating profitability. Table 2 contains summary statistics of these variables and additionaly the following four control variables typically analyzed in the context of profitability: The natural logarithm of the book-to-market ratio, with the book value of equity defined as shareholder's equity plus balance sheet deferred taxes (if available), the natural logarithm of the monthly market capitalization lagged by one month, momentum calculated as the cumulative return from $t-12$ until $t-2$ and the current return lagged by one month. As in McLean, Pontiff, and Watanabe (2009), we winsorize each of the variables at the top and bottom 1% to eliminate the effects of outliers.

Table 2: Summary statistics for profitability measures and control variables
The table presents time-series averages of the cross-sectional means, standard deviations and 1%-, 25%-, 50%-, 75%- and 99%-quantiles of the following variables: (1) Gross profitability (gpr) according to Novy-Marx (2013), defined as revenues minus costs of goods sold, divided by the book value of total assets, (2) Operating profitability (op_ff) according to Fama and French (2015), defined as gross profit minus selling, general, and administrative expenses, interest expenses and costs of goods sold, divided by the book value of equity, (3) Operating profitability (op) according to Ball et al. (2016), defined as gross profit minus selling, general, and administrative expenses (excluding R&D expenditures) and costs of goods sold, divided by the book value of total assets, (4) Cash-based operating profitability (cbop) according to Ball et al. (2016), defined as operating profitability (op) minus the change in accounts receivable, the change in inventory, and the change in prepaid expenses, plus the change in deferred revenues, the change in accounts payable, and the change in accrued expenses, deflated by the book value of assets, (5) Cash-based gross profitability (cgbpr), defined the same way as cbop, but starting with gpr instead of op, (6) Accruals (accr), defined as the change in current assets minus the change in cash, the change in current liabilities, the change in current debt, the change in income taxes payable, and depreciation, divided by the book value of total assets, (7) the natural logarithm of book-to-market (logbm), (8) the natural logarithm of the 1-month lagged market value (loglmv), (9) the 1-month lagged return (lret) and (10) momentum (mom).

	gpr	op_ff	op	cbop	cbgpr	accr	logbm	loglmv	lret	mom
mean	0.24	0.21	0.11	0.10	0.22	-0.03	-0.42	11.76	0.01	0.15
sd	0.20	0.41	0.13	0.15	0.21	0.08	0.95	1.82	0.12	0.51
1st	-0.15	-1.43	-0.32	-0.40	-0.25	-0.33	-3.75	7.63	-0.28	-0.67
25th	0.11	0.07	0.05	0.03	0.09	-0.06	-0.94	10.52	-0.06	-0.16
50th	0.20	0.18	0.10	0.09	0.19	-0.03	-0.38	11.69	0.00	0.06
75th	0.32	0.33	0.17	0.17	0.32	0.01	0.16	12.92	0.06	0.33
99th	0.98	1.90	0.55	0.60	1.00	0.24	1.94	16.33	0.47	2.37

C. Fama-MacBeth regressions

In this section, we investigate the return predictability potential of the six profitability measures for the full sample including 49 countries, which are, or were at some point in time, part of the Developed Markets or Emerging Markets Universe according to MSCI. The results are shown in Table 3. Every month from 07/1990 until 06/2016, we perform Fama and MacBeth (1973) regressions of monthly stock returns on one of the six profitability measures (model 1 to 6), on accruals (model 7), on each of the profitability measures in combination with accruals (Panel B), and on cash-based gross profitability in combination with each of the other profitability definitions, respectively (Panel C). Moreover, every model includes the four control variables introduced in section B. In Panel A, we examine the profitability measures separately, whereas Panel C depicts the horse race. Panel B examines the effect of the profitability measures on the accrual anomaly.

We find that the most prominent profitability definitions in the literature, namely gross profitability, operating profitability (according to Fama and French 2015 as well as Ball et al. 2015) and cash-based operating profitability, are significantly priced in the cross-section of expected

Table 3: A comparison of profitability measures and accruals in Fama-MacBeth regressions

The table reports average Fama-MacBeth premiums (multiplied by 100) and their t-values from monthly cross-sectional regressions to predict stock returns (model 1 to 16). The regressions are performed from 07/1990 to 06/2016 for a global sample of DM and EM countries, as defined in the legend of Table 1, controlling for country fixed effects. The independent variables are the 1-month-lagged stock return (lret), momentum (mom), the natural logarithm of the book-to-market ratio (logbm), the natural logarithm of the lagged market value (loglmv), the growth rate of total assets (dtotas), operating profitability (op), gross profitability (gpr), operating profitability according to Fama and French (op_ff), cash-based operating profitability (cbop), cash-based gross profitability (cbgpr) and accruals (accr). Further details on the variable construction are given in Table 2. The last row contains the average adjusted R^2.

Panel A: Individual forecasting potential of profitability measures

	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Mod 6	Mod 7
lret	−4.69	−4.74	−4.70	−4.71	−4.70	−4.73	−4.68
	(−10.93)	(−11.05)	(−10.94)	(−10.97)	(−10.95)	(−11.04)	(−10.87)
mom	0.32	0.29	0.32	0.31	0.31	0.30	0.33
	(1.69)	(1.57)	(1.68)	(1.64)	(1.65)	(1.57)	(1.71)
logbm	0.27	0.33	0.28	0.29	0.29	0.33	0.29
	(6.94)	(8.35)	(6.93)	(7.22)	(7.35)	(8.37)	(7.39)
loglmv	−0.18	−0.17	−0.18	−0.18	−0.18	−0.17	−0.17
	(−6.81)	(−6.29)	(−6.80)	(−6.97)	(−6.84)	(−6.24)	(−6.26)
dtotas	−0.48	−0.45	−0.48	−0.47	−0.39	−0.38	−0.41
	(−8.57)	(−8.48)	(−9.01)	(−8.88)	(−7.65)	(−7.05)	(−7.64)
ROE	0.12						
	(1.33)						
gpr		1.10					
		(7.99)					
op_ff			0.33				
			(5.93)				
op				1.12			
				(5.79)			
cbop					1.08		
					(7.50)		
cbgpr						1.05	
						(9.07)	
accr							−1.19
							(−7.89)
R^2	12.92%	12.93%	12.90%	12.92%	12.90%	12.92%	12.86%

	Panel B: Influence on the accrual anomaly				*Panel C: Horse race of profitability measures*				
	Mod 8	Mod 9	Mod 10	Mod 11	Mod 12	Mod 13	Mod 14	Mod 15	Mod 16
lret	−4.75	−4.71	−4.71	−4.74	-4.75	−4.74	−4.75	−4.75	−4.74
	(−11.09)	(−10.99)	(−10.98)	(−11.07)	(-11.13)	(−11.07)	(−11.12)	(−11.11)	(−11.08)
mom	0.29	0.31	0.31	0.29	0.29	0.29	0.29	0.29	0.29
	(1.54)	(1.64)	(1.64)	(1.56)	(1.53)	(1.56)	(1.55)	(1.53)	(1.56)
logbm	0.34	0.29	0.29	0.33	0.33	0.33	0.32	0.33	0.33
	(8.42)	(7.02)	(7.28)	(8.28)	(8.33)	(8.36)	(7.91)	(8.17)	(8.37)
loglmv	−0.17	−0.18	−0.18	−0.17	-0.17	−0.17	−0.18	−0.17	−0.17
	(−6.28)	(−6.80)	(−6.81)	(−6.25)	(-6.53)	(−6.26)	(−6.55)	(−6.56)	(−6.39)
dtotas	−0.38	−0.41	−0.37	−0.35	-0.37	−0.38	−0.39	−0.38	−0.36
	(−7.26)	(−7.73)	(−7.15)	(−6.59)	(-6.61)	(−7.13)	(−7.13)	(−7.02)	(−6.98)
ROE					0.00				
					(0.03)				
gpr	1.08					0.34			
	(7.86)					(1.65)			
op_ff		0.32					0.16		
		(5.88)					(3.10)		
op								0.37	
								(2.07)	
cbop			0.92						0.22
			(5.63)						(1.50)
cbgpr				0.97	1.04	0.78	0.94	0.93	0.95
				(7.77)	(9.55)	(5.03)	(8.39)	(9.00)	(7.53)
accr	−1.14	−1.23	−0.61	−0.53					
	(−7.59)	(−8.14)	(−3.38)	(−3.12)					
R^2	12.95%	12.92%	12.92%	12.94%	12.99%	12.95%	12.96%	12.96%	12.94%

stock returns. The new measure, cash-based gross profitability, however, has the highest economical and statistical significance in either the individal tests (model 1 to 6), or in the horse race scenario (Panel C). Model 7 confirms the existance of the 'accrual anomaly' in our sample and Panel B shows that the anomaly becomes less prevalent if we add cash-based operating profitability or cash-based gross profitability as explanatory variables to the model.

Thus, we can confirm the result by Novy-Marx (2013) internationally, that gross profitability is a superior profitability measure to ROE. Moreover, similar to Ball et al. (2016), there is a clear positive effect in the adjustment for accounting accruals, i.e. cash-based operating profitability according to Ball et al. (2016) is superior to its non cash-based predecessor. However, we cannot confirm that deducting reported SG&A (but not R&D expenditures) from gross profits improves its predictive power, i.e. that operating profitabilty by Ball et al. (2015) is superior to gross profitability by Novy-Marx (2013). We can also confirm Fama and French (2016a) in their assertion, that cash-based operating profitability beats their original version of operating profitability.

However, in particular from model 5, 6 and 16, we follow that cash-based gross profitability is superior to cash-based operating profitability. Therefore, based on the Fama and MacBeth (1973) regressions, we appoint this measure to the winner of the horse race and believe it is the most suitable profitability definition in international markets.

D. Portfolio analysis

Another, arguably more robust way than the Fama-MacBeth regressions to evaluate the return prediction potential of the profitability measures is to analyze portfolios. Hence, we also form decile portfolios based on every sorting profitability variable at june of every year, from 07/1990 to 06/2016, and calculate value-weighted monthly excess returns from july of year t until june of year $t+1$, respectively. Table 4 presents the average returns and the associated t-values for each of the profitability variables.

The excess return on the high-minus-low decile portfolio created on the basis of ROE, gross profitability (gpr), operating profitability by Fama and French (op_ff), operating profitability (op), cash-based profitability (cbop), cash-based gross profitability (cbgpr), and accruals (acc) is 57 bp, 48 bp, 12 bp, 37 bp, 42 bp, 50 bp and -24 bp, respectively. The associated t-value is 3.20, 3.46, 0.80, 2.71, 3.08, 3.55 and -1.81, respectively. It follows that all the measures, besides op_ff, predict future returns in portfolio sorts. Notably, accruals are a bit less significant than the other profitability measures besides op_ff. Similar to the cross-sectional regressions, the high-minus-low decile portfolio based on cbgpr is from both, an economic and statistical perspective, dominating, even though the equivalent return based on ROE is economically a bit higher (by 7 bp).

Next, we want to determine if this result also holds in the context of the most prominent asset pricing models in the literature. From the previous results, we would expect asset pricing models which incorporate a cash-based operating profitability factor to perform better than those which do not or which rely on factors based on other measures of profitability. In order

Table 4: Summary statistics for excess returns on portfolios from sorts on different profitability measures

The table reports the average excess returns for decile portfolios formed at june of every year and held for the next 12 months, from 07/1990 to 06/2016, based on return on equity (ROE), gross profitability (gpr), operating profitability according to Fama and French (op_ff), operating profitability (op), cash-based operating profitability (cbop), cash-based gross profitability (cbgpr) and accruals (acc). The sorting is only based on big stocks, which are in the top 90% of the aggregate market capitalization, per country. The sample is described in the legend of Table 1. Further details on the variable construction are given in Table 2.

	ROE	gpr	op_ff	op	cbop	cbgpr	acc
				Monthly excess returns			
1 (low)	−0.03	0.02	0.13	0.02	0.02	0.02	0.42
2	0.19	0.14	0.31	0.20	0.14	0.16	0.32
3	0.25	0.21	0.27	0.38	0.45	0.16	0.36
4	0.29	0.27	0.44	0.31	0.25	0.28	0.31
5	0.36	0.50	0.27	0.34	0.39	0.42	0.26
6	0.40	0.30	0.34	0.38	0.28	0.32	0.35
7	0.47	0.37	0.43	0.32	0.34	0.36	0.26
8	0.58	0.39	0.50	0.40	0.38	0.36	0.45
9	0.53	0.48	0.33	0.46	0.45	0.49	0.29
10 (high)	0.54	0.50	0.25	0.40	0.44	0.52	0.19
10-1	0.57	0.48	0.12	0.37	0.42	0.50	−0.24
				t-values			
1 (low)	−0.09	0.06	0.41	0.08	0.07	0.08	1.43
2	0.66	0.46	1.09	0.66	0.44	0.53	1.13
3	0.86	0.71	0.97	1.30	1.57	0.55	1.29
4	1.07	0.91	1.55	1.10	0.86	1.01	1.08
5	1.31	1.68	0.97	1.20	1.41	1.41	0.95
6	1.39	1.04	1.23	1.38	1.05	1.14	1.27
7	1.67	1.30	1.55	1.13	1.21	1.22	0.93
8	2.01	1.37	1.75	1.43	1.38	1.29	1.57
9	1.83	1.73	1.18	1.61	1.50	1.76	1.01
10 (high)	1.87	1.91	0.85	1.38	1.55	2.02	0.61
10-1	3.20	3.46	0.80	2.71	3.08	3.55	−1.81

to test this, we implement the Fama-French-Carhart four-factor model, originally introduced by Carhart (1997), complemented by an investment factor, as well as the Fama-French five-factor model, based on Fama and French (2015). Moreover, we test a new variant of the latter model, that includes a factor based on cbgpr instead of op_ff. Consequently, we have to calculate the following factors: 'small minus big' (SMB), 'high minus low' (HML), 'momentum' (MOM), 'conservative minus aggressive' (CMA) and 'robust minus weak' (RMW), with the latter in two variants: (1) the original version, based on op_ff (RMW), and a new version, based on cbgpr (RMW_cbgpr). Before the results of the asset pricing tests are presented, we briefly describe the factor construction and perform basic analyses on the factors (summary statistics, spanning tests) in order to get a better feeling for the importance and interactions of the factors.[4]

SMB and HML are constructed as follows: At june every year, the stocks of every country are sorted independently into two size groups, Big (B) and Small (S) and three book-to-market (BM) groups, High (H), Medium (M) and Low (L). At the intersection of the 2x3 size and book-to-market groups, six portfolios are created. SMB is calculated as the difference between the average monthly portfolio returns of the three small stock and the three big stock portfolios and HML is calculated as the difference between the average monthly returns of the two high and the two low BM stock portfolios.

In order to construct MOM, the stocks are sorted every month t by their cumulative past performance from month t-11 to month t-1 into winners (W) and losers (L). In addition, similar to HML, the stocks are allocated every month t to the two size portfolios, Big (B) and Small (S). Apart from this, the calculation of MOM is analogous to HML.

Fama and French (2015) account for recent findings in the literature, that a huge part of the variation of average returns, which is related to profitability and investment, cannot be explained adequately by their original three-factor model. Therefore, they add a new risk factor based on operating profitability (RMW) and another one based on investment (CMA) to the model. RMW is the delta of portfolio returns of stocks with robust and weak profitability and CMA is the delta of portfolio returns of stocks of low and high investment firms. Both of these factors are constructed analogously to HML, except for the sorting variable besides size, which is operating profitability (op_ff) in case of RMW, and the growth rate of the book value of total assets from t-2 to t-1 in case of CMA.

With regard to the size breakpoints in the 2x3 sorts, we follow the common approach of Fama and French (2012) for international data: The stocks in the top 90% of the aggregate market capitalization of a country are classified as Big (B) and the stocks in the bottom 10% are classified as Small (S). The breakpoints for the second sorting variable are calculated as the 30th and 70th percentiles per country (e.g. Fama and French 1993, Fama and French 2015).

Table 5 provides an overview of the average monthly returns, the monthly standard deviations and the t-values of the aforementioned factors. In the context of profitability, RMW_ROE has the lowest mean return (13 bp) and RMW_cbgpr the highest (38 bp). RMW_cbgpr also shows

[4] In the current version of this working paper, only the results for the new version of the Fama-French five-factor model, incorporating RMW_cbgpr, are shown (see Table 7). In undocumented results, we can confirm our expectation, that the other two models to be tested perform worse.

the highest significance of all the factors, with a t-value of 4.99. ACC has a comparably lower return (14 bp), but also carries a high t-value (2.66). In contrast, SMB has a negative return (-4 bp) and is insignificant. Moreover, RMRF has a return in the range of the profitability factors (31 bp), but is not as significant (t-value: 1.12). Overall, the factors based on the different profitability measures (besides ROE) exhibit strong statistical and economical significance.

Table 5: Factor summary statistics
The table reports the average monthly returns, the monthly standard deviations and the t-values of the following factors: robust minus weak (RMW), based on (1) ROE, (2) gpr, (3) op_ff, (4) op, (5) cbop and (6) cbgpr, accruals (ACC), small minus big (SMB), high minus low (HML), conservative minus aggressive (CMA), momentum (MOM) and the market return minus the risk-free rate (RMRF). The factors are created at june of every year (except for MOM, which is created at every month t) based on 2x3 sorts of size and the second sorting variable of the respective factor. The holding period is 12 months (except for MOM, where it is 1 month). SMB is calculated as the difference between the average monthly value-weighted portfolio returns of the three small stock and the three big stock portfolios. The other factor returns are calculated as the difference between the average monthly value-weighted returns of the two highly and the two lowly ranked portfolios with regard to the respective sorting variable.

	mean return	standard deviation	t-value
RMW_ROE	0.13	1.24	1.88
RMW_gpr	0.35	1.40	4.42
RMW	0.21	1.08	3.46
RMW_op	0.29	1.37	3.76
RMW_cbop	0.30	1.21	4.40
RMW_cbgpr	0.38	1.33	4.99
ACC	0.14	0.96	2.66
SMB	-0.04	1.96	-0.35
HML	0.46	2.19	3.75
CMA	0.26	1.52	3.04
MOM	0.71	3.32	3.79
RMRF	0.31	4.89	1.12

In order to understand, which of the factors are more important than others, or which of them are possibly redundant, factor spanning tests are performed. In these tests, an asset pricing model is used to explain factors, which are not part of the model. If the model generates sizeable and statistically significant alphas, it is likely that the omitted factors contain important information that is not covered by the model.

For the first set of spanning regressions, we use the Fama-French-Carhart four-factor model complemented by an investment facor, CMA, in order to explain RMW, based on the profitability measures ROE, gpr, op_ff, op, cbop, cbgpr, and also to explain ACC. For the second set of regressions, we add RMW_cbgpr to the model; in the case when RMW_cbgpr is the explanatory variable, we use RMW (based on op_ff) as independent variable instead. The results are presented in Table 6.

The first set of regressions shows that the six profitability factor returns and the accruals factor return exhibit a significant alpha. This underlines the hypothesis, that profitability is

Table 6: Factor spanning tests

The table presents the results from factor spanning regressions. The dependent variables are the monthly factor returns of robust minus weak (RMW), based on (1) ROE, (2) gpr, (3) op_ff, (4) op, (5) cbop and (6) cbgpr and accruals (ACC). The independent variables are the excess return of the market (RMRF), small minus big (SMB), high minus low (HML), conservative minus aggressive (CMA), momentum (MOM), RMW based on cbgpr (RMW_cbgpr) and RMW based on op_ff (RMW).

	Intercept	RMRF	SMB	HML	CMA	MOM	RMW_cbgpr	RMW
RMW_ROE	0.19	−0.09	−0.10	−0.04	−0.25	0.08		
	(2.98)	(−7.20)	(−3.16)	(−1.35)	(−5.20)	(4.04)		
RMW_gpr	0.47	−0.13	−0.15	−0.24	−0.13	0.08		
	(7.64)	(−10.02)	(−5.14)	(−7.40)	(−2.87)	(4.35)		
RMW	0.21	−0.06	−0.13	−0.02	−0.09	0.08		
	(3.59)	(−5.04)	(−4.58)	(−0.83)	(−2.21)	(4.50)		
RMW_op	0.36	−0.10	−0.25	−0.15	−0.20	0.10		
	(6.10)	(−8.28)	(−8.70)	(−4.80)	(−4.48)	(5.79)		
RMW_cbop	0.35	−0.10	−0.22	−0.14	−0.07	0.08		
	(6.46)	(−8.64)	(−8.44)	(−4.98)	(−1.72)	(4.91)		
RMW_cbgpr	0.48	−0.13	−0.14	−0.24	−0.04	0.08		
	(8.08)	(−10.29)	(−4.82)	(−7.89)	(−1.01)	(4.62)		
ACC	0.11	−0.01	−0.13	−0.10	0.22	0.02		
	(2.15)	(−0.98)	(−5.12)	(−3.48)	(5.73)	(1.28)		
RMW_ROE	0.04	−0.05	−0.05	0.03	−0.23	0.05	0.32	
	(0.57)	(−3.75)	(−1.75)	(0.93)	(−5.12)	(2.70)	(5.39)	
RMW_gpr	−0.00	−0.00	−0.02	0.00	−0.09	−0.00	1.00	
	(−0.07)	(−0.72)	(−1.73)	(0.23)	(−6.00)	(−0.11)	(52.36)	
RMW	0.05	−0.02	−0.08	0.06	−0.08	0.05	0.33	
	(0.82)	(−1.41)	(−3.01)	(1.79)	(−1.98)	(3.01)	(6.31)	
RMW_op	0.04	−0.02	−0.16	0.01	−0.17	0.05	0.67	
	(0.90)	(−1.67)	(−7.08)	(0.53)	(−5.08)	(3.52)	(15.50)	
RMW_cbop	0.04	−0.02	−0.13	0.02	−0.04	0.03	0.64	
	(1.03)	(−1.74)	(−6.83)	(0.68)	(−1.41)	(2.27)	(17.08)	
RMW_cbgpr	0.40	−0.10	−0.09	−0.23	−0.01	0.05		0.35
	(7.13)	(−8.75)	(−3.35)	(−8.06)	(−0.28)	(3.17)		(6.31)
ACC	0.01	0.02	−0.10	−0.04	0.23	0.00	0.21	
	(0.24)	(1.26)	(−3.95)	(−1.53)	(6.12)	(0.20)	(4.20)	

priced in the cross-section of stock returns and contains valuable information, which is not already covered by the Fama-French-Carhart model complemented by CMA. If we add, however, RMW_cbgpr as an additional dependent variable in the second set of regressions, the alpha generally becomes insignificant. Only for the case when RMW_cbgpr is the dependent variable and RMW is among the independent variables, the alpha stays significant. This confirms the previous results, that RMW_cbgpr is superior to the other profitability measures.

In the following section, we test how an asset pricing model that includes RMW_cbgpr performs in the explanation of returns from decile portfolios that were formed on the basis of the profitability variables introduced in Table 4. We implement the Fama-French five-factor model with RMW_cbgpr instead of RMW for this purpose (hereafter: Modified five-factor model). The results are shown in Table 7.

Overall, the modified five-factor model does a very good job in explaining the decile portfolio returns, which result from sortings based on ROE, gpr, op_ff, op, cbop, cbgpr and acc. Table 7 illustrates the resulting alphas for every decile as well as for the high-minus-low decile strategies and the associated t-values. The absolute values of the alphas across the high-minus-low strategies of the different sorting variables are all below 15 bp and not significantly different from zero. Most notably, the alpha of the high-minus-low strategy based on accruals seems to vanish in the presence of RMW_cbgpr, as it is only -7 bp and carries a low t-value of -0.59.

E. Outlook

Currently, we are implementing other asset pricing models and applying additional statistical analyses in order to further strengthen our results. Moreover, we are working on different robustness checks for the preceding findings, i.e. a subsample analysis for all but microcaps and microcaps and different regional (and country based) tests. Finally, we plan to investigate why profitability is a priced factor.

Table 7: A five-factor model test

The table reports the value-weighted, average five-factor model alphas and the associated t-values for decile portfolios formed at june of every year and held for the next 12 months, from 07/1990 to 06/2016, based on return on equity (ROE), gross profitability (gpr), operating profitability according to Fama and French (op_ff), operating profitability (op), cash-based operating profitability (cbop), cash-based gross profitability (cbgpr) and accruals (acc). The sorting is only based on big stocks, which are in the top 90% of the aggregate market capitalization, per country. The sample is described in the legend of Table 1. Further details on the variable construction are given in Table 2. The following factors are used: RMRF, defined as $R_{Mt} - R_{ft}$, small minus big (SMB_t), high minus low (HML_t), conservative minus aggressive (CMA_t) and robust minus weak based on cbgpr (RMW_cbgpr_t). The factor construction is explained in more detail in Table 5. The following model is tested:

$$R_{it} - R_{ft} = \alpha_i + \beta_{iM}(R_{Mt} - R_{ft}) + s_i SMB_t + h_i HML_t + c_i CMA_t + g_i RMW\_cbgpr_t + e_{it}$$

	ROE	gpr	op_ff	op	cbop	cbgpr	acc
				Monthly alphas			
1 (low)	−0.17	0.06	0.02	−0.07	−0.01	0.05	0.11
2	−0.01	0.01	0.01	0.03	−0.04	0.05	−0.01
3	0.07	−0.01	−0.06	0.11	0.18	−0.02	−0.01
4	−0.01	−0.01	0.08	−0.10	−0.05	0.02	−0.06
5	0.15	0.19	−0.08	0.01	0.00	0.06	−0.16
6	0.03	−0.07	0.02	0.02	−0.13	−0.02	−0.04
7	0.06	−0.09	0.06	−0.05	−0.05	−0.06	−0.10
8	−0.01	−0.04	0.15	0.01	0.03	−0.14	0.17
9	0.07	−0.05	−0.03	0.09	0.11	0.02	0.14
10 (high)	−0.03	0.09	−0.04	0.06	0.04	0.07	0.04
10-1	0.14	0.04	−0.06	0.13	0.05	0.02	−0.07
				t-values			
1 (low)	−1.99	0.72	0.22	−0.95	−0.13	0.59	1.22
2	−0.10	0.12	0.11	0.33	−0.53	0.61	−0.09
3	0.93	−0.08	−0.77	1.51	2.64	−0.39	−0.11
4	−0.17	−0.18	1.06	−1.21	−0.61	0.32	−0.81
5	2.06	2.42	−1.13	0.13	0.00	0.79	−2.28
6	0.50	−0.95	0.32	0.22	−1.75	−0.27	−0.56
7	0.77	−1.36	0.86	−0.65	−0.72	−0.79	−1.44
8	−0.09	−0.57	2.45	0.15	0.48	−2.09	2.09
9	0.90	−0.75	−0.38	1.24	1.55	0.28	1.89
10 (high)	−0.48	1.35	−0.41	0.67	0.44	1.04	0.46
10-1	1.34	0.42	−0.40	1.11	0.41	0.25	−0.59

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