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Article

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Size effect alive or dead: Evidence from European markets

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Abstract: In this paper, we examine whether the size effect is present in four European markets viz. France, Germany, Spain and Italy. We also investigate whether the size effect can be explained through the sources as available in the literature. We employ prominent asset pricing models to ascertain if size anomaly in our sample countries passes the risk story. We find single-factor model i.e. capital asset pricing model to be still relevant in explaining size anomaly for Spain and Italy. We find FF3 factor model to be a suitable model to explain for alphas in Germany, while we find that none of the asset pricing model is able to fully explain the size effect for France. Hence, we conclude that though size anomaly does not provide any opportunities to portfolio managers for making extra normal returns for their investors in three of the four sample countries. France, however, provides an opportunity to portfolio managers for exploiting size anomaly. Our findings have implications for portfolio managers, academia as well as regulators.

Subjects: Economics; Corporate Finance; Investment & Securities

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PUBLIC INTEREST STATEMENT

In this paper, we have tested an important asset pricing anomaly i.e. size anomaly for four west European markets. It is one of the prominent equity market anomalies which states that small capitalization firms provide higher returns as compared to large capitalization firms, and investors can make profitable trading strategies using them. We test the efficacy of size anomaly using the prominent asset pricing models and find that size effect in Spain and Italy gets subsumed by capital asset pricing model which means that investors cannot form risk-adjusted trading strategies based on size for these markets. Similarly, size effect in Germany gets explained by FF3. However, we find that France is the only exception where none of the model is able to subsume size effect. Hence, we recommend that global fund managers can use this anomaly for France to create profitable trading strategies for their investors.

| **Keywords:** Size anomaly; European markets; asset pricing

1. Introduction

In the past few decades, many asset pricing anomalies also named as capital asset pricing model (CAPM) anomalies have been investigated in the asset pricing literature (size anomaly (Banz, 1981), Value anomaly (Stattman, 1980), momentum anomaly (Carhart, 1997), volatility anomaly (Clarke et al., 2006; Pandey & Sehgal, 2017) and net stock issues (Loughran & Ritter, 1995; Sehgal & Pandey, 2013) to name a few. Portfolio managers are constantly looking to exploit such anomalies in order to generate extra normal returns for their investors (Sehgal and Pandey (2012, 2014)). The prevalence of such anomalies suggests that CAPM is unable to fully explain the variation in cross-section average stock returns. Out of various anomalies, the size anomaly, as first observed by Banz (1981), is the most controversial and explored anomaly. Banz found that small-sized firms, due to various risks present in them, provide higher returns as compared to large cap firms over a long period of time. However, since past three decades, the research in regard to size anomaly has been paradoxical. Initial observations, especially for mature markets, were that the size effect persists after adjusting for market risk (Berk, 1996; Carlson et al., 2004; Gomes et al., 2003). Few studies document the presence of size effect in micro-firms within the small size firms (Fama & French, 2008; Horowitz et al., 2000a; Michou et al., 2010). Similarly, emerging market also confirmed the presence of size effect (Chan & Chien, 2011; Hilliard & Zhang, 2015; Mohanty, 2001; Sehgal & Tripathi, 2006). However, more recent literature on size is providing mixed results. Few studies are documenting the diminishing effect of the size anomaly both in matured (Cederburg & O'Doherty, 2015; Crain, 2011; Dijek, 2011) and emerging markets (Pandey & Sehgal, 2016; Wu, 2011).

However, recent studies have ignited the debate of size anomaly by showing its persistence in matured markets (Asness et al., 2018; Ciliberti et al., 2017; Leite et al., 2018). Similarly, several studies on size effect have been conducted for European markets as well (Cakici et al., 2013; Fama & French, 2012; Roy & Shijin, 2018; Zaremba & Czapkiewicz, 2017). Thus, there has been sufficient literature available for both matured and emerging markets. However, the literature on the size anomaly, especially for Western European markets, is limited. This motivated us to conduct this study to find out the presence of size effect for four major West European countries, namely, France, Germany, Spain and Italy. The reason for choosing these economies was that they are large Eurozone countries with well-developed security market. The second reason for taking these economies is that in order to test cross-sectional variation in returns, it is important to have large samples and these are the only economies in West European markets with a sample of at least 250 companies trading in their respective stock markets.

Another important rationale for conducting this study has been that though there has been sufficient literature available examining the validity of size effect; however, there has been limited research being carried out to find out the rationale sources of size effect. Existing literature provides various explanations for potential size effect as described below:

- (1) Non-Synchronous Trading: Roll (1977), Scholes and Williams (1977), and Dimson (1979) have shown that shares of infrequently traded firms tend to have biased betas and non-synchronous trading biases their betas downwards. Since small size firms tend to trade infrequently, their betas are underestimated and alphas overestimated. Dimson (1979) estimates that market sensitivities (betas) correct for thin trading by taking lead and lags of betas.
- (2) Business risks and financial distress: Small firms are expected to be operationally riskier compared to large firms owing to less diversified product base, less efficient workforce, lower bargaining power in procurement of raw materials, less sophisticated technology, lower customer loyalty and less committed workforce. Besides, higher operational risk small firms also tend to have greater financial risk exposure owing to higher cost of borrowing. In addition, small firms may be relatively distressed i.e. they exhibit low sales and earnings growth rates and hence exhibit low or negative economic profits. This relative distress is reflected by a low price-to book value (P/B) ratios for such firms. Fama and French (1993) introduced a three-

factor asset pricing model which incorporates size and a value factors in addition to the market factor of CAPM. These size and value factors proxy for business risks (operating as well as financial) and relative distress, respectively. These size and value premiums tend to explain extranormal returns relating to several company characteristic sorted portfolios including firm size. Fama and French also introduced two additional factors namely, investment rate and profitability to their existing three-factor model and popularly named as Fama French five-factor model (Fama and French (2015, 2017) to explain various anomalies including size effect.

- (3) **Stock Momentum:** Momentum in stock market terminology means that past winners shall remain winners in future and past losers shall remain losers in future (over the next 12 months). Jegadeesh and Titman (1993) found that a trading strategy to buy stocks that have provided higher returns and sell stocks with low returns over a period of last 3–12 months leads to generate supernormal profits. The behavioral models (see Barberis et al. (1998), Daniel et al. (1998), Hong et al. (2000) and Chordia and Shivkumar (2002)) have shown that investor's underreaction or overreaction to specific news is the reason for creation of momentum anomaly. In contrast, Fama and French (1996) and Conrad et al. (1991) provide a risk argument in favor of stock momentum factor. Chordia and Shivkumar (2002) provide an economic foundation for stock momentum factor by showing that past returns contain information about future returns which are predicted based on economic fundamentals. Further, stock momentum may proxy for sector momentum as winning stocks may belong to winning sectors, while losing stocks may be a part of low performing sectors (see Moskowitz & Grinblatt, 1999; Sehgal & Jain, 2012). Thus, stock momentum may proxy for sector momentum assuming that winning sectors exhibit higher risk owing to stronger growth potential as compared to losing sectors (see, Liu & Zhang, 2008; Sehgal et al., 2012). Carhart (1997) gave a four-factor model, an extension to Fama French three-factor model by including momentum as a fourth risk factor in explaining stock returns.
- (4) **The business cycle:** Merton (1973), Ross (1976), Cox et al. (1985) and Chen et al. (1986) tested the firm size effect relating it to business cycle proxied by the yield spread of a portfolio of low-grade bonds vis a vis portfolio of long-term government bonds which is termed as the premium factor. They find a substantial part of size effect got subsumed by the premium factor. Their argument was that since small firms are riskier than large firms they are more sensitive to the changes in economic conditions. In the Indian context, Sehgal and Tripathi (2006) find that returns on size sorted portfolios are not sensitive to business cycle conditions.
- (5) **The January Effect:** Keim (1983), Brown et al. (1983a), (1983b), and Daniel and Titman (1997) show that the majority of small firm effect occurs in the first week of January. The argument given is that since December is the financial year closing so in order to get tax incentive firms tend to sell their stocks in December and start buying them back in the first week of January. It is called as tax loss selling hypothesis. Another explanation is the window dressing hypothesis which states that in order to show more profits to investors, portfolio managers tend to sell speculative stocks (majorly small size firms) and buy winners at the end of the year. Once the New Year starts they again start buying speculative stocks. The last argument for January effect could be information patterns. Since December is the fiscal year closing thereof, the month of January leads to increased uncertainty and anticipation due to the forthcoming release of important information, especially for small size companies as less information is available in the public domain for such companies.

Moor and Sercu (2013) conducted a comprehensive study to test whether potential sources of size effect explain size anomaly in 39 matured and emerging markets for a period of January 1980 to May 2009. They find that none of the existing sources could fully explain the size anomaly. On the other hand, Pandey and Sehgal (2016) did a similar study for Indian market and found size effect to be explained by their rationale sources mainly market, size value and default premium. Mere confirmation of size effect is not sufficient, unless it persists after controlling for risk factors. Thus, we conduct this study with the following objectives: to confirm if the size effect persists in West

European markets for a recent time period and to evaluate whether rationale sources explain the size effect for our sample countries.

The paper is divided into five sections including the present one. We discuss data in Section 2, while section 3 deals with research methodology and estimation procedure. The empirical results are provided in Section 4, and summary and concluding remarks are discussed in the last section.

2. Data

Month end adjusted closing prices have been taken from January 2008 to March 2018 for 505 companies of France and Germany, 427 companies of Spain and 503 companies of Italy. Prices have been converted into returns to carry out further estimations. The selected companies have been selected on the basis of their market capitalization, and the rationale for taking 505 companies is to match our sample size with S&P 500 Index which is constituted by 505 companies. Both for France and Germany, we get the requisite number of companies but for Spain and Italy we could get 427 and 503 companies, and hence, we have taken all the companies for these two countries. CAC 40, DAX 30, IBEX 35 and FTSE MIIB indices have been taken to measure market return for France, Germany, Spain and Italy. 91 days US treasury bills have been taken to proxy for risk-free rates.

In order to create size and value factors, we use market capitalization and price-to-book value for our sample companies. All the year-end corporate attributes have been taken as on end of December for the sample period. Momentum factor has been created as an average of 6 months past returns. The default spread has been defined as the difference between the AAA and BBB+ for France; AAA securities and BBB- for Germany; AA- and BBB for Spain and Italy based on data availability. All data have been obtained from Bloomberg database.

3. Methodology

We start our investigation by first examining the presence of size effect in France, Germany, Spain and Italy. Quintile portfolios have been formed based on market capitalization to proxy for size for our sample period. In December of year (t), we rank securities on the basis of market capitalization. Subsequently, the ranked stocks are divided into five portfolios, i.e. P1 to P5 and equally weighted monthly returns are estimated for these portfolios for the next 12 month (January of year t to December of year t + 1). We call them unadjusted returns. P1 is the small size portfolio, which contains least 20% of the stocks as measured by market capitalization, while P5 is the big size portfolio consisting of 20% stocks with the highest market capitalization. Portfolios are rebalanced in December of each year, and this process continues till the last year of our sample period.

In the next stage, we test whether the size effect can be explained by its rationale source for our sample countries. We start with the standard capital asset pricing model (CAPM) to evaluate if market factor is able to absorb the cross-section of average returns for the sample portfolios. The familiar excess return version of market model is used to operationalize CAPM wherein excess returns are regressed on excess market returns as shown below:

$$R_{p_t} - R_{f_t} = \alpha + \beta(R_{m_t} - R_{f_t}) + e_t \quad (1)$$

where

$R_{p_t} - R_{f_t}$ = excess return on sample portfolio,

$R_{m_t} - R_{f_t}$ = excess return on the market factor,

α and β are the estimated parameters

and e_t = error term.

In order to test for non-synchronous trading bias, we augment CAPM with the lagged value of market return (see Dimson, 1979) and further test if the size effect gets absorbed by this modification in the estimation procedure. The equation for the same is as below:

$$R_{p_t} - R_{f_t} = \alpha + \beta(R_{m_t} - R_{f_t}) + \beta_L(R_{m_{t-1}} - R_{f_{t-1}}) + e_t \quad (2)$$

where $R_{m_{t-1}} - R_{f_{t-1}}$ is lagged excess return on market factor. Other terms have the same meaning as in Equation (1).

In order to capture the January effect, we introduce a dummy variable to Equation (2) which takes a value of 1 for January months and 0 for all other months. We use the following equation to test for January effect:

$$R_{p_t} - R_{f_t} = \alpha + \beta(R_{m_t} - R_{f_t}) + \beta_L(R_{m_{t-1}} - R_{f_{t-1}}) + \beta_D D_t + e_t \quad (3)$$

where D_t is the dummy variable having a value of 1 from January months and 0 for other months. Other terms have the same meaning as in Equation (2).

We further employ multifactor model to account for the role of missing risk factors i.e size and value factors. We examine if the Fama French (F-F) three-factor model augmented by lagged excess market returns could explain the returns missed by CAPM. The F-F model equation is as follows:

$$R_{p_t} - R_{f_t} = \alpha + \beta(R_{m_t} - R_{f_t}) + \beta_L(R_{m_{t-1}} - R_{f_{t-1}}) + s(SMB_t) + l(LMH_t) + e_t \quad (4)$$

where,

SMB and LMH proxy size and value factors. s and l are coefficients of SMB and LMH factors respectively. Other terms have the same meaning as in Equation (3).

SMB and LMH factors are constructed by the intersection of two independently sorted size as well as three value portfolios (2 x 3 formations) as in the case of Fama and French (1993). SMB is defined as the difference between average return on small and big stocks, while LMH is measured as the difference between average return on low and high P/B stocks on period-to-period basis. Any multicollinearity problem is sorted out before introducing these factors in the F-F framework.

Finally, we examine if the returns on the sample portfolio could be explained by augmenting Fama French model with an additional risk factor(s). Two versions of augmented Fama French models are implied involving: (1) Carhart (1997) stock momentum factor and (2) business cycle premium. The full-blown equation for our augmented F-F versions is as follows:

$$R_{p_t} - R_{f_t} = \alpha + \beta(R_{m_t} - R_{f_t}) + \beta_L(R_{m_{t-1}} - R_{f_{t-1}}) + s(SMB_t) + l(LMH_t) + w(WML_t) + \beta_{Prem}(BBB - AAA) + e_t \quad (5)$$

where WML and (BBB-AAA) are proxies for price momentum and premium and w and β_{Prem} are the sensitivity coefficients. Other terms have the same meaning as in Equation (4).

Equation (5) describes the four-factor model. The momentum and premium augmented versions of the F-F model are estimated using the above said equation by eliminating one of the factors which doesn't find a place in our five-factor framework.

In order to create momentum factor each year starting December 2008, we rank the sample stocks on the basis of average past six-month excess returns and form five portfolios which are then held for next 12 months i.e. from January to December. We rebalance the portfolios on a yearly basis, and continue till the end of the sample period. Finally, we take a difference of P5 and P1 to form momentum factor where P5 comprises of past winners while P1 contains past losers. The premium factor has been created by taking the difference of monthly BBB and AAA corporate bond yield from January 2008 to March 2018.

Table 1. Descriptive Statistics: Portfolios formed for European Countries. In this table, we show results for unadjusted returns on quintile portfolios of our sample countries. P1 represents small size portfolio, while P5 includes big size portfolio. Table also provides descriptive statistics measures of the quintile portfolios

PANEL A—FRANCE

	P1	P2	P3	P4	P5
Mean	0.009	0.008	0.005	0.004	0.004
Std. Dev	0.066	0.064	0.066	0.066	0.066
Skewness	-0.486	-0.798	-0.807	-1.016	-0.473
Kurtosis	4.279	5.967	4.971	5.921	3.963
Jarque-Bera	13.219	58.180	33.261	64.910	9.329
p-value	0.001	0.000	0.000	0.000	0.009

PANEL B—GERMANY

	P1	P2	P3	P4	P5
Mean	0.012	0.010	0.011	0.007	0.004
Std. Dev	0.064	0.065	0.065	0.068	0.072
Skewness	-0.422	-0.587	-0.741	-0.517	-0.339
Kurtosis	5.365	4.920	4.816	5.118	4.738
Jarque-Bera	32.306	25.959	28.158	28.459	17.831
p-value	0.000	0.000	0.000	0.000	0.000

PANEL C—SPAIN

	P1	P2	P3	P4	P5
Mean	0.001	-0.003	-0.004	-0.002	-0.002
Std. Dev	0.044	0.054	0.048	0.051	0.054
Skewness	-0.005	-0.128	-0.408	-0.564	-0.347
Kurtosis	3.290	3.141	3.516	4.062	3.618
Jarque-Bera	0.420	0.430	4.658	12.001	4.320
p-value	0.811	0.806	0.097	0.002	0.115

PANEL D—ITALY

	P1	P2	P3	P4	P5
Mean	0.002	0.002	0.002	0.002	-0.001
Std. Dev	0.083	0.083	0.079	0.080	0.080
Skewness	-0.219	-0.197	-0.136	-0.248	-0.205
Kurtosis	2.918	3.623	3.550	3.126	2.835
Jarque-Bera	0.991	2.715	1.882	1.313	0.973
p-value	0.609	0.257	0.390	0.519	0.615

4. Empirical results

4.1. Descriptive statistics

We start by providing the unadjusted returns and their descriptive statistic for the portfolios of our sample countries in Table 1. We find that the mean monthly, unadjusted returns are extremely high for P1 (portfolio of smallest 20% capitalization companies) as compared to P5 (portfolios of highest 20% market capitalization companies) for all sample countries. In fact, P5 of Spain and Italy provide negative returns for the sample period. The annualized unadjusted returns for P1 vary from 0.84% for Spain to 14.4% for Germany for our sample period. We further find that there is no major difference between the standard deviations of lowest to highest portfolios for our sample countries. Thus, we confirm the presence of size effect in the four European countries. However, mere confirmation of the presence of size anomaly is not sufficient unless it provides risk-adjusted extra normal returns.

4.2. CAPM results

In order to test whether the size effect gets explained by the risk story, we examine it by operationalizing the one-factor CAPM framework and results are provided in Table 2. We start by testing size effect for France and find that the alpha value of P1 to be 0.87% on monthly basis which is also statistically significant. In fact, barring P3 none of the portfolios are explained by

Table 2. CAPM Results. We regress excess returns of our sample portfolios on the excess returns for the market factor. Alpha and Beta values are reported for the sample countries

PANEL A—FRANCE

Portfolios	Alpha (a)	Beta (B)	t(a)	t(B)	Adj. R squared
P1	0.009	0.825	2.460	15.275	0.687
P2	0.008	0.833	2.555	11.552	0.734
P3	0.005	0.870	1.762	16.044	0.765
P4	0.004	0.932	2.170	17.147	0.871
P5	0.004	0.969	3.057	33.852	0.943

PANEL B—GERMANY

Portfolios	Alpha (a)	Beta (B)	t(a)	t(B)	Adj. R squared
P1	0.009	0.745	2.552	9.561	0.665
P2	0.007	0.811	2.145	13.318	0.753
P3	0.007	0.853	2.710	15.935	0.832
P4	0.004	0.871	1.574	14.118	0.817
P5	0.000	0.997	0.066	26.284	0.952

PANEL C—SPAIN

Portfolios	Alpha (a)	Beta (B)	t(a)	t(B)	Adj. R squared
P1	0.002	0.428	0.591	14.167	0.598
P2	-0.002	0.549	-0.639	20.308	0.643
P3	-0.003	0.519	-1.442	19.455	0.719
P4	0.000	0.581	-0.143	16.604	0.803
P5	-0.001	0.661	-0.650	30.988	0.924

PANEL D—ITALY

Portfolios	Alpha (a)	Beta (B)	t(a)	t(B)	Adj. R squared
P1	0.002	0.973	0.339	14.563	0.601
P2	0.002	1.057	0.530	17.443	0.717
P3	0.002	1.019	0.521	18.003	0.730
P4	0.002	1.087	0.858	26.205	0.810
P5	0.000	1.083	-0.173	19.027	0.815

CAPM. Similarly, for Germany, we find significant alpha of P1 to be 0.93% on a monthly basis. However, we find that for Germany both P4 and P5 are explained by market factor. CAPM is also able to explain all the portfolios of Spain and Italy. Thus, we find that among our sample countries the size effect persists for France and Germany, wherein P1 provides risk-adjusted annualized return of about 10.44% and 11.16% for France and Germany, respectively. However, CAPM proves to be a significant model in explaining the size effect for Italy and Spain.

4.3. Non-synchronous trading bias

The size effect may result because of the presence of non-synchronous trading bias due to which alphas may be overestimated. In order to check for non-synchronous trading bias, we next implement the Dimson (1979) correction procedure by adding lagged market factor in the CAPM framework. The results for the same are shown in Table 3. Portfolio betas should be read as the sum of the two betas. We find that for both France and Germany, the t statistics for the lagged market factor is significant for P1. However, the correction procedure has a negligible impact on lowering the values of alpha. Hence, we proclaim that non-synchronous trading bias, though present in our sample portfolios, has limited effect in explaining alphas.

4.4. January seasonality

Next, we check for the seasonality impact on size effect. As prior, literature shows that most of the small cap effect, due to various explanations like tax loss selling hypothesis or window dressing hypothesis, is found in the month of January. We create a dummy factor to test for January seasonality, wherein we put value of 1 for January months and 0 for all other months. We find the t statistics (Table 4) for all the small cap portfolios to be insignificant for the dummy variable. Thus, we find no January effect in our sample countries.

4.5. Fama French three factor and other augmented models

Post-CAPM, the next prominent asset pricing model being used in empirical work has been Fama and French (1993) three-factor model. Authors argue that because of operational and financial risk as well as due to relative distress, small cap firms provide higher returns as compared to large cap firms. Their argument is that market fails to capture these risks and therefore separate risk factors viz. size

Table 3. Non-Synchronous trading bias results. We regress excess returns of our sample portfolios on the excess returns for the market factor as well as lagged market factor to correct for non-synchronous trading bias. Alpha, Beta and lagged beta values are reported for the sample countries

PANEL A—FRANCE							
Portfolio	Alpha (a)	Beta (B)	Beta (L)	t(a)	t(B)	t(L)	Adj. R squared
P1	0.009	0.812	0.206	2.843	17.456	4.294	0.729
P2	0.008	0.820	0.205	3.158	14.562	4.260	0.777
P4	0.005	0.924	0.130	2.629	19.411	3.935	0.887
P5	0.004	0.967	0.033	3.054	36.336	1.633	0.944
PANEL B—GERMANY							
Portfolio	Alpha (a)	Beta (B)	Beta (L)	t(a)	t(B)	t(L)	Adj. R squared
P1	0.009	0.733	0.161	2.652	10.472	3.142	0.694
P2	0.006	0.800	0.150	2.132	14.596	3.043	0.777
P3	0.007	0.845	0.102	2.862	17.172	2.430	0.843
P4	0.004	0.869	0.030	1.482	13.952	0.644	0.815
P5	0.001	0.994	0.033	0.032	27.031	1.549	0.953

Table 4. SEASONALITY RESULTS (January Effect) We regress excess returns of our sample portfolios on the excess returns for the market factor corrected as per Dimson (1979) and a dummy variable to check seasonality effect. Dummy variable takes on value of 1 for January months and 0 for all other months for our sample period. Alpha, Betas and coefficient of dummy variable values are reported for the sample countries

PANEL A—FRANCE

Portfolios	Alpha (a)	Beta (B)	Beta (L)	Beta (D)	t(a)	t(B)	t(L)	t(D)	Adj. R squared
P1	0.006	0.822	0.198	0.025	2.034	19.603	4.158	1.818	0.739
P2	0.007	0.827	0.200	0.018	2.351	14.509	4.191	1.590	0.782
P4	0.003	0.929	0.126	0.013	1.979	19.827	3.897	1.440	0.889
P5	0.003	0.971	0.030	0.009	2.422	34.781	1.508	1.735	0.945

PANEL B—GERMANY

Portfolios	Alpha (a)	Beta (B)	Beta (L)	Beta (D)	t(a)	t(B)	t(L)	t(D)	Adj. R squared
P1	0.007	0.745	0.153	0.023	2.012	10.482	2.836	1.803	0.702
P2	0.005	0.806	0.145	0.012	1.934	14.342	2.887	1.296	0.778
P3	0.006	0.851	0.098	0.010	2.164	17.177	2.316	1.047	0.843

Table 5. Fama French Three-Factor Model Results. We regress excess returns on the excess returns for the market factor corrected for non-synchronous trading bias, as well as on size and value factors. Alpha, beta coefficients of market, size and value factor are reported for the sample countries. Beta (B) represents market factor, Beta (L) represents lagged market factor, Beta(s) represents size factor and Beta (v) represents value factor

PANEL A—FRANCE

Portfolios	Alpha (a)	Beta (B)	Beta (L)	Beta (s)	Beta (v)	t(a)	t(B)	t(L)	t(s)	t(v)	Adj. R squared
P1	0.003	0.957	0.053	1.410	0.338	2.257	29.265	2.033	13.587	5.465	0.912
P2	0.004	0.931	0.093	1.061	0.230	2.815	17.733	2.521	9.476	1.873	0.883
P4	0.003	0.960	0.097	0.327	0.054	1.874	18.955	3.071	3.621	0.619	0.894
P5	0.004	0.955	0.032	-0.069	0.048	3.042	34.697	1.533	-0.740	0.589	0.943

PANEL B—GERMANY

Portfolios	Alpha (a)	Beta (B)	Beta (L)	Beta (s)	Beta (v)	t(a)	t(B)	t(L)	t(s)	t(v)	Adj. R squared
P1	0.002	0.901	0.037	1.296	0.290	1.214	14.600	1.019	11.833	3.551	0.844
P2	0.001	0.910	0.055	0.935	0.305	0.512	17.433	1.512	9.017	2.930	0.852
P3	0.004	0.893	0.057	0.438	0.173	1.910	16.440	1.484	4.326	1.727	0.858

and value should be created to account for operational and financial, and distress risks, respectively. We estimate the Fama-French (F-F) three-factor equation using Dimson correction and report our results in Table 5. We find that all the remaining portfolios of Germany get explained by Fama French three-factor model. Thus, it appears to be a significant model for explaining returns for Germany. We find that the monthly alpha value significantly reduce for P1 in France from 0.87% in CAPM to 0.33% in F-F three-factor model which is a significant reduction of about 62%. However, the size effect in France remains an anomaly as the three-factor model is not able to explain the unexplained portfolios (except P4 which gets explained) in France.

In the next stage, we augment the Fama French three factors with additional factors and report results in Table 6. We first employ momentum as an additional factor to the F-F three-factor model. It is popularly known as Carhart model and re-run the estimations for the unexplained portfolios of France and provide results in Table 6, Panel A. We find that momentum factor, though significant for P3 and P4, is unable to explain any of the unexplained portfolios for France. Thus, we observe that the Carhart model fails to explain the alphas for France.

Another rationale source of size effect provided in the literature is business cycle conditions. It argued that small size companies are prone to sensitivities in business cycles, and thus, a proxy for business cycle, named as premium factor, has been deployed in the F-F three-factor model. It can be seen from Table 6, Panel B that by employing premium factor though alpha of P2 is explained, but, P1 and P5 remain unexplained. Thus, premium factor has a limiting role in explaining size effect from France.

Finally, we augment F-F three-factor model with two additional factors i.e. investment rate and profitability named as Fama French five-factor model to examine if the risk story gets explained in case of France. Though the model partly explains the alphas, just like previous augmented models, Fama French five-factor model, is also unable to fully explain both P1 and P5 for France. Thus, we find that none of the asset pricing models employed by us are able to fully explain the size anomaly for France. Another interesting finding is that in case of France even P5 is not being explained by any of the prominent asset pricing models.

5. Summary and conclusion

In this paper, we test one of the important asset pricing anomalies, i.e., the size anomaly, for four European markets namely France, Germany, Spain and Italy. Mere confirmation of the size anomaly is not sufficient, so we examine if the rational sources of size effect as given in the literature are able to explain the anomaly. We use data of month end adjusted closing prices from January 2008 to March 2018 for 505 companies of France and Germany, 427 companies of Spain and 503 companies of Italy. We confirm the presence of size effects in each of the respective economies as provided in their unadjusted returns.

We further employ single factor as well as multifactor models to verify if size effect sustains the test of prominent asset pricing models. We observe CAPM to be the significant factor in explaining size anomaly for both Spain and Italy. However, single-factor model is not able to explain size effect for France and Germany. Thus, we employ multi-factor models to explain size anomaly for France and Germany. We find that correcting non-synchronous trading bias has a limited role in explaining size anomaly. We observe that seasonality affect as proclaimed through January effect appears to be missing for our sample countries.

We next employ multi-factor models to explain returns of the unexplained portfolios for France and Germany. We observe that F-F three-factor model is able to explain all the unexplained portfolios in Germany. Thus, F-F three-factor model appears to be the appropriate asset pricing model for explaining returns in Germany. For France, though the model sufficiently explains the alphas of P1 but it does not fully explain portfolios alphas. Finally, we augment the F-F three-factor model with momentum, default premium and two additional factors namely investment rate and

Table 6. Results of Fama French Augmented Model for France. We regress excess returns of our sample portfolios on augmented Fama French three-factor model. Apart from alpha and beta coefficients of three-factor model we provide Beta coefficients of momentum represented as B(M), coefficient of default premium as Beta (DP), investment rate coefficient as Beta (I) and profitability coefficient as B(P)

Panel A: CARHART Results

Portfolios	Alpha (a)	Beta (B)	Beta (L)	Beta (S)	Beta (v)	Beta(M)	t(a)	t(B)	t(L)	t(S)	t(v)	t(m)	Adj. RSq.
P1	0.004	0.934	0.059	1.378	0.251	-0.132	2.507	2.507	30.840	2.060	14.537	2.917	0.917
P2	0.005	0.915	0.097	1.039	0.171	-0.091	2.999	20.114	2.587	8.943	1.157	-1.387	0.885
P5	0.005	0.938	0.037	-0.095	-0.020	-0.104	3.403	37.429	1.691	-0.993	-0.228	-2.330	0.946

Panel B: FF3 + Default Premium Results

Portfolios	Alpha (a)	Beta (B)	Beta (L)	Beta (S)	Beta (v)	Beta(DP)	t(a)	t(B)	t(L)	t(S)	t(v)	t(DP)	Adj. RSq.
P1	0.005	0.975	0.066	1.442	0.314	0.004	2.353	30.119	2.174	14.625	3.741	1.527	0.913
P2	0.003	0.917	0.083	1.039	0.247	-0.003	1.653	17.913	2.257	9.104	1.874	-0.966	0.883
P5	0.005	0.940	0.038	-0.092	-0.021	0.000	2.830	32.368	1.602	-0.972	-0.236	0.129	0.946

Panel C: Fama French Five Factor Model Results

Portfolios	Alpha (a)	Beta (B)	Beta (L)	Beta (S)	Beta (v)	Beta(I)	Beta(P)	t(a)	t(B)	t(L)	t(S)	t(v)	t(I)	t(P)	Adj. RSq.
P1	0.004	0.929	0.054	1.344	0.286	-0.054	-0.165	2.218	28.773	1.871	13.540	3.077	-0.569	-2.534	0.915
P5	0.004	0.952	0.032	-0.085	0.065	-0.107	-0.057	3.000	29.317	1.488	-0.986	0.868	-1.215	-1.501	0.944

profitability for France. We find that none of the augmented model is fully able to explain returns on P1 and P5 for France. Thus, we find that none of the prominent asset pricing model is fully able to explain the size anomaly for France.

Our results have implications for portfolio managers, academia as well as regulators. Using data for over 10 years we show that, of the four sample countries, size effect gets explained in three (Germany, Spain and Italy) economies. However, it persists in case of France. This provides portfolio managers an opportunity to exploit size anomaly for France and use it for making profitable trading strategies for their investors. Our study contributes to the academic literature of equity anomalies by verifying the presence of size anomaly in four west European countries. Our results show that size anomaly gets explained for all the sample countries except France. Future research would have to explore the puzzling behavior of equity returns in France for the size effect. For regulators, we showcase that different markets in Europe are at different stages of market efficiency as shown by the success and failure of various asset pricing models for sample countries.

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