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Day-of-the-week effect: a meta-analysis

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Abstract

This study conducts a meta-analysis on the day-of-the-week effect to shed more light on the replication crisis of this stock market anomaly. The findings confirm that Mondays and Tuesdays provide, on average, lower daily returns. In addition, Wednesdays and Fridays indicate higher returns, with an unexpectedly strong middle-of-the-week effect on Wednesdays. The study highlights the influence of study design on these findings and notes a more substantial effect in the 1980s and 1990s. While differences in empirical methods do not impact the anomaly, index choices affect findings on day-dependent returns. The real estate sector especially stands out with a stronger day-of-the-week effect. However, geographic differences are mostly insignificant except for Oceania. Cultural differences demonstrate a weak but significant effect on abnormal daily returns. From a meta-perspective, outliers remain an essential driver for this stock market anomaly, indicating that study design is not the only factor driving the replication crisis.

Keywords Meta-analysis · Day-of-the-week effect · Weekend effect · Stock market anomalies · Replication crisis

JEL Classification G12 · G13 · G14 · G15

1 Introduction

The day-of-the-week effect has a long history in empirical research. Since Cross (1973) published the first study, a worldwide research hype has begun. Numerous indices, countries, and sectors have been studied for this stock market anomaly (Akbalik & Ozkan, 2017; Apolinario et al., 2006; Dubois & Louvet, 1996). However, there is an ongoing debate about the existence of the day-of-the-week effect and stock market anomalies. On the one hand, the "Monday effect," the "Tuesday blues,"

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the "Friday effect," or the "Weekend effect" are popular findings that point to day-dependent returns (Plastun et al., 2019; Chiah & Zhong, 2021; Berument, 2001). The literature explains this anomaly by mispricing (Jakobs and Müller, 2020). On the other hand, authors doubt the existence of the day-of-week effect and refer to the anomaly of biases in data mining (Kohers et al., 2004; Bampinas et al., 2016). All in all, the literature remains divided into two groups that constantly contradict each other. With strong evidence on both sides, the debate on the existence of this stock market anomaly remains an open puzzle.

Previous studies have examined the anomaly using different methods, periods, and data sets. However, it is unclear what drives the differences in the results. Fifty years of research have produced several primary studies and demonstrated the relevance of the day-of-the-week effect in financial research (Cross, 1973; Khan et al., 2023). However, the results of primary studies are still inconclusive. Stock market anomalies are challenged by a present replication crisis (Bampinas et al., 2016; Hou et al., 2020; Jensen et al., 2023). Recent research by Cakici et al. (2024) questions whether anomalies are generally related to stock market returns and concludes that there is no evidence. More general hypothesis testing is necessary to validate the evidence of the day-of-the-week effect and shed light on the replication crisis. Singleton and Wingender (1994) point out that seasonal anomalies, such as the day-of-week effect, do not follow identical paths in financial markets. Unexplained differences in literature are likely to be attributed to study design (Bampinas et al., 2016; Cakici et al., 2024). However, comparing study designs has only been carried out in qualitative literature reviews, and broad empirical research on this hypothesis is missing (Chiah & Zhong, 2021; Al-Hajraf, 2021; Kahn et al., 2023). Consequently, a quantitative review is lacking in linking research findings and generalizing the day-of-the-week effect research results. This study adds a meta-analysis of 85 studies to quantify the impact of variation in study designs and present a common understanding of this stock market anomaly. Due to the extensive literature coverage, including various geographical regions, sectors, and periods, our meta-perspective enhances the general applicability of the findings on the day-of-the-week effect.

Following meta-analyses in finance, the meta-regression approach is used to identify and quantify underlying patterns and reach a global conclusion about the drivers of the day-of-the-week effect (Albertini, 2013; Horváthová, 2010; Stanley & Doucouliagos, 2012; Valickova et al., 2015). The study results validate the popular Monday and Friday effects, known as the Weekend effects. Counterintuitively, Wednesdays have a positive effect, which is as strong as the Friday Effect. The strong evidence for this "Middle-of-the-week Effect" shifts the predominant understanding of the day-of-the-week effect. Previous research focuses on the weekend effect (AlHajraf, 2021; French, 1980; Jaffe & Westerfield, 1985b; Keim & Stambaugh, 1984). Only a few studies highlight the Wednesday so far (Chawla & Shastri, 2023; Zhang et al., 2017). The meta-analysis suggests that the middle of the week should be equally important for investors and researchers. The findings also underline that it is a "Beginning-of-the-week Effect" rather than a negative Monday effect (Demirer et al., 2002; Ulussever et al., 2011). Additionally, identifying a pronounced day-of-the-week effect in the real estate sector provides valuable sector-specific insights, marking the meta-analysis as a notable contribution to the existing literature. The

meta-analysis proves that study designs affect the evidence of the day-of-the-week effect and illustrates a time-dependency with small evidence for geographical differences. The high impact of outliers on day-dependent returns calls for more future research on the drivers of this seasonality. Overall, the findings serve as a synthesis of the accumulated research on the day-of-the-week effect. Day-dependent returns remain from the meta-perspective, allowing for valuable trading strategies in weekly patterns by indicating optimal trading days. The highest returns are on Wednesdays and Fridays, while the lowest return is at the beginning of the week. In a broader picture, the results validate the existence of seasonal stock market anomalies, which challenge the Efficient Market Hypothesis (Fama, 1970).

The study is structured as follows. First, there is an overview of existing literature to provide the theoretical background in Sect. 2. Section 3 describes the methodology used for the meta-analysis. Effect sizes and moderator variables are specified, and empirical methods are introduced. Section 4 presents the meta-analysis results to provide the basis for discussion with limitations, implications, and the influence of publication bias. The last Sect., 5, concludes and provides an outlook for future research.

2 Literature overview on the inconsistency of the day-of-the-week effect

The day-of-the-week effect is a popular stock market anomaly in the financial literature and has been analyzed since the 1970s (Cross, 1973). In studying this anomaly, financial economists come to both support (Gibbons & Hess, 1981; Arsal and Coutts, 1997; Aharon & Qadan, 2019a, 2019b) and rejection of the stock market anomaly (Board & Sutcliffe, 1988; Apoliriono et al., 2006; Alagidede & Panagiotidis, 2009; Bampinas et al., 2016). The most observed effect is the so-called "Weekend effect," which describes that returns are significantly lower on Mondays and higher on Fridays (AlHajraf, 2021; French, 1980; Keim & Stambaugh, 1984). Even when the first trading day is a different day of the week, such as Saturday, the weekly pattern remains significant (Ulussever et al., 2011). An effect that research focuses on less is the "Tuesday blues," which represents the observed lower returns on Tuesdays (Agrawal and Tandom, 1994; Jaffe & Westerfield, 1985b; Chiah & Zhong, 2021). Moreover, there is little evidence for a Wednesday effect (Chawla & Shastri, 2023; Zhang et al., 2017).

The literature widely discusses the effects of stock market anomalies because of a replication crisis. For example, Agrawal and Tandom (1994) challenge the idea of general seasonal patterns. They analyze the stock markets of 18 countries from 1971 to 1987. Monday has the highest negative return in nine countries, while in eight countries, it is Tuesday. The average return on Friday is the highest. Agrawal and Tandom (1994) conclude that calendar anomalies are not due to selection bias alone. Other authors also confirm that the day-of-the-week effect is not uniform across stock markets. For example, the absence of the Monday effect has been documented for emerging markets (Ajayi et al., 2004). Differences between assets are additionally identified (Singelton and Wingender, 1994). Demirer et al. (2002) cannot

confirm that certain days have significantly different returns; they prefer a more general effect at the beginning of the week. The large inconsistency in the study results raises questions about the global existence of the day-of-the-week effect. It is argued that the day-of-the-week effect has been present in the past but has weakened since 1990 (Steely, 2001; Gu, 2004; Kohers et al., 2004). According to Stavarek and Heryán (2012), the effect diminishes in the Central European market from 2006 to 2012. Moreover, Karanovic (2018) examined the Balkan countries from 2012 to 2016 for the day-of-the-week effect and concluded that the effect has mostly disappeared. The broad inconsistency of study results demonstrates the difficulties in replicating the anomaly and raises the question of drivers behind this stock market anomaly.

2.1 The jungle of hypotheses to explain the day-of-the-week effect

Various theories have been proposed to explain the stock market anomaly, including the "Information Hypothesis," the "Behavioral Hypothesis," the activity of short sellers around the weekend, and the inelasticity of demand (Dyl and Marberly, 1988; Pettengill, 1993; Dubois & Louvet, 1996; Chen & Singal, 2003). These theories offer diverse perspectives in explaining the day-of-the-week effect. From a psychological standpoint, the information hypothesis suggests that negative news is more likely to be released on weekends, leading to a subsequent adverse market reaction on Mondays and accounting for the lower average returns on that day (Dyl and Marberly, 1988). However, this hypothesis fails to explain the positive effects observed at the end of the week. The behavioral hypothesis states that investor sentiment improves throughout the week, with investors being more risk-averse at the beginning of the week, resulting in lower returns on Monday and higher on Friday (Jacobs & Levy, 1988; Pettengill, 1993; Rystrom & Benson, 1989). Conversely, Solnik and Laurence (1990) challenge the psychological explanations, arguing against any inherent reason for traders to be unhappy at the beginning of the week. Alternatively, the day-of-the-week effect can be understood as an investment strategy from an economic perspective. This is attributed to the inelasticity of demand, which arises due to settlement periods (Dubois and Louvet, 1996). Abraham and Ikenberry (1994) support this notion by noting that selling pressure on Mondays can be transferred to Tuesdays. Furthermore, Chen and Singal (2003) find evidence of concentrated short-seller activity around the weekend, with short sellers tending to buy on Mondays and sell on Fridays to mitigate risk when unable to trade on weekends. This behavior reinforces the day-of-the-week effect, particularly for this type of investor.

The broad set of hypotheses demonstrates the complexity of explaining the day-of-the-week effect. However, the theory still fails to explain the inconsistent picture of support and rejection of the anomaly in previous studies. Inconsistent study results underline the replication crisis of stock market anomalies (Hou et al., 2020; Jensen et al., 2023). Most recent research refers to unexplained differences in study design (Bampinas et al., 2016; Cakici et al., 2024). Study design differs in multiple temporal, regional, and methodological dimensions for the day-of-the-week effect. However, the literature lacks empirical validation to connect the replication crisis to

choices in study design. A meta-perspective is necessary to quantify the underlying factors of study design in previous studies.

2.2 The impact of geographical differences in study design on the day-of-the-week effect

The data selection of the studies varies among indices worldwide and is mainly based on the return. Countries worldwide are studied for the day-of-the-week effect (Chang and Pinegar, 1993; Dubois & Louvet, 1996; Kiymaz & Berument, 2003). However, the literature finds evidence of the day-of-the-week effect in different countries or regions (Kiymaz & Berument, 2003; Yadimci and Erdem, 2020). Regional differences generally lead to different financial development (De Gregorio & Guidotti, 1995; Rousseau & Wachtel, 2011; Yu et al., 2012). The growth effect of the financial sector also varies across regions, which affects local returns (De Gregorio & Guidotti, 1995; Rousseau & Wachtel, 2011; Yu et al., 2012). For this reason, research based on different regions may lead to geographical differences in the day-of-the-week effect.

Initial day-of-the-week effect research focused on the United States (US) stock market (Cross, 1973; French, 1980; Gibbons & Hess, 1981; Keim & Stambaugh, 1984). The authors extend the idea to international stock markets in the following steps. Compared to earlier studies in the US, Jaffe and Westerfield (1985a, 1985b) do not show negative returns on Mondays but on Tuesdays when studying Japanese and Australian stock markets. Consequently, the anomaly of the day-of-the-week effect is inconsistent concerning specific days of the week and regions. Jaffe and Westerfield (1985a, 1985b) also show seasonal patterns for the US, British, and Canadian stock markets. They conclude that foreign investors are confronted by the day-of-the-week effect of the US stock market in their home markets (Jaffe & Westerfield, 1985a, 1985b). In this regard, literature shows that the day-of-the-week effect can be connected to cross-country correlation. For example, Tuesday's negativity in Australia depends on Monday's performance in the US (Chiah & Zhong, 2021). A similar spillover through the day-of-the-week effect exists between the US and Europe (Sewraj et al., 2019). Moreover, the market opening in the US on Mondays can affect additional stock markets (Bahcivan & Karahan, 2022). The results show that cross-regional dependencies exist at the global level. Consequently, the day-of-the-week effect can differ between regions, identifying regional correlations. However, cross-country correlations have no general regional pattern (Chandra, 2006). The effect of geographical choices in a study is still unclear.

2.3 Cultural differences in investor behavior and the day-of-the-week effect

As an additional indicator of regional differences, cultural aspects can play a role in investor behavior. Santini et al. (2019) demonstrated that financial literacy influenced by culture leads to different behaviors in terms of "willingness to take investment risks" (Santini et al., 2019). Culture significantly impacts the frequency of

trades, trading volume, and the time a position is held (Tan et al., 2019). To quantify cultural differences, Hofstede (2009) introduces six dimensions measuring power distance, individualism, masculinity, uncertainty avoidance, long-term versus short-term orientation, and indulgence. Financial research adapts cultural differences and shows correlations to stock market return. The literature demonstrates that higher power distance, higher individualism, higher uncertainty avoidance, and long-term orientation are connected to higher returns of sustainable investment in Asia (Darsono et al., 2021). Individualism significantly impacts individual trading behavior, which measures how strongly people focus on differentiating themselves from others based on internal attributes and abilities (Chui et al., 2010). As shown by Chui et al. (2010), the individualism of investors influences trading volume and volatility when following the momentum strategy. Moreover, portfolio allocation and international investments are affected by cultural distance (Beugelsdijk & Frijns, 2010).

However, culture can also support inefficient investor behavior like herding (Chang & Lin, 2015). As Hofstede (2009) has noted, cultural aspects can be further associated with investors' moods, which change over the week (Tsai, 2019). According to the "Behavioral hypothesis", sentiment rises during the week with a low mood on Mondays and a high mood on Fridays (Jacobs & Levy, 1988; Rystrom & Benson, 1989). In line with their mood, Investors are more likely to take risks before the weekend and avoid risks at the beginning of the week, reinforcing the day-of-the-week effect (Pettengill, 1993). By influencing the mood of investors, culture can influence the day-dependent returns, as illustrated by the lower return on Tuesdays, known as the "Tuesday Blues" (Chiah & Zhong, 2021). In conclusion, culture influences investment behavior, which can lead to a culture-specific day-of-the-week effect (Tsai, 2019). We hypothesize that inconsistent study outcomes from international research can result from cultural differences.

2.4 Time-dependency and the adaption of the day-of-the-week effect

Global stock markets have been further examined in more detail. Ulussever et al. (2011) studied the effect on the Saudi stock exchange TADAWUL, where trading takes place from Saturday to Wednesday. Even when the active trading days are shifted, the first trading day systematically performs worse than the last trading day of the week (Ulussever et al., 2011). Thus, the day-of-the-week effect is also present in markets where trading does not occur from Monday to Friday. AlHajraf (2021) confirms these results for the Kuwaiti stock market, indicating that time can play a role in day-dependent returns. Literature shows that the day-of-the-week effect in the real estate sector was more pronounced in the 1980s and 1990s in the smaller markets than in the later years, which indicates a time dependency (Brounen & Ben-Hamo, 2009). Gu (2004) also examines the influence of time. His research showed that the weekend effect persists for half of the 49 years examined for the Dow Jones and the S&P 500 and 12 out of 15 years for the Russell 2000. The weekend effect reversed from the late 1980s to the late 1990s, and this trend decreased year by year (Gu, 2004). The anomaly tends to vary over time. Time dependence is an aspect that has already been mentioned before by Board and Sutcliffe (1988). They examine the

Financial Times All Share (FTA) index from 1962 to 1986, and the results show a weekend effect in the United Kingdom that decreases over time. In addition, Steeley (2001) supports the idea of a day-of-the-week effect trend. He also analyzes the daily returns of the UK stock market between 1991 and 1998 and concludes that the effect decreased in the 1990s (Steeley, 2001).

The literature strongly suggests that time dependence of study designs affects the anomaly. The observed weakening can be explained by the adaptive market hypothesis, which states that investors adapt to anomalies, leading to the disappearance over time (Lo, 2004; Schwert, 2003; Urquhart & McGroarty, 2016). Previous research validates that market adaption to the day-of-the-week effect can reduce the abnormal return of the anomaly (McLean & Pontiff, 2016). However, contrary to the assumption of the adaptive market hypothesis, the anomaly does not disappear completely. Previous research still finds evidence for abnormal day-dependent returns (Singal and Tayal, 2020; Li & Liu, 2021). Consequently, the market cannot adapt completely, or additional drivers impact the day-of-the-week effect. Again, the study design question remains to explain the replication crisis (Bampinas et al., 2016; Cakici et al., 2024).

2.5 The day-of-the-week effect and the impact of data mining

Study design covers multiple dimensions in data mining. Besides geographical and temporal differences, different sectors, asset classes, and size effects are analyzed. There is evidence that data mining is one of the main drivers of the anomaly (Agrawal & Tandon, 1994; Bampinas et al., 2016). Geographical and time-dependent effects already demonstrated how study design can influence the evidence of the day-of-the-week effect. The broad research on this stock market anomaly indicates further effects connected to data mining. First, portfolio decisions on company size can play a role in the strength of day-dependent returns (Aharon & Qadan, 2019a, 2019b; Kohers & Kohers, 1995). In particular, smaller companies experience a stronger day-of-the-week effect (Dicle & Levendis, 2014; Kohers & Kohers, 1995). Even when a market generally does not provide evidence for the day-of-the-week effect, small-cap companies provide a weekly pattern in Australia (Marrett & Worthington, 2008). This size effect is stable over time and international indices (Aharon & Qadan, 2019a, 2019b). Consequently, portfolio composition affects the day-of-the-week effect.

Second, besides company size, the day-of-the-week effect occurs mainly in specific sectors (Narayan et al., 2014). The real estate sector differs primarily because of its level of mispricing (Bampinas et al., 2016). While mispricing is referred to as one of the main drivers of stock market anomalies (Jacobs & Müller, 2020), the real estate sector is analyzed separately (Friday & Higgins, 2000; Redman et al., 1997; Reis et al., 2023). Brounen and Ben-Hamo (2009) also confirmed a sector-specific day-of-the-week effect in the world's ten largest real estate stock markets. In all data sets, they find significant patterns for higher returns on Fridays and lower on Mondays.

Third, next to the predominant focus on stocks, the day-of-the-week effect is present in additional asset classes like the treasury market, the crypto market, or commodities (Flannery and Propopapadakis, 1988; Singleton & Wingender, 1994; Aharon & Qadan, 2019a, 2019b; Caporale & Plastun, 2019; Qadan & Idilbi-Bayaa, 2021). The treasury market indicates a weekend effect with a more negative Monday and positive Friday return (Flannery and Propopapadakis, 1988; Singleton & Wingender, 1994). However, abnormal weekends, identified as the main driver of the weekend effect, differ between the stock market and the bond market. The authors conclude that institutional and general-equilibrium explanations cannot explain the dynamics of the day-of-the-week effect (Flannery and Propopapadakis, 1988). Consequently, the day-of-the-week effect is non-parallel in financial markets and is more likely due to individual market characteristics (Singleton & Wingender, 1994).

Nevertheless, day-dependent returns are present in different asset classes. Even the comparable “new” crypto market indicates evidence for the day-of-the-week effect in Bitcoin (Dorfleitner & Lung, 2018; Aharon & Qadan, 2019a, 2019b; Caporale and Plastun, 2019). Authors widely agree on a positive Monday effect in Bitcoin, but findings disagree on additional effects on Thursday or Sunday (Dorfleitner & Lung, 2018; Ma & Tanizaki, 2019). In addition, evidence from other cryptocurrencies is inconsistent with suggesting both the support and rejection of a weekly pattern (Dorfleitner & Lung, 2018; Caporale and Plastun, 2019). Sample periods are especially indicated as an underlying factor that influences the evidence of the anomaly (Ma & Tanizaki, 2019). Research on cryptocurrencies again illustrates the discrepancy in replicating the day-of-the-week effect. While the Monday effect is mainly negative in stock markets, the crypto market has a positive effect. Therefore, the non-parallel characteristic of the anomaly remains even in more developed financial markets, which contradicts the adaptive market hypothesis and raises the question of underlying factors.

The research on cryptocurrencies indicated another dimension of the day-of-the-week effect by analyzing weekly patterns in volatility. Findings suggest that the market volatility of cryptocurrencies is also driven by a weekly pattern with higher volatility on Mondays, which is in line with the significant results of the Monday effect (Aharon & Qadan, 2019a, 2019b; Caporale and Plastun, 2019). The market volatility index (VIX) further analyzes the weekly pattern in market volatility. The indicator for market uncertainty demonstrates day-dependent effects with significant abnormal volatility on Mondays and Fridays (Idilbi-Bayaa & Qadan, 2022). Most recent research generalizes the effect on market volatility for stocks, bonds, and commodities with a significant presence of a weekly pattern in daily returns (Quadan et al., 2022). The comparable weekly pattern between market volatility and daily returns indicates similarities with a present weekend effect. However, the day-of-the-week effect presents itself again as a dynamic and unstable phenomenon. While market uncertainty changes over time, the choice of sample periods in the study design can impact the evidence of the weekly pattern.

Finally, research methodology on the day-of-the-week effect developed over time. Early studies relied mainly on descriptive statistics, while more recent studies use OLS and GARCH models or other machine learning algorithms. The often-used OLS regressions are criticized for lacking heteroskedasticity, leading to

misspecification and biased model results (Wiedermann et al., 2017). Consequently, differences in returns on weekdays can result from methodological biases. A major criticism of the day-of-the-week effect is an argument of Bampinas et al. (2016), who use a rolling regression to demonstrate that the day-of-the-week effect exists due to sampling selection bias. Bampinas et al. (2016) conclude that the day-of-the-week effect is due to a lack of data mining. Moreover, Connolly (1989) demonstrates that the significance of the day-of-the-week effect is due to outliers. Misapplied statistical methods may have contributed to the occurrence of the anomaly. Literature underlines that sample size and error term adjustments affect the significance of the day-of-the-week effect (Chang et al., 1993). From this point of view, the day-of-the-week effect appears as a phenomenon caused by the choice of empirical methods.

The literature indicates geographical, day-dependent, time-dependent, asset-dependent, and methodological-dependent differences for the day-of-the-week effect. The many theories provide multiple explanations for day-dependent returns from different perspectives to explain this anomaly. However, the unstructured appearance and disappearance of the day-of-the-week effect cannot be explained completely and remains an open puzzle. Consequently, the day-of-the-week effect (like other stock market anomalies) is confronted with a replication crisis (Hou et al., 2020; Jensen et al., 2023). Inconsistent and non-reproducible significance for certain days of the week raises the question of manipulated results to achieve relevant results for publication. This publication bias based on unexpectedly low significance levels is declared as “p-hacking” (Harvey et al., 2016). P-hacking, as an unorthodox way of data mining, can strongly affect study results, leading to broad differences between previous researchers. To test for publication bias, published and unpublished studies

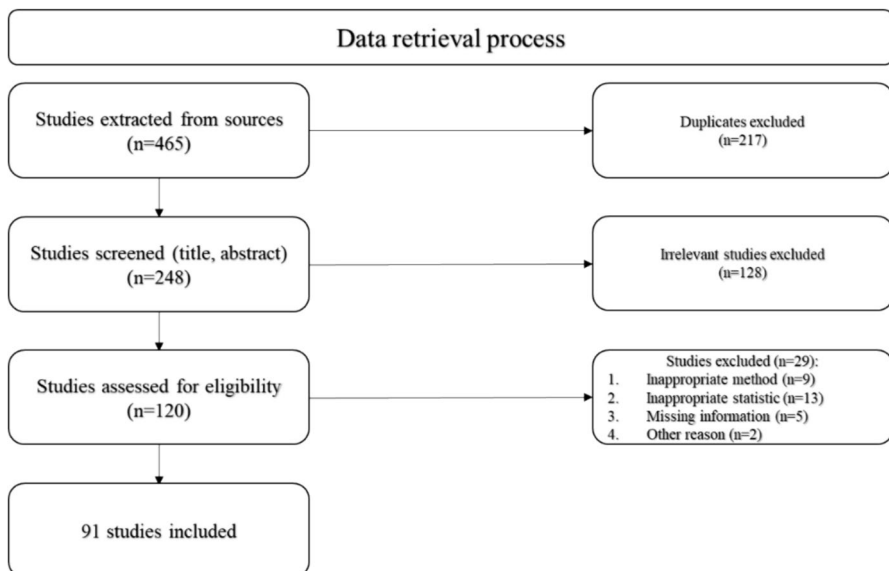


Fig. 1 PRISMA flow diagram Notes: Provided to illustrate literature retrieval for the meta-analysis (McKenzie et al., 2021)

must be compared from a meta-perspective (Geyer-Klingenberg et al., 2020). In addition, the year of publication must be considered, as more recent studies may benefit from new econometric techniques that can alter publication patterns in the literature (Valickova et al., 2015). The unclear picture of previous research indicates that additional underlying factors are not captured by previous conventional research methodology. Most recent literature refers to unexplained inconsistency in choices in the study design (Bampinas et al., 2016; Cakici et al., 2024). However, the research lacks a structured and quantitative analysis of the impact of study characteristics on day-of-the-week effect research. Therefore, instead of adding an additional primary study, this study adds a meta-perspective to shed light on drivers behind the dynamic of the day-of-the-week effect and analyze the impact of study designs.

3 Data and method

The long history of research on the day-of-the-week effect has produced numerous individual studies. By reviewing the study results of research from the last 50 years, our meta-analysis allows us to quantify the impact of variations in study designs. The meta-analysis method is chosen for the following reasons. As Hubler et al. (2019) state, meta-analysis can quantitatively summarize research findings. As a result, meta-analysis creates an overall understanding, reduces sampling error, and examines heterogeneity in study design (Geyer-Klingenberg et al., 2020). In addition, it is currently the most objective method for comparing studies (Hubler et al., 2019). The picture of the replication crisis can become more apparent by understanding the underlying factors caused by choices in study design. This section describes the research methodology, including the dataset, research framework, moderator variable specification, and empirical models.

3.1 Dataset selection and composition

The dataset is created through a literature search, which includes a systematic database search. In the first step, keyword searches are used to find initial studies. Scientific databases such as Google Scholar or Web of Science are filtered for topic-related keywords "day-of-the-week effect," "day-of-the-week effect on the stock market," "day-of-the-week effect stock market anomaly," "stock market seasonality," "Friday effect," or "weekend effect." The keyword search yields 465 potentially relevant studies. First, 217 duplicates are sorted out. Second, the titles and abstracts of the reports are screened, leading to the exclusion of 128 for the meta-analysis's irrelevant analysis. Third, studies with missing statistical information, unusable statistics, or non-comparable methodology are excluded. We mainly focus on the day-of-the-week effect in the stock market because of non-parallel effects across different financial markets (Flannery & Propopapadakis, 1988; Singleton & Wingerder, 1994). However, we add different asset classes to control the asset dimension. Finally, 91 studies are used for the meta-analysis. The PRISMA flow diagram (Fig. 1) summarizes the systematic literature process (Moher et al., 2009).

The meta-analysis includes 91 primary studies from 1980 to 2022, with 686 individual samples coded, resulting in 4230 observations. The observations are based on 1,921,327 data points. Sample sizes vary from 225 to 24,140 data points per study with a mean of 2804 data points. The information splits into two levels: paper characteristics and study characteristics. The characteristics of the papers include all general information such as authors, publication year, sample size, subsamples, region, and methodology. Many authors combine multiple studies and subsamples into one paper to analyze regional, time, and methodological differences. All usable subsamples are included in the meta-analysis. Due to country-specific differences, the dataset comprises weekdays from Monday to Sunday. In addition, coders extract available statistical information such as sample size, t-tests, F-tests, regression coefficients, and correlations for the meta-analysis to validate the impact of the study design.

3.2 Basic model of the day-of-the-week effect

In previous studies, the day-of-the-week effect is analyzed based on the average daily return R_t (French, 1980). Authors use logarithmic or normal returns based on the daily index price P_t and the index price of the previous day P_{t-1} (Jaffe & Westerfield, 1985b; Kiyamaz et al., 2003; Singal and Tayal, 2020). In this study, results are represented as percentage values. Initial research started by analyzing daily returns using descriptive statistics and t-tests (Cross, 1973; French, 1980). The methodology developed and econometric methods are integrated. OLS regression models analyze the day-of-the-week effect (Gibbons and Hees, 1981; Abraham & Ikenberry, 1994). The standard regression model (Eq. 1) includes a constant, dummy variables for days of the week, and an error term ε_t . To escape the dummy variable trap, one weekday stays included in the intercept β_0 . Regression coefficients are estimated for the dummy variables (β_1 to β_4) the constant β_0 :

$$R_t = \beta_0 + \sum_{n=1}^4 \beta_n \text{Weekday}_n + \varepsilon_t \quad (1)$$

Some authors extend the basic model with additional terms to reduce model biases, such as autocorrelation (Berument and Kiyamaz, 2001). Moreover, most recent studies use different types of GARCH models to correct for heteroskedasticity (Apolinario et al., 2006; Ghalot & Datta, 2022). However, day-of-the-week effect research focuses on daily price differences following a seasonal, weekly pattern. Empirical results are based on hypothesis tests and regression models. This empirical information represents the baseline for the meta-analysis.

3.3 Introduction of Meta-Analysis: Effect Size Calculation and Integration

Effect sizes (ES) are the standard measure in a meta-analysis (Kirk, 1996). The effect size of the day-of-the-week effect (DoW) is the relationship between specific days of the week and daily returns. T-tests, F-tests, and regression

coefficients of primary studies are the source for effect size calculation (Peterson & Brown, 2005; Doucouliagos, 2005). For the meta-analysis, effect sizes are calculated and transformed into a common size. ESs are partial correlations (Pearson's r) because of the paired quantitative data structure (Cohen, 2013). Partial correlations are used to compare literature because of the unitless characteristics (Asongu, 2015). The study follows previous meta-analyses in finance and economy to calculate effect sizes from the study results (Eqs. 2–4):

1. Calculate ES from t-test ($t = t\text{-value}$, $df = \text{degrees of freedom}$) (Webel and Greene, 2011; Doucouliagos & Ulubasoglu, 2006; Doucouliagos, 2005):

$$ES = \frac{t}{\sqrt{t^2 + df}} \quad (2)$$

2. Calculate ES from F-test ($F = F\text{-value}$, $df = \text{degrees of freedom}$):

$$ES = \frac{\sqrt{F}}{\sqrt{F + df}} \quad (3)$$

3. Calculate ES from regression coefficients ($\beta = \text{coefficient}$, $\lambda = 1$ for non-negative β) (Peterson & Brown, 2005):

$$ES = \beta + 0.05\lambda \quad (4)$$

Effect sizes are z-transformed to reduce the impact of non-normal distributed data (Borenstein et al., 2009; Silver & Dunlap, 1987):

$$DoW = ES_Z = 0.5 \log \left[\frac{1 + ES}{1 - ES} \right] \quad (5)$$

The meta-analysis summarizes existing primary studies. For this reason, effect sizes are calculated and integrated. In the case of the day-of-the-week effect, effect sizes are expected to be around zero because of the size of the effect. ESs close to zero are defined as small (Cohen, 2013). However, "small effect sizes can be more informative than large ones if predicted by theory" (Fern & Monroe, 1996). A weighting factor integrates ESs from different studies to standardize differences in study design. The weighting factors are the sample sizes (Schmidt, 2015). The standard errors are not calculated as a weighting factor because of a lack of data in multiple primary studies (Ewing and Cevero, 2010). Using sample sizes as standard errors is discussed in previous meta-analyses. On one side, Hunter & Schmidt (2004) argue that sample sizes as weighting factors are less biased than standard deviations. On the other side, Sánchez-Meca & Marin-Martínez (1998) demonstrate, that there is a loss in efficiency when estimating with the sample size. However, the difference in efficiency is only small, with an average of 2.8% (Sánchez-Meca and Marin-Martínez, 1998). Effect sizes allow us to compare differences of primary studies from a meta-perspective.

3.4 Multivariate multilevel meta-regression

The meta-analysis aims to explain heterogeneity in study results. As an initial test, a Q-test analyzes variance for homogeneity (Lipsey & Wilson, 2001). A significant Q-test indicates that the heterogeneity variance between studies is greater than zero (Huedo-Medina et al., 2006). In cases of heterogeneity, further moderator analysis is performed to explain differences in study variance (Lipsey & Wilson, 2001). Following previous financial meta-analysis, data is analyzed by multivariate multilevel regression (Doucouliagos & Stanley, 2009; Havranek & Irsova, 2011; Valickova et al., 2015). Multivariate meta-regression test for systematic variation of results in different contexts. “It is a tool that explicitly accounts for heterogeneity and determines the sources of variability of study outcomes” (Geyer-Klingenberg et al., 2020). The regression model is based on a two-level random effects model and distinguishes between within-study and between-study variance. Level 1 focuses on between-study variance, which includes the impact of differences in study design, such as the choice of statistical methods. Level 2 integrates within-study variance, for example, geographical differences of subsamples or periods moderator variables.¹ The model is specified with an intercept α which includes Thursday because of the low evidence for the day-of-the-week effect on this day. Moreover, day-dependent parameters are summarized in β . Control variables with parameters γ integrate essential study characteristics to search for patterns in the primary study designs. The error term is split in u which includes study fixed errors and ϵ (Eq. 6):

$$DoW = \alpha + \beta Weekdays + \gamma Study_Characteristics + u + \epsilon \quad (6)$$

To explain the heterogeneity of study design, study characteristics are differentiated into five main dimensions. The five dimensions include geographic, cultural, index, empirical, and publication.

3.5 Quantifying differences in study design by moderators

Based on the literature research, multiple moderators are included to cover differences in study design. First, the scope of the indices ranges from individual countries to global scope. Cross-country or global indexes combine multiple cultures, reducing the influence of country-specific differences. Dummy variables group indexes into country-specific, cross-country, and global indexes to identify the effects of index scope. Different sectors are also covered. In particular, the real estate sector differs from other sectors in that it has a lower level of mispricing (Bampinas et al., 2016). Birz et al. (2022) argue that real estate needs to be analyzed separately due to institutional characteristics. The divergence may lead to a specific day-of-the-week effect for real estate, analyzed by the meta-analysis. Moreover, differences between

¹ Calculations are made with R (Version 4.2.2.) and the package “metafor” is used to estimate meta-regression models (Balduzzi et al., 2019).

Table 1 Descriptive statistics of effect sizes of the day-of-the-week effect

Weekday	Number of observations	Mean	Variance	CI + 95%	CI – 95%	Q-test
Monday	840	– 0.0031	0.0567	0.4636	– 0.4698	138,541***
Tuesday	800	– 0.0164	0.0441	0.4280	– 0.3952	165,189***
Wednesday	757	– 0.0962	0.0396	0.4862	– 0.2938	180,057***
Thursday	789	– 0.0578	0.0394	0.4468	– 0.3312	89,586***
Friday	806	– 0.1016	0.0340	0.4630	– 0.2598	116,641***
Saturday	207	– 0.0247	0.0161	0.2734	– 0.2240	555***
Sunday	031	– 0.1112	0.0357	0.2591	– 0.4815	924***

In previous studies, Monday was the most analyzed day, while the weekend was underrepresented because of inactive trading days in most stock markets. Mondays provide a negative mean, while Fridays have the highest mean during the week. Heterogeneity is indicated for all days according to the significant Q test. (CI provides the confidence interval for +95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.)

Table 2 Results of multivariate meta-regression for day-dependent returns

Day-of-the-week effect from a meta-perspective	Estimate	Standard error	z-value	p-value	CI – 95%	CI + 95%
Intercept (Thursday included)	0.4090***	0.4811	0.8500	0.3953	– 0.5340	13.519
Days of the week						
Monday	– 0.0299***	0.0047	– 64.264	<0.0001	– 0.0390	– 0.0208
Tuesday	– 0.0201***	0.0047	– 42.719	<0.0001	– 0.0293	– 0.0109
Wednesday	– 0.0195***	0.0048	– 40.861	<0.0001	– 0.0101	– 0.0288
Friday	– 0.0225***	0.0047	– 47.842	<0.0001	– 0.0133	– 0.0316
Saturday	– 0.0157***	0.0107	– 14.652	0.1429	– 0.0368	– 0.0053
Sunday	– 0.1621***	0.0347	– 46.711	<0.0001	– 0.2301	– 0.0941

Mondays and Tuesdays show significantly lower daily returns, while Wednesdays and Fridays have higher returns. Results confirm the weekend effect but surprise with a strong Wednesday effect. Sunday indicates the negative Monday effect, which is shifted in the specific stock market (CI provides the confidence interval for +95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.)

asset classes, including cryptocurrencies and futures, are integrated to test for the impact of choices in study design.

Second, to include geographic differences, we followed Asongu (2015) and added cross-country moderators for each continent. Moreover, Hofstede's cultural dimensions identify regional differences in behavior. Following previous cross-cultural meta-analyses, culture is measured using Hofstede's six dimensions (Jaramillo et al., 2005; Maroun, 2015; Steenkamp & Geyskens, 2012). According to Hofstede, cross-national cultural differences are measured using power distance, masculinity, individualism, uncertainty avoidance, indulgence, and long-term orientation (Hofstede,

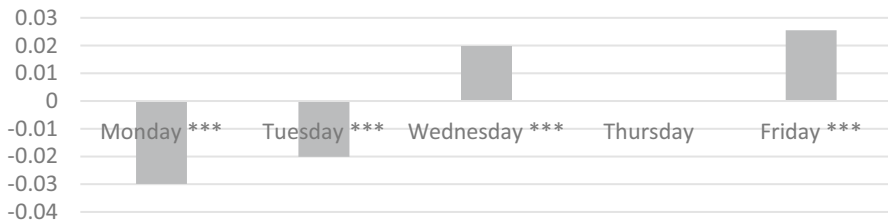


Fig. 2 The day-of-the-week effect on weekdays Notes: The day-of-the-week effect is highly significant on weekdays. The figure illustrates the meta-regression results for the most active trading days, while Thursdays are set as a baseline because they are integrated into the regression intercept. The beginning of the week shows lower returns, while the middle and the end suggest higher returns. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

2009).² Beugelsdijk and Frijns (2010) highlight that uncertainty avoidance and individualism impact portfolio allocation and trading activity. The dimensions are rated on a scale from 0 (weakest expression) to 100 (strongest expression).

Third, indices do not differ only by region. The time dependence of the day-of-the-week effect remains an open question and is widely discussed (Gu, 2004; Nippani & Greenhut, 2011). For this reason, research periods covered by the studies are divided into ten-year periods to identify changes in long-term trends. Furthermore, a moderator is used to test for the significance of the length of the study periods. Chang et al. (1993) show that sample size and error term adjustments affect the significance of the day-of-the-week effect. A short period indicates a smaller sample size, which also leads to a greater weighting of outliers. For this reason, the day-of-the-week effect may result from sample selection bias and may occur primarily in smaller samples. Furthermore, outliers can lead to significance in statistical models (Aguinis et al., 2013). Conolly (1989) demonstrates that the day-of-the-week effect is strongly associated with the presence of outliers. In this study, outliers are defined as effect sizes more than three times the standard error around the mean of all effect sizes. Finally, the study tests for publication bias, which is one of the main threats to meta-analyses (Geyer-Klingenberg et al., 2020). Studies that produce significant results are more likely to be published (Stanley, 2005). Published and unpublished studies are included, and a moderator distinguishes between published and non-published studies. In addition, the year of publication is included, as more recent studies may benefit from new econometric techniques that can alter publication patterns in the literature (Valickova et al., 2015). The Appendix (Table 9) shows an overview of all moderators.

² Additional information can be found on the following website (Accessed on 23.11.2023): <https://www.hofstede-insights.com/models/national-culture/>.

4 Empirical results of the meta-analysis on the day-of-the-week effect

The meta-analysis is based on 4230 observations, extracted from the 91 studies. Table 1 provides an overview of day-dependent study results, represented by the effect sizes. Disregarding the weekend, Mondays have the largest proportion of observations, while Wednesdays have the smallest. The distribution suggests a concentration of research at the beginning and end of a week, which is explainable by the often-analyzed weekend effect. The descriptive statistics indicate the Weekend effect with the lowest and negative mean on Mondays and the highest mean on Fridays. Counterintuitively, the mean of effect sizes on Tuesdays is slightly positive, contradicting the “Tuesday Blues.” In addition, Wednesdays surprise with a high mean, comparable to Fridays. The weekend covers the strongest negative daily effects on Sunday. However, effect sizes for all days vary around zero with positive and negative attributes, as indicated by the confidence intervals (CI) for 5% and 95%. Because of the variance, all variables are heterogenous based on the significant Q tests, which suggests the usage of a meta-analysis.

4.1 Evidence of the day-of-the-week effect from a meta-perspective

The meta-analysis analyses the day-of-the-week effect from a more general perspective (Table 2). We support the widely held notion of the previous literature with evidence for the Monday effect, the Tuesday effect, the Wednesday effect, and the Friday effect. The regression results show that daily returns on Mondays and Tuesdays are significantly lower from a meta-perspective. Therefore, we support the Tuesday Blues from a meta-perspective (Agrawal & Tandom, 1994; Jaffe & Westerfield, 1985b; Chiah & Zhong, 2021). In contrast, Wednesdays and Fridays provide a significantly higher positive correlation between weekday and daily returns. As a result, the popular Weekend effect, which combines a higher return on Fridays with

Table 3 Effect of index choice on the day-of-the-week effect

Asset effects in study design	Estimate	Standard error	z-value	p-value	CI + 95%	CI – 95%
Index country	0.0015**	0.0171	0.0881	0.9298	– 0.0320	0.0350
Index cross-country	–	–	–	–	–	–
Index global	– 0.0112**	0.0412	– 0.2730	0.7848	– 0.0920	0.0695
Index real estate	0.0363**	0.0166	21.902	0.0285	0.0038	0.0687
Futures	– 0.0027**	0.0295	– 0.0930	0.9259	– 0.0605	0.0550
Cryptocurrency	–	–	–	–	–	–
Bitcoin	–	–	–	–	–	–

Only indices of the real estate sector show a specific day-of-the-week effect. Global, cross-country, and country-specific indices do not differ from a meta-perspective (Variables with “–” are dropped because of redundancy. CI provides the confidence interval for +95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.)

a weaker return on Mondays, is underlined (AlHajraf, 2021; French, 1980; Keim & Stambaugh, 1984). The results are visualized in Fig. 2. Data from the weekend must be considered separately due to the small number of observations and low trading activity.

The meta-analysis widely proves the existence of the day-of-the-week effect. However, Wednesday demonstrates an unexpectedly high positive effect. In contrast to the common understanding of the Wednesday, which is widely seen as unimportant, results show that the Wednesday effect is nearly as strong as the popular Friday effect. Consequently, the focus on days around the weekend must be extended. The meta-analysis proves a “middle-of-the-week effect,” partially known in the literature but rather underestimated (Chawla & Shastri, 2023). For example, the results of Jaffe and Westerfield (1985b) indicate that the Wednesday effect is as strong as the Friday effect in some cases. However, after the study, only the Weekend effect is highlighted.

In addition, the Weekend effect itself is also different for countries that trade on Saturday or Sunday. Saturdays show no significance, while Sundays provide a strong negative effect. Therefore, the weekend can be seen as an early “Monday effect” because of the shift in trading days in specific countries and supports the information hypothesis, which states that bad news is more likely to be published at the weekend (Dyl and Marberly, 1988). The results align with AlHajraf’s (2021) and Ulussever et al. (2011) research, which also found the Weekend effect on shifted weekends. Consequently, the term “Monday effect” is appropriately misleading. Instead, it is a “beginning of the week effect,” as Demirer et al. (2002) concluded.

Table 4 Time-dependency of the day-of-the-week effect

Time-dependent effects in study design	Estimate	Standard error	z-value	p-value	CI + 95%	CI – 95%
1900s	0.0021*	0.0385	0.0552	0.9560	– 0.0734	0.0776
1910s	– 0.0167*	0.0423	– 0.3948	0.6930	– 0.0996	0.0662
1920s	0.0156**	0.0249	0.6251	0.5319	– 0.0333	0.0644
1930s	– 0.0160*	0.0228	– 0.7020	0.4827	– 0.0607	0.0287
1940s	0.0013*	0.0187	0.0704	0.9439	– 0.0354	0.0381
1950s	0.0123**	0.0145	0.8486	0.3961	– 0.0161	0.0407
1960s	– 0.0162*	0.0082	– 19.804	0.0477	– 0.0321	0.0002
1970s	0.0102*	0.0069	14.741	0.1405	– 0.0034	0.0237
1980s	0.0136*	0.0056	24.312	0.0151	0.0026	0.0245
1990s	0.0098*	0.0053	18.311	0.0671	– 0.0007	0.0203
2000s	– 0.0073*	0.0056	– 12.949	0.1954	– 0.0183	0.0037
2010s	0.0005*	0.0066	0.0832	0.9337	– 0.0124	0.0134
Research Period	0.0006**	0.0003	22.025	0.0276	0.0001	0.0011

The 1960s effect is weaker, while the 1980s and 1990s indicate a stronger day-of-the-week effect. In addition, a longer study period reinforces the anomaly. (Variables with “–” are dropped because of redundancy. CI provides the confidence interval for + 95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively)

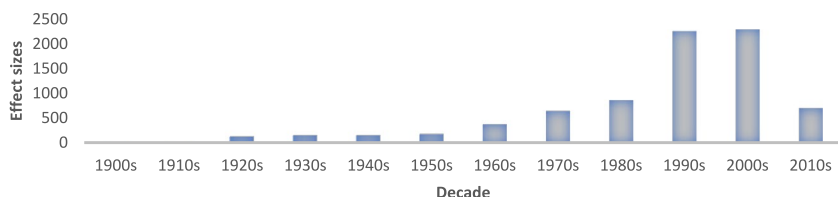


Fig. 3 Distribution of research over time. Notes: The distribution of periods covered by day-of-the-week effect studies is indicated by the number of effect sizes covering a period. The figures illustrate a research hype in the 1990s and 2000s

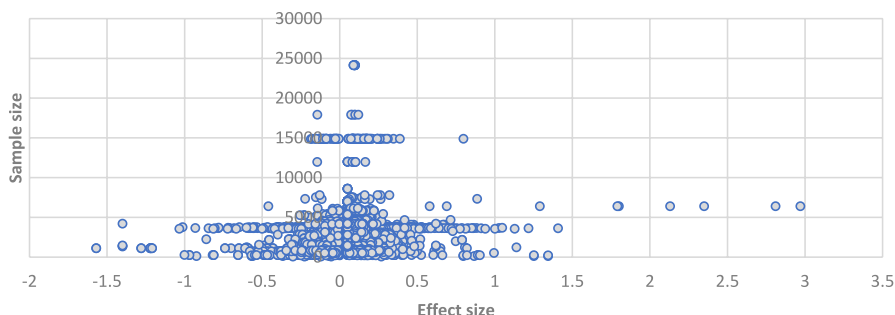


Fig. 4 Funnel plot to test for publication bias. Notes: Funnel plot of effect sizes in combination with sample size (number of daily observations of primary studies), which visualizes the absence of the publication bias by showing no gap around zero

In conclusion, the meta-analysis suggests that the day-of-the-week effect is present from a more general perspective. However, the focus on the week's beginning and end connected to the weekend effect can be misleading because of the strong Wednesday effect and shifted trading days.

4.2 Effect of data mining on the day-of-the-week effect

Study design differs in multiple dimensions. In a broader picture, the choice of asset type and study length are essential differences in primary studies. The dataset includes sector-specific, country-specific, cross-country, and global indices. 602 subsamples are based on country-specific indices, 18 samples on cross-country indices, and 46 samples on global indices. The findings suggest that the day-of-the-week effect is unchanged for country-specific or global indices (Table 3). Regarding sector-specific effects, the real estate sector shows a significantly stronger seasonality (Birz et al., 2022). Results support the idea that the real estate sector needs to

be considered separately (Friday & Higgins, 2000; Redman et al., 1997; Reis et al., 2023). Jacobs and Müller (2020) argue that anomalies tend to represent mispricing. The real estate sector exhibits lower mispricing than other sectors (Bampinas et al., 2016). Consequently, the anomaly should be weaker. The meta-regression results contradict with a significantly higher magnitude. However, the expected impact of mispricing stated by Bampinas et al. (2016) cannot be confirmed.

The effect on cryptocurrencies and futures is also tested because of the non-parallel findings in the literature regarding different asset classes. The results show that there is no specific day-of-the-week effect in futures. In addition, and contrast to previous findings, we cannot support differences in the day-of-the-week effect for cryptocurrencies from a meta-perspective. While Bitcoin showed specific day-dependent effects in some studies (Aharon & Qadan, 2019a, 2019b; Caporala and Plastum, 2019), this cryptocurrency was tested separately. The variable was also dropped because of redundancy, signaling that the inconsistency in the day-of-the-week effect arises from different sources.

The findings validate that choices in study design can impact the evidence of this stock market anomaly. The results suggest that index-specific differences affect the sector choice, but there are no differences when evaluating a broader scope.

Table 5 Geographical and regional differences Notes: The differences in the study design of the day-of-the-week effect are mainly redundant in the meta-analysis

Geographical effects in study design	Estimate	Standard error	z-value	p-value	CI + 95%	CI – 95%
Africa	0.0026	0.0112	– 0.2352	0.8141	– 0.0192	0.0245
Asia	0.0096	0.0071	– 13.436	0.1791	– 0.0044	0.0236
Europe	–	–	–	–	–	–
Latin America	–	–	–	–	–	–
North America	0.0016	0.0074	– 0.2098	0.8338	– 0.0161	0.0130
Oceania	0.0346***	0.0123	– 28.220	0.0048	– 0.0106	0.0586
Cultural						
Power distance	0.0001*	18.243	– 0.0681	0.0000	– 0.0006	0.0001
Individualism	–	–	–	–	–	–
Long term orientation	0.0000	0.0001	– 0.1272	0.8988	– 0.0002	0.0003
Indulgence	0.0005*	0.0001	– 31.062	0.0019	0.0002	0.0008
Masculinity	– 0.0001	0.0001	– 10.325	0.3018	– 0.0003	0.0001
Uncertainty avoidance	– 0.0001	0.0001	– 0.9737	0.3302	– 0.0003	0.0001

Only Oceania and cultures with indulgence suggest a higher day-of-the-week effect. Variables with “–” are dropped because of redundancy. CI provides the confidence interval for + 95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.3 Effect of time-dependency on the day-of-the-week effect

The inconsistency of stock market anomalies is often referred to as time dependency (Gu, 2004; Nippani & Greenhut, 2011). Based on the adaptive market hypothesis, the literature suggests that investors adapt to anomalies that can lead to a disappearance over time (Lo, 2004; Urquhart & McGroarty, 2016). For this reason, an additional meta-regression test was conducted over all decades, as covered by previous research on the day-of-the-week effect (Table 4). The meta-analysis confirms time-dependency in the stock market anomaly. The findings suggest a weaker day-of-the-week effect in the 1960s. As first published in the 1970s by Cross (1973), investor adaption should lead to additional lower day-dependent returns in the following decades.

Counterintuitive, the results show that the anomaly is significantly more robust in the 1980s and 1990s, demonstrating a positive dynamic of the day-of-the-week effect. The positive peak contradicts the expected weakening according to the adaptive market hypothesis in the first place. After the peak in the 1980s, the effect falls back with a lower positive effect in the 1990s. This “weakening” in the 1990s, also found in previous literature (Brounen & Ben-Hamo, 2009; Gu, 2004; Steeley, 2001), is a recession because of a late adoption. Consequently, the publication of the day-of-the-week effect reinforces the anomaly before investors adapted. The maximum can further explain the high public interest in this topic indicated by the broad number of studies in the 1990s and 2000s (Fig. 3).

Finally, the meta-analysis suggests that more extended study periods lead to a significantly higher day-of-the-week effect. Thus, the day-of-the-week effect is more pronounced in a long-term perspective, indicating an additional aspect of time dependency in study design. Besides time-related differences, geographical choices are one of the main differences in previous studies (Fig. 4).

Table 6 The effect of empirical methodology choices on the day-of-the-week effect is insignificant (represented by differences between OLS, GARCH, and logarithmic returns)

Methodological effects in study design	Estimate	Standard error	z-value	p-value	CI + 95%	CI – 95%
Regression	0.0330***	– 0.1066	0.9151	– 0.0682	0.0612	0.0330
OLS	0.0070***	0.7810	0.4348	– 0.0083	0.0193	0.0070
GARCH	0.0083***	– 0.9490	0.3426	– 0.0240	0.0084	0.0083
Logarithmic return	0.0054***	0.6417	0.5211	– 0.0071	0.0140	0.0054
Outlier	0.0319***	0.0122	26.061	0.0092	0.0079	0.0558

However, outliers play a pivotal role by enhancing the day-of-the-week effect. CI provides the confidence interval for + 95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

4.4 Effect of geographical and cultural aspects on the day-of-the-week effect

To generate a more general understanding of regional differences in the day-of-the-week effect, the data set includes research from 61 countries. We clustered the data by continents to compare regional differences from a meta-perspective. Countries from Europe (33%), North America (33%), and Asia (27%) include 93% of the data. The remaining 7% is divided between Africa (2%), Latin America (2%), and Oceania (3%). The empirical results of geographical variables in Table 5 do not suggest significant differences in Asia, Europe, and North America. Regional differences are found in Oceania, which indicates a significantly stronger day-of-the-week effect. However, the small amount of data for Oceania makes this region more susceptible to outliers, which can affect the significance of the results.

In conclusion, geographic differences only occur in underrepresented regions of the dataset, such as Oceania. Although study results are widely inconsistent for different countries, from a meta-perspective, there are no differences in the day-of-the-week effects in Europe, North America, and Asia. The day-of-the-week effect is similar across the three economically dominant continents. The equalizing effect of heterogeneity in primary studies can explain this result.

For a deeper understanding of geographic differences, we extend the model by cultural indicators. From a cultural perspective, indulgence and power distance have a positive but weak effect on the magnitude of the day-of-the-week effect. Cultures with higher indulgence and higher power distance experience a slightly stronger day-of-the-week effect. The remaining cultural moderators are not significant. While the day-of-the-week effect is often explained by psychological theories (DeFusco et al., 1993; Pettengill, 1993; Chen & Singal, 2003), the cultural aspects offer a possible explanation for the behavioral hypothesis and the informational hypothesis. Literature suggests that culture affects financial decision-making (Nabar & Boonlert-U-Thai, 2007; Falmarzi et al., 2023).

Table 7 Descriptive analysis of outliers in the data set of the meta-analysis

Determinants for Outliers	Value (percentage value)
Number of outliers in the data set	71 (1.67%)
Number of studies with outliers	18 (19.78%)
Number of countries (regions)	17 (Europe, Asia, North America)
Periods	1980s, 1990s, 2000s
Outliers on weekdays	
Mondays	24 (33.8%)
Tuesday	19 (26.7%)
Wednesday	12 (16.9%)
Thursday	9 (12.6%)
Friday	7 (9.8%)

Outliers summarize effect sizes more than three times the standard deviation around the mean of effect sizes. Mondays and Tuesdays have the highest number of outliers from 17 different studies.

In detail, indulgence is defined as weak impulse control (Hofstede, 2009). Weak impulse controls can lead to “actions that seem ill-conceived, rashly uttered, inappropriately risky, or inappropriate to the situation and often lead to undesirable consequences” (Daruna & Barnes, 1993). Consequently, our findings suggest a relationship between weak impulse control and the day-of-the-week effect, and we show that culture can affect this stock market anomaly. As a result, indulgence can lead to irrational behavior that can cause inefficient daily investment decisions. In addition, the findings show that higher power distance reinforces inefficient weekly patterns, which underlines the negative effect of power distance on investor decisions (Galariotis & Karagiannis, 2021).

Because of the comparable small estimate, we conclude that the day-of-the-week effect is only weakly related to cultural and regional differences.

4.5 Effect of choice of empirical methodologies on the day-of-the-week effect

Data mining is cited as one of the main criticisms of the day-of-the-week effect (Bampinas et al., 2016). We tested the effect of different methodologies to estimate the day-of-the-week effect equation. The findings in Table 6 suggest that empirical models do not affect the significance of the day-of-the-week effect. The choice between OLS or GARCH models shows no significant effect on the day-of-the-week effect. Consequently, the correction of heteroscedasticity in previous studies with GARCH models does not result in a significant difference in the day-of-the-week effect research. Moreover, the widely used study design based on logarithmic returns does not affect study results.

However, outliers play a significant role. The result is in line with the literature, which suggests that outliers have a strong influence on the day-of-the-week effect (Connolly, 1989, Arguinis et al., 2013). Outliers are defined as observations that are more than three times the standard deviation away from the mean. The highly significant variable indicates that unexpected study results have a strong impact on previous research’s evidence of the day-of-the-week effect. In this regard, the drivers of outliers remain an open question.

Table 8 Significance for publication bias in the meta-analysis Notes: It is indicated by the publication year, differences between published and unpublished studies, and studies with estimated sample sizes

Publication variables	Estimate	Standard error	z-value	p-value	CI + 95%	CI – 95%
Year of publication	– 0.0003	0.0005	– 0.6652	0.5059	– 0.0013	0.0006
Published	– 0.0495	0.0379	– 13.053	0.1918	– 0.1237	0.0248
Sample size estimation	0.0002	0.0134	0.0160	0.9872	– 0.0261	0.0266

There is no significant publication bias. (CI provides the confidence interval for + 95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.)

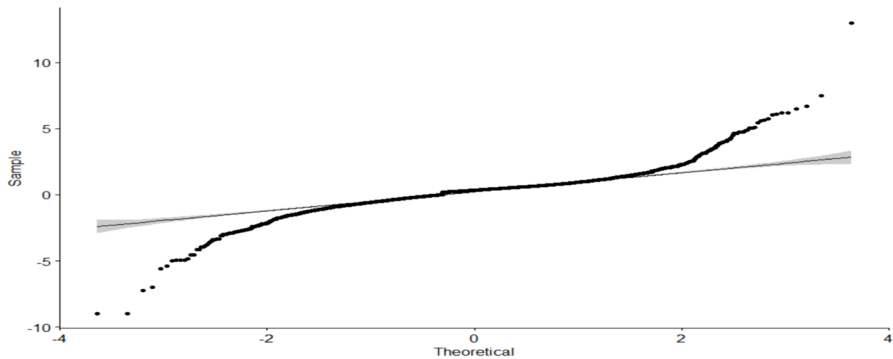


Fig. 5 Visualization of evidence of outliers by the QQ plot for day-of-the-week effect sizes. Notes: The QQ plot shows that outliers are significantly stronger and more pronounced than those in a normal distribution

4.6 Effect of outliers on the day-of-the-week effect

Outliers play an essential role in the literature on the day-of-the-week effect (Connolly, 1989, Arguinis et al., 2013). The meta-regressions underline that the influence of outliers in research is highly significant and strongly influences findings on the day-of-the-week effect. The findings are consistent with those of Arguinis et al. (2013) and Connolly (1989), who found that the day-of-the-week effect strongly depends on outliers. An outlier meta-analysis is additionally performed to better understand outliers in previous studies (Table 7). In total, 71 outliers arise from 18 studies spanning over 17 countries. The occurrence of outliers concentrates at the beginning of the week and weakens towards the end. The distribution indicates that the Monday effect and the Tuesday Blues are significantly affected by unexpectedly strong study results in previous research. Moreover, outliers mainly occur between the 1980s and 2000s. The temporal concentration aligns with the stronger day-of-the-week effect in the 1980s and 1990s and the research hype in the 1990s and 2000s.

We finally control for a pattern in the occurrence of outliers. An additional multivariate regression on outliers tests the impact of empirical, data-related, and geographical moderators (see Appendix, Table 11). The results show no significant differences between weekdays and the moderators. As a result, there is no evidence of a pattern in the occurrence of outliers in primary studies.

4.7 Publication-related effects on the day-of-the-week effect

Stock market anomalies have experienced a replication crisis in recent years (Cakici et al., 2024; Hou et al., 2020; Jensen et al., 2023). Significant published results fail to be replicated, indicating publication bias, which is also a fundamental threat to meta-analysis methodology (Geyer-Klingenberg et al., 2020). Publication bias implies that significant results are more likely to be published, known as the effect of “p-hacking” in financial research (Harvey et al., 2016).

The effect of sample composition is mentioned by Geyer-Klingenberg et al. (2020) as a challenge of meta-analysis in finance. One primary threat is "garbage-in-garbage-out" (Borenstein et al., 2009), which describes the risk of low study quality in primary studies. Geyer-Klingenberg et al. (2020) suggest integrating as much data as possible so that errors in primary studies compensate for each other. Compared with the most relevant meta-analyses in finance, the dataset contains more studies than the average (Albertini, 2013; Valickova et al., 2015; Hang et al., 2019; Kaiser & Menkhoff, 2020; Velte, 2022). As much data as possible is included. Therefore, this study focuses on a trade-off between the number of studies and data quality. In addition, published and unpublished studies are included in the regression models.

The time-dependence (Sect. 4.3) with an unexpected peak in the 1980s raises the question of publication bias. Many authors published during this period may lead to a higher probability of biased results being published. However, the results of the robustness check in Table 8 do not confirm the presence of a publication bias. The year of publication does not affect evidence of the day-of-the-week effect, and our analysis has no difference between published and unpublished research. Consequently, there is no evidence of manipulated or misleading publication in the regression model. To validate the regression results, publication bias is visualized using a funnel plot (Fig. 5). The funnel plot does not show gaps for effect sizes around zero, which underlines the non-significance of the publication bias in the study. The funnel plot indicates that a few effect sizes are over the expected -1 to 1 window, which stands for unrealistic results, probably p-hacked or biases in study design. The figure underlines that there is no favor in publishing only significant results of the day-of-the-week effect. In conclusion, the robustness tests cannot detect publication bias. However, research may still be biased, which is in line with the ongoing debate on the existence of this stock market anomaly.

5 Conclusion

The day-of-the-week effect has been studied for 50 years. Research has published numerous studies and theories to describe and explain this stock market anomaly. The recent replication crisis raises the question of the underlying factors driving the day-of-the-week effect. A meta-analysis approach is used to analyze and compare 91 primary studies to explain inconsistent results. The results dispel the myths of the day-of-the-week effect from a meta-perspective and quantify the effect of variation in study designs at multiple points. First, there is evidence for the weekend effect, with a weaker return on Mondays and a stronger return on Fridays. Second, the data indicates that the weekend effect is not directly related to Monday, but instead to the beginning of the week. Third, study design plays a role in the significance of the day-of-the-week effect, and time dependency especially led to a dynamic in the research results. Therefore, future research should focus on additional drivers to further explore the inconsistency of the day-of-the-week effect and explain the dynamics. Fourth, developing empirical methods such as GARCH models does not change the evidence for the effect. Fifth, geographic differences in regions like Oceania lead to variation in the day-of-the-week effect.

Table 9 Overview of moderator variables of meta-analysis, covering multiple study characteristics

Study characteristics	Moderator variable	Measurement
Data characteristics	Time range	Period of dataset in years
	Index global	1 = global indices, 0 = other Index
	Index cross-country	1 = cross-country indices, 0 = other Index
	Index country	Index
	Index real estate	1 = country indices, 0 = other Index
	Future	1 = real estate indices, 0 = other sector
	Cryptocurrency	1 = data of futures, 0 = other asset
	Bitcoin	1 = cryptocurrency data, 0 = other 1 = Bitcoin data, 0 = other
	1900s	1 = data in period, 0 = data not in period
	1910s	1 = data in period, 0 = data not in period
	1920s	1 = data in period, 0 = data not in period
	1930s	1 = data in period, 0 = data not in period
	1940s	1 = data in period, 0 = data not in period
	1950s	1 = data in period, 0 = data not in period
	1960s	1 = data in period, 0 = data not in period
	1970s	1 = data in period, 0 = data not in period
	1980s	1 = data in period, 0 = data not in period
	1990s	1 = data in period, 0 = data not in period
	2000s	1 = data in period, 0 = data not in period
	2010s	1 = data in period, 0 = data not in period
Empirical characteristics	Regression	1 = regression, 0 = other method
	OLS	1 = OLS, 0 = other estimator
	GARCH	1 = GARCH, 0 = other estimator
	Logarithmic Return	1 = logarithmic, 0 = other
	Sample size estimation	1 = estimated, 0 = sample size given
Geographical characteristics (Asongu, 2015)	Outlier	1 = outlier, 0 = no outlier
	Africa	1 = Africa, 0 = other region
	Asia	1 = Asia, 0 = other region
	Europe	1 = Europe, 0 = other region
	Latin America	1 = Latin America, 0 = other region
	North America	1 = North America, 0 = other region
	Oceania	1 = Oceania, 0 = other region

Table 9 (continued)

Study characteristics	Moderator variable	Measurement
Cultural characteristics (Hofstede, 2009)	Power distance	0 = lowest power distance,
	Individualism vs. Collectivism	100 = highest power distance
	Masculinity vs. Femininity	0 = collectivism,
	Uncertain avoidance	100 = individualism
	Long-term vs Short-term orientation	0 = gender equality,
	Indulgence vs Restraint	100 = strongest masculinity
		0 = weakest uncertain avoidance,
		100 = strongest uncertain avoidance
Publication characteristics	Published	0 = strongest short-term orientation,
	Publication year	100 = strongest long-term orientation
		0 = strongest short-term orientation,
		100 = strongest long-term orientation
		1 = published, 0 = unpublished
		Year of publication

Moreover, a culture with a higher degree of indulgence and power distance amplifies the anomaly's effect. Finally, the return on Wednesdays is nearly as strong as the often-reported Friday effect. As a result, the meta-analysis reveals a midweek effect that has so far been too weakly considered. Results suggest considering the day-of-the-week effect to develop more efficient investment strategies. For short sellers, selling at the beginning of the week and buying on Fridays can lead to higher returns. Investing in a long position is predestined at the beginning of the week, and selling on Fridays. Indices of the real estate sector have the significantly highest day-of-the-week effect.

Our results suggest the day-of-the-week effect from a meta-perspective, which aims to shed more light on the present replication crisis of stock market anomalies and provide a clearer picture of daily seasonality. All in all, the day-of-the-week effect is correlated to study design. Outliers, time dependence, and culture are the most essential moderators to explain differences in research on the day-of-the-week effect. However, the highly significant results of outliers suggest that essential elements are still unknown. Consequently, future research can lean on a more detailed outlier analysis.

Given the strong influence of outliers, we hypothesize that the day-of-the-week effect is an anomaly correlated with high uncertainty or shocks in the stock market. This hypothesis needs to be substantiated by further research. In this regard, we emphasize further extending the research on market volatility (Qadan et al., 2022) and the impact of investor uncertainty on the day-of-the-week effect. Moreover, a deep dive into company characteristics can lead to a more detailed understanding of the day-of-the-week effect. For example, the research could focus on stock market reactions to recurring daily events or the effect of hindsight on stock market reactions.

In conclusion, the meta-analysis provides a new perspective on the long history of the day-of-the-week effect. By generalizing previous findings, we identified a

Table 10 Overview of primary studies with publication year. Notes: Sample size stands for the number of trading days covered (when not given by the primary study, the sample size is estimated), start and end of research period, and regions of study design. 91 studies are included in the meta-analysis

ID	Author	Year	Sample size	Start	End	Country/Countries	Region
1	Abraham and Ikenberry	1994	7295	1963	1991	USA	North America
2	Abrahamsson and Creutz	2018	4695	2000	2017	Sweden	Europe
3	Aggarwal and Rivoli	1989	2928	1976	1988	Hong Kong	Asia
4	Agrawal and Tandon	1994	4081	1971	1987	Global countries	Global
5	Aharon and Qadan	2019	1400	2010	2017		Global
6	Akbalik and Ozkan	2017	1350	2009	2015	Brazil	Latin America
7	Alagidede and Panagiotidis	2009	1507	1994	2004	Ghana	Africa
8	Al-Loughani and Chappell	2001	1131	1993	1997	Kuwait	Asia
9	Apolinario et al	2006	1754	1997	2004	European countries	Europe
10	Arsad and Coutts	1997	14,888	1935	1994	UK	Europe
11	Athanassakos et al	1994	2700	1977	1989	Canada	North America
12	Ball et al	1982	1109	1975	1979	UK	Europe
13	Bampinas et al	2015	5301	1990	2010	European countries	Europe
14	Basher and Sandorsky	2006	2827	1992	2003	Argentina	Latin America
15	Berument and Kiymaz	2001	6409	1973	1997	USA	North America
16	Board and Sucliff	1988	6088	1962	1986	UK	Europe
17	Brahmana and Asmar	2011	2250	2000	2010	Lithuania	Europe
18	Brooks and Kim	1997	225	1989	1989	USA	North America
19	Brooks and Persaud	2001	1581	1989	1996	South Korea	Asia
20	Brounen and Hano	2009	5000	1987	2007	Global countries	Global
21	Caporale and Plastun	2019	800	2013	2017		Global
22	Chamberlain et al	1988	1769	1978	1985	Canada	North America
23	Chang et al	1995	1839	1986	1993	France	Europe
24	Chang et al	1993	1541	1985	1993	Austria	Europe
25	Charles	2010	1800	1999	2007	Greece	Europe
26	Chia et al	2008	1350	2000	2006	Asia	Asia
27	Choudhry	2000	1125	1990	1995	Asia	Asia
ID	Author	Year	Sample size	Start	End	Country	Region
29	Condoynanni et al	1987	4170	1969	1984	USA	North America
30	Conolly	1989	5273	1963	1983	USA	North America
31	Cornell	1985	524	1982	1984	USA	North America
32	Dangi	2020	600	2017	2020		Global
33	David et al	2002	754	1994	1999	Global countries	Global
34	Demirer and Karan	2002	2060	1988	1996	Turkey	Asia
35	Dhaoui et al	2012	2176	2002	2011	Japan	Asia

Table 10 (continued)

ID	Author	Year	Sample size	Start	End	Country/Countries	Region
36	Dorflleitner and Jung	2018	600	2015	2018		Global
37	Doyle and Chen	2009	3773	1993	2007	USA	North America
38	Dyl and Martin	1985	473	1957	1967	USA	North America
39	Easton and Faff	1994	3013	1974	1985	Australia	Oceania
40	Ercan Balaban	1995	1646	1988	1994	Turkey	Asia
41	French	1980	6024	1953	1977	USA	North America
42	Friday and Higgins	2000	5890	1970	1995	USA	North America
43	Gao et al	2015	3650	1980	1993	Hong Kong	Asia
44	Ghalot and Datta	2012	1125	2003	2008	Brazil	Latin America
45	Gibbons and Hees	1981	4128	1962	1978	USA	North America
46	Guidi et al	2011	2615	1999	2009	Eastern European countries	Europe
47	Hardin et al	2005	2267	1994	2002	USA	North America
48	Ho	1990	2358	1975	1987	Australia	Oceania
49	Högholm and Knif	2009	1125	1993	1998	Finland	Europe
50	Huang et al	2010	1350	1991	1997	Taiwan	Asia
51	Izadi and Noman	2019	24,140	1926	2017	USA	North America
52	Jaffe and Westerfield	1985a	3694	1970	1983	Japan	Asia
53	Jaffe and Westerfield	1985b	5369	1962	1983	USA	North America
54	Kamara	1997	7927	1962	1993	USA	North America
55	Karanovic and Karanovic	2018	1246	2012	2016	Greece	Europe
56	Keef and McGuinness	2001	1897	1989	1996	New Zealand	Oceania
57	Keim and Stambough	1984	14,863	1928	1982	USA	North America
58	Khan et al	2021	14,887	2013	2019	Asian countries	Asia
59	Kiyamaz and Berument	2003	3150	1988	2002	Global countries	Global
60	Kohers et al	2004	2250	1980	1990	USA	North America
61	Lakonishok and Levi	1982	4208	1962	1979	USA	North America
62	Lakonishok and Smidt	1988	17,908	1896	1986	USA	North America
63	Lee and Ou	2010	1350	2001	2007	USA	North America
64	Lenkerri et al	2006	3647	1990	2003	Europe	Europe
65	Li and Liu	2021	4530	2000	2017	China	Asia
66	Lokanishok and Levi	1990	4208	1962	1979	USA	North America
67	Lu and Gao	2016	2396	2005	2015	China	Asia
68	Ma and Tanizaki	2019	2191	2013	2018	Global	Global
69	Mazviona et al	2022	5839	1995	2018	South Africa	Africa
70	Mittal and Jain	2009	475	2007	2008	India	Asia
71	Nippani and Greenhut	2011	2693	1977	1987	Canada	North America
72	Olowe	2011	5439	1988	2009	UK	Europe
73	Patev et al	2003	1125	1997	2002	European countries	Europe
74	Penman	1987	2205	1971	1982	USA	North America
75	Poshakwale	1996	2042	1987	1994	India	Asia
76	Qiao et al	2011	3150	1994	2008	China	Asia

Table 10 (continued)

ID	Author	Year	Sample size	Start	End	Country/Countries	Region
77	Quayyounm	2017	1235	1991	1997	Pakistan	Asia
78	Rahman	2009	729	2005	2008	Senegal	Africa
79	Razvan Stefanescu et al	2009	225	2009	2009	Romania	Europe
80	Redman et al	1997	1575	1986	1993	USA	North America
81	Saklauskas and Kriksciuniene	2012	782	2003	2006	Lithuania	Europe
82	Singal and Tayal	2019	7016	1990	2018	Global countries	Global
83	Smirlock and Starks	1986	4799	1963	1983	USA	North America
84	Solnik and Bousquet	1990	2609	1978	1987	French	Europe
85	Stavarek and Heryan	2012	261	2006	2007	Czech Republic	Europe
86	Steeley	2001	1803	1991	1998	UK	Europe
87	Stefanescue et al	2009	130	2009	2009	Romania	Europe
88	Theobald and Price	1984	1458	1975	1981	UK	Europe
89	Tilica and Oprea	2014	1350	2005	2011	Romania	Europe
90	Ulussever et al	2011	1575	2001	2009	Saudi Arabia	Asia
91	Hsu et al	2021	1119	2015	2019	Taiwan	Asia

pattern in the study design, which can cause the replication crisis of this stock market anomaly. However, we conclude that study design is not the only driver of the replication crisis. Therefore, we want to encourage further research on the underlying factors of day-dependent returns.

Appendix

The Appendix provides additional information to explain moderator variables further, summarize the studies included in the meta-analysis, and present the additional regression analysis on outliers.

A.1: Additional information on moderator variables of the *meta-analysis*

Table 9 provides an overview of all moderators and the measurement of moderator variables.

A.2: Additional information on the dataset of the *meta-analysis*

An overview of all studies of the meta-analysis is provided in Table 10.

Table 11 Results of multivariate regression for outliers

Variable	Estimate	Standard error	z-value	p-value	CI + 95%	CI – 95%
intercept	31.949*	53.960	0.5921	0.5538	-73.810	137.71
Days of the week						
Monday	- 0.0627*	0.3563	- 0.1760	0.8603	- 0.7611	0.6357
Tuesday	- 0.3824*	0.3712	- 1.0301	0.3030	- 1.1100	0.3452
Wednesday	0.3979*	0.4382	- 0.9080	0.3639	- 0.4609	1.2567
Thursday	- 0.1733*	0.4185	- 0.4141	0.6788	- 0.9937	0.6470
Friday	–	–	–	–	–	–
Saturday	- 0.0147*	1.2595	- 0.0116	0.9907	- 2.4540	2.4833
Sunday	–	–	–	–	–	–
Data						
Indice country	–	–	–	–	–	–
Indice cross-country	–	–	–	–	–	–
Indice global	–	–	–	–	–	–
Indice real estate	–	–	–	–	–	–
Time range	- 0.0075*	0.0108	- 0.6953	0.4869	- 0.0136	0.0286
Geographical						
Region Africa	–	–	–	–	–	–
Region Asia	- 0.2335*	0.5284	- 0.4418	0.6586	- 1.2691	0.8022
Region Europe	–	–	–	–	–	–
Region Latin America	–	–	–	–	–	–
Region North America	- 0.1955*	0.6698	- 0.2918	0.7704	- 1.5083	1.1173
Cultural						
Power distance	- 0.0247*	0.0125	- 1.9801	0.0477	- 0.0003	0.0491
Long term orientation	- 0.0049*	0.0095	- 0.5121	0.6086	- 0.0236	0.0138
Indulgence	- 0.0153*	0.0151	- 1.0125	0.3113	- 0.0143	0.0450
Masculinity	- 0.0082*	0.0093	- 0.8778	0.3801	- 0.0100	0.0264
Uncertainty avoidance	- 0.0024*	0.0074	- 0.3187	0.7500	- 0.0169	0.0122
Empirical						
OLS	- 0.4102*	0.9024	- 0.4546	0.6494	- 2.1789	1.3585
GARCH	- 0.7592*	0.9715	- 0.7815	0.4345	- 2.6633	1.1449
Logarithmic return	- 0.4737*	0.3448	- 1.3736	0.1696	- 0.2022	1.1495
Publication						
Year	- 0.0171*	0.0268	- 0.6366	0.5244	- 0.0696	0.0355
Sample size estimation	- 0.4870*	0.4229	- 1.1516	0.2495	- 1.3158	0.3418
Published	- 0.7815*	0.7008	- 1.1151	0.2648	- 0.5921	2.1550

All variables are insignificant except the positive effect of power distance. Results indicate no pattern in day-dependent outliers. (Variables with “–” are dropped because of redundancy or multicollinearity. CI provides the confidence interval for +95% and – 95%. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively)

A.3: Additional information on outliers

Outliers play a significant role in analyzing the day-of-the-week effect. The tails of the QQ plot (Fig. 5) show that the effect sizes are not normally distributed. Consequently, outliers can impact the analysis.

See Fig. 5.

To indicate patterns in outliers, an additional multivariate regression is estimated on the outliers of the day-of-the-week effect Table 11. Results of multivariate regression for outliers. All variables are insignificant except the positive effect of power distance. Results indicate no pattern in day-dependent outliers. (Variables with “–” are dropped because of redundancy or multicollinearity. Table 11 shows the results. All variables are insignificant except for the reinforcing effect of research on cultures with higher power distances. Results suggest that there is no pattern in outliers of day-dependent effects.

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Conflict of interest The authors report there are no conflict of interests to declare.

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