IPO Underpricing: What about the Shipping Sector?

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Abstract

This paper looks at IPO underpricing in the shipping sector. This sector is of interest as it has unique characteristics, among them pro-cyclicality, long history, and ownership concentration. Moreover, the average level of underpricing in shipping is reported to be substantially lower than the overall level. The effects of shipping-specific factors on underpricing are exhaustively studied in this paper for the first time. In connection with shipping characteristics, we hypothesize several underpricing theories to be relevant explanations of underpricing in the shipping sector. More specifically, we investigate an investor sentiment theory as shipping is highly exposed to business cycles; an information asymmetry argument as there seems to be low information asymmetry in shipping; and two ownership and control theories, namely, the Brennan and Franks managerial control theory and the Stoughton and Zechner agency cost theory, due to the highly-concentrated ownership prevalent in the shipping sector. In addition, we consider a partial adjustment theory that has gained substantial empirical support in the literature. In order to test the aforementioned theories and shipping-specific factors, we perform a cross-sectional regression analysis using a sample of 60 shipping IPOs from four different stock exchanges. The partial adjustment theory and the Stoughton and Zechner agency cost theory are supported by the results, while the investor sentiment theory, information asymmetry argument, and the Brennan and Franks managerial control theory are rejected. Importantly, the Stoughton and Zechner theory and downward price revisions prevalent among shipping firms can partially explain the low underpricing "puzzle" in shipping. The robustness of the obtained empirical results is verified using a control sample of non-shipping IPOs.

Keywords: Initial Public Offering; IPO underpricing; Shipping sector; Partial adjustment theory; Investor sentiment theory; Stoughton and Zechner theory.

JEL Classification: G3

1 Introduction

This paper investigates initial public offerings (IPOs) in shipping firms. We choose to focus on this particular sector because of its unique characteristics and low level of underpricing compared to other sectors. More specifically, shipping firms tend to have a highly-concentrated ownership structure. Shipping is also a sector that is more exposed to business cycles. Further, several studies suggest that the shipping sector exhibits low information asymmetry. The aforementioned characteristics have been hypothesized to be important for shipping firms' IPO decisions. We therefore advocate a sector-level approach for explaining IPO performance as it may give us further insights into a well-known "puzzle" of IPO underpricing.

The existing IPO literature concentrates on an overall IPO market and does not fully control for firm-specific characteristics. As firm characteristics may differ across industries, studies at the sector level should be encouraged. While shipping IPOs have been investigated before (Grammenos and Marcoulis (1996); Merikas, Gounopoulos, and Nounis (2009)), this paper considers additional shipping-specific factors and underpricing theories. We suggest to look at characteristics that make the shipping sector distinct from other sectors, such as pro-cyclicality, highly-concentrated ownership, high tangibility, and long history.

Typically, shipping firms are family-owned or have a highly-concentrated ownership structure which may positively impact underpricing according to the managerial control theory (Brennan and Franks, 1997). On the contrary, the agency cost theory by Stoughton and Zechner (1998) suggests a negative relationship between family ownership and underpricing as family firms are less exposed to agency problems. Neither of these control theories has gained sufficient empirical support, hence, it is difficult to claim that one theory is superior to another one, and further testing is required.

Merikas et al. (2009) argue that the shipping sector exhibits lower information asymmetry due to high tangibility and long history. As implied by the information asymmetry argument, underpricing should be lower for shipping IPOs.

Another distinct feature of the shipping industry is its exposure to business cycles. As reported by Ritter (1984), IPO underpricing tends to be higher during the "hot" periods and respectively lower during the "cold" periods in the market. Such herding behavior of investors in the "hot" IPO markets, which results in first-day positive abnormal returns, is consistent with investor sen-

timent theory of underpricing. Furthermore, pro-cyclicality might be able to resolve the long-term IPO underperformance "puzzle". As investors are overly optimistic about "hot" IPOs, presumed underpricing could simply arise from bubble-pricing, while long-term underperformance could be regarded as mean reversion of a price to a fundamental value. Thus, the effect of business cycles on IPO performance in the shipping sector is expected to be significant.

This paper, therefore, hypothesizes that the aforementioned unique characteristics related to shipping may shed light on the sources of IPO underpricing. In addition to the investor sentiment theory, information asymmetry argument, and two ownership and control theories, we also test a partial adjustment theory by Benveniste and Spindt (1989). This theory has gained considerable empirical support in the literature and seems to be an adequate explanation of underpricing from a theoretical viewpoint.

In this paper, we investigate different IPO underpricing explanations using a sample of 60 shipping IPOs from four different stock exchanges, associated with a developed shipping sector, namely, NYSE, NASDAQ, London Stock Exchange (LSE), and Oslo Stock Exchange (OSE). We find an average underpricing of 2.8% in our sample of shipping IPOs, which is rather low compared to non-shipping IPOs. The low level of underpricing in shipping is partially explained by the results of this paper. Conforming to our expectations, the partial adjustment theory is able to explain most of the variation in shipping IPO underpricing. More specifically, the prevalence of negative price revisions in our sample results in low underpricing. Moreover, our results reveal that the Stoughton and Zechner agency cost theory can partially explain low underpricing in shipping. This result clearly undermines the Brennan and Franks managerial control theory. The sample in our analysis also renders the investor sentiment theory and information asymmetry argument insignificant. Among shipping-specific factors, we find post-IPO ownership concentration and pre-IPO family ownership to be significant. The robustness of the results obtained for a sample of shipping IPOs is verified by constructing a control sample of non-shipping IPOs and testing for significant differences between the two samples.

The results of this paper can be useful for managers and investors in their decision-making. Depending on the validity of the various theories, what constitutes the optimal strategy for both managers and investors will vary. From a manager's perspective, for instance, if the investor sentiment theory is supported, it would be beneficial to time the IPO or to utilize so-called "windows of

opportunity" in the "hot" markets where investors are overly-optimistic and are willing to pay more for the stock. From investors' perspective, for instance, if the Stoughton and Zechner agency cost theory is true, an optimal strategy would be to invest in non-family IPOs as they are underpriced more compared to family IPOs, and then short-sell IPO stock and realize profits from underpricing. In short, there are many proposed theories of IPO underpricing. As some of these theories are mutually exclusive and provide opposite predictions, more empirical research is needed on IPO underpricing to provide clarity and enable decision-makers to make more informed decisions.

The main contribution of this paper is empirical testing of sector-relevant IPO underpricing theories and factors, in contrast to other studies that focus only on several leading theories. The findings of this paper can be also relevant outside shipping, for example, for other sectors that exhibit similar characteristics. The energy sector and industrial sector share several characteristics with the shipping sector, such as sensitivity to business cycles, highly-concentrated ownership, high tangibility, and low total asset turnover. Therefore, IPO underpricing in those sectors might be driven by the same factors as in shipping. However, in the information technology and telecommunications sectors, which exhibit opposite characteristics, we should expect underpricing theories with mirrored predictions to be relevant, as well as high underpricing on average. Hence, the results of this paper have the potential to be applicable to other sectors and, therefore, are of essential interest to a broader audience.

2 Related literature

The initial public offering (IPO) is the public sale of a firm's stock for the first time. There are a number of reasons why firms choose to go public, such as capital needs, publicity, potential M&As, and diversification. However, it is agreed in the literature that the primary reason for going public is the need to raise capital for the firm's investment or production activities. Therefore, it is natural to assume that an optimal pricing strategy for a firm would be to set the highest possible price based on the market valuation of stock.

This is not what we observe, however, as IPO firms tend to underprice stock, i.e., the offer price is lower than the fair value of the stock. The argument regarding firms' inability to incorporate public and private information into the offer price seems an unlikely explanation of underpricing

since the bookbuilding method dominates in the majority of countries. Subsequently, investors' demand and valuation of stock is no longer a "black box" for issuers, which is suggestive of deliberate underpricing. This explanation is rather puzzling and raises even more questions. For instance, why do firms underprice even though they miss out on IPO proceeds? What are the issuers' motives for a seemingly suboptimal behavior?

2.1 Theories of underpricing

A vast amount of literature is dedicated to resolving the IPO underpricing "puzzle", and consequently a comparative analysis of existing underpricing theories is quite challenging. Among numerous studies, we hold reviews of IPO underpricing theories by Jenkinson and Ljungqvist (2001), Ljungqvist (2005), and Ritter and Welch (2002) in high regard. Jenkinson and Ljungqvist (2001) suggest the following classification of IPO underpricing theories: asymmetric information, ownership and control, and institutional theories. Ljungqvist (2005) additionally points out behavioral theories of underpricing. Ritter and Welch (2002) divide existing underpricing theories into asymmetric information and symmetric information theories. We will refer to the classification by Ljungqvist (2005) as it is more specific and clarifying compared to others (see Table 1).

Asymmetric information theories are most mature among underpricing theories. An underlying assumption in these models is information asymmetry between the parties in the IPO process. Consequently, arising informational frictions lead to underpricing. Institutional theories relate underpricing to institutional characteristics, such as litigation risk, tax regime, etc. Ownership and control theories point out a potential agency problem and control motivation for underpricing. Finally, behavioral theories state that underpricing may be the result of the behavioral biases of the parties. This array of theories represents a real challenge for researchers, as they cannot be easily tested or verified.

Among the aforementioned theories of underpricing, the partial adjustment theory and investor sentiment theory seem to have gained the most support from both theoreticians and practitioners. Other theories, such as ownership and control theories and behavioral theories, are still at a development and testing stage. Importantly, according to Ritter (2011), there are no universal explanations of underpricing, only country- or market-specific explanations:

Table 1: **Classification of IPO underpricing theories**

This table provides the list of competing theories of IPO underpricing. These theories represent only a fraction of numerous explanations proposed in the literature. However, they are the most well-grounded and backed up by empirical evidence. This classification of theories is analogous to that of Ljungqvist (2005). Additionally, proponents and opponents of theories are mentioned.

Theory	Proponents	Opponents
	Asymmetric information theories	
Signaling theory	Allen and Faulhaber (1989), Welch (1989), Grinblatt and Hwang (1989)	Michaely and Shaw (1994), Jegadeesh, Weinstein, and Welch (1993) Ritter (2011)
Partial adjustment theory	Benveniste and Spindt (1989), Hanley (1993), Cornelli and Goldreich (2003)	Jenkinson and Jones (2004), Loughran and Ritter (2002b)
Principal-agent theory	Baron (1982), Loughran and Ritter (2003), Ljungqvist and Wilhelm (2003)	Muscarella and Vetsuypens (1989)
Winner's curse	Rock (1986), Koh and Walter (1989)	Chambers and Dimson (2009), Ritter (2011)
	Institutional theories	
Lawsuit theory	Ibbotson (1975), Tinic (1988), Lowry and Shu (2002)	Drake and Vetsuypens (1993), Keloharju (1993), Ritter (2011)
Price support theory	Ruud (1993), Benveniste, Busaba, and Wilhelm (1996), Schultz and Zaman (1994), Hanley, Kumar, and Seguin (1993), Ellis, Michaely, and O'hara (2000)	Asquith, Jones, and Kieschnick (1998)
Tax	Rydqvist (1997), Taranto (2003)	
	Ownership and control theories	
Managerial control theory	Brennan and Franks (1997), Boulton, Smart, and Zutter (2010b)	Stoughton and Zechner (1998)
Agency cost theory	Stoughton and Zechner (1998)	Brennan and Franks (1997)
	Behavioral theories	
Informational cascade	Welch (1992), Amihud, Hauser, and Kirsh (2001)	
Investor sentiment	Ljungqvist, Nanda, and Singh (2006), Ritter (1991), Ofek and Richardson (2003)	Krigman, Shaw, and Womack (1999)
Prospect theory	Loughran and Ritter (2002b), Daniel (2002), Ljungqvist and Wilhelm (2005), Hanley (1993)	

The asymmetric information-based theories would be plausible if the average first-day return was in the vicinity of 2%, or maybe even 5%. In almost all countries, average underpricing is noticeably higher than this. In some cases, such as China, institutional constraints explain severe underpricing. In other cases, I think that agency problems between issuers and underwriters, combined with a willingness of at least some issuers to focus on factors other than maximizing the net proceeds raised in the IPO, are

important.

Therefore, the specifics of a particular market should be taken into account and related to underpricing in that market.

2.2 Evidence on IPO underpricing

Despite a substantial body of literature dedicated to resolving the IPO underpricing "puzzle", a consensus has not been reached. The stylized facts of IPO underpricing and long-term underperformance appear to be the only consistent findings across numerous studies in the multiple markets.

Table 2 reports the average levels of underpricing and post-IPO performance across different countries, as well as globally. The average underpricing appears to vary substantially across countries and over time. Stoll and Curley (1970), Logue (1973), Reilly (1973), and Ibbotson (1975) first reported positive abnormal initial returns or underpricing of initial public offerings. Ritter and Welch (2002) document an average underpricing of 18.8% in the US during 1980-2001. Loughran and Ritter (2003) also document changes in IPO underpricing over time; specifically, they show that it has increased dramatically since the 1980s.

Further, IPO firms with larger positive abnormal returns seem to underperform more in the long-term (see Table 2). Such significant underperformance in three years after an IPO is consistent with the prediction of investor sentiment theory. More specifically, initial returns might be driven by overly-optimistic investors, which would explain price reversion to the fundamental value in the long-run.

Based on the evidence in Table 2, it is critical to have a country-specific and in some cases a sector-specific perspective when identifying possible relevant explanations of IPO underpricing. The observed cross-sectional variation in underpricing is likely to be related to idiosyncratic characteristics of particular countries or sectors.

2.3 Underpricing in the shipping sector

The shipping industry is interesting to look at as it exhibits a number of unique characteristics. Moreover, the global shipping sector carries around 90% of international trade, and therefore is of great importance in the world's economy. The distinct characteristics of the shipping sector enable

Table 2: **Global evidence on short- and long-term IPO performance**

This table presents empirical evidence on IPO initial returns and post-IPO three-year returns across different countries. The IPO performance at a global level is also documented (see World). The time range covered by the represented studies is 1960-2012.

Country	Researcher(s)	Sample size	Time period	Average initial return	Average 3-year return
Australia	Lee, Taylor, and Walter (1996)	266	1976-1989	19.80%	-51.25%
China	Chan, Wang, and Wei (2004)	570	1993-1998	164.50%	75.07%
Denmark	Jakobsen and Sørensen (2001)	76	1984-1992	8.10%	-30.40%
Italy	Arosio, Giudici, and Paleari (2000)	108	1985-1997	18.20%	-11.53%
Finland	Keloharju (1993)	79	1984-1989	17.20%	-21.00%
France	Chahine (2008)	172	1996-1998	10.70%	-9.40%
Germany	Stehle, Ehrhardt, and Przyborowsky (2000)	187	1960-1992	26.90%	-6.00%
Greece	Thomadakis, Nounis, and Gounopoulos (2007)	254	1994-2002	38.94%	-15.35%
Sweden	Loughran, Ritter, and Rydqvist (2008)	162	1980-1990	27.30%	1.20%
Norway	Boulton, Smart, and Zutter (2011)	60	2000-2006	4.18%	
UK	Levis (1993)	483	1980-1988	16.80%	-8.31%
US	Aggarwal and Rivoli (1990)	1,598	1977-1987		-13.73%
	Ritter (1991)	1,526	1975-1994	18.00%	-34.47%
	Lowry, Officer, and Schwert (2010)	8,759	1965-2005	22.00%	
	Liu and Ritter (2011)	4,510	1993-2008	24.40%	
Europe	Gajewski and Gresse (2006)	1,846	1988-1998		-32.61%
	Akyol, Cooper, Meoli, and Vismara (2014)	3,677	1998-2012	16.50%	
World	Banerjee, Dai, and Shrestha (2011)	8,776	2000-2006	29.11%	
	Boulton et al. (2011)	7,306	2000-2006	27.53%	

us to hypothesize which theories of underpricing are more probable. The IPO underpricing among shipping firms is also unusually low, which implies that firms' pricing incentives might be different from those in other sectors and need to be investigated.

One prominent feature among shipping firms is long history, which is complemented with old traditions and strong networks. Furthermore, the shipping industry is mainly associated with tangible assets. Long history and high tangibility, consequently, imply lower information asymmetry experienced by shipping firms compared to other firms. Another feature is the more pronounced impact of business cycles on performance in the shipping sector. Further, shipping firms are mostly family-owned or have a highly-concentrated ownership structure and, therefore, tend to experience less severe agency problems. In addition, the shipping industry is very volatile and highly-levered. The recent trend towards going public via an IPO can be explained by the high leverage of shipping firms as they need to finance large investments. Lastly, growth in the shipping sector is quite rapid and mostly realized through M&A activity. The essential characteristics of the shipping sector, as outlined in previous studies, are summarized in Table 3.

The aforementioned shipping characteristics may have an impact on IPO underpricing in the

Table 3: **Shipping sector characteristics**

This table summarizes shipping-specific characteristics reported in the literature.

Characteristic	**Researcher(s)**
Long history	Merikas et al. (2009)
Family ownership	Harlaftis and Theotokas (2004)
Pro-cyclicality	Stopford (1997)
High tangibility	Stopford (1997)
High volatility	Stopford (1997)
High leverage	Stopford (1997)
M&A activity	Alexandrou, Gounopoulos, and Thomas (2014)

shipping sector. Moreover, these unique features may indicate which underpricing theories are more plausible explanations of IPO underpricing in shipping. For instance, low level of underpricing can be related to long history and high tangibility, which follows from the information asymmetry argument. While concentrated or family ownership may provide incentives for higher underpricing among shipping IPOs, according to the Brennan and Franks managerial control theory. The opposite prediction is yielded by the Stoughton and Zechner agency cost theory. The pro-cyclicality of the shipping industry is supportive of the investor sentiment theory. Therefore, it seems reasonable to investigate the outlined theories as they are particularly relevant for the shipping sector.

IPO underpricing in the shipping sector is relatively unresearched, and there are only a few shipping IPO studies to the author's knowledge. It is also evident from Table 2 that levels of IPO underpricing and long-term underperformance in the shipping sector are relatively low. Shipping IPO studies report average underpricing of 2-5%. Therefore, the shipping sector is of interest to researchers from two perspectives: (1) it has unique characteristics which can possibly explain lower underpricing in this sector, and (2) there is room for more research as only the mainstream theories of underpricing and a few shipping characteristics have been tested so far.

IPO performance in the global shipping sector was first investigated by Grammenos and Marcoulis (1996) with a small sample of 31 IPOs, and later by Merikas et al. (2009) with a larger sample of 143 IPOs over a longer time period. Grammenos and Marcoulis (1996) find an average underpricing of 5.32% in their sample. Their paper concentrates on testing the effects of gearing and age of fleet on IPO performance as shipping firms are mostly high-levered and have long histories. They find that long-term performance is positively related to financial leverage and negatively related to

the average age of fleet.

Merikas et al. (2009) find considerably higher underpricing of 17.69%. Their paper captures the relation between the business cycles and IPO performance, in addition to testing the effects of the trivial firm- and deal-specific factors. Merikas et al. (2009) show that, in periods of economic expansion, IPOs tend to be more underpriced, and vice versa. With respect to long-term performance, "hot" IPOs tend to underperform in the long-term, while "cold" IPOs outperform, which can be explained by the price reversion. These findings provide support for the investor sentiment theory of underpricing.

Further, their study somewhat incorporates shipping specifics into the analysis, though it still leaves out some important characteristics unique to shipping. In particular, they hypothesize the age of the firm to have a negative impact on IPO underpricing and a positive impact on the long-term performance. Both predictions are based on the information asymmetry argument and receive empirical support in their study. Other factors considered in their analysis are not shipping-related and, consequently, cannot account for the effects present exclusively in shipping. According to Merikas et al. (2009), this sector should exhibit lower information asymmetry[1] and underpricing, respectively, compared to other sectors. Their paper does not develop any further theoretical predictions in this regard and, hence, leaves more thorough investigation of shipping-specific factors to forthcoming research. The authors also find that both underpricing and long-term underperformance in the shipping sector are lower than the levels reported in the overall market. This empirical fact provides even stronger incentives to analyze the effects of shipping-related factors. There are no other empirical studies, at least to our knowledge, that consider shipping-specific characteristics in the IPO analysis at a cross-country level.

Further, there are two US studies worthy of our attention as they examine IPO performance in the shipping sector and take into account shipping market conditions and maturity. Merikas, Gounopoulos, and Karli (2010) investigate a signaling explanation of initial and long-term IPO returns. Their sample consists of 61 IPOs listed during 1987 - 2007. The authors report an average underpricing of only 4.44% and hypothesize that low underpricing is related to the maturity of the shipping sector. Grammenos and Papapostolou (2012) empirically test two leading asymmetric

[1]First, the market value is associated with the value of physical assets, i.e., the shipping industry exhibits high tangibility. Second, extensive information flows reduce information asymmetry.

information theories of underpricing, namely, a partial adjustment theory and a winner's curse theory. The data set contains 51 shipping firms and covers the period of 1987 - 2008. They report an average underpricing of 2.69%. Their findings provide support for the partial adjustment theory, but are inconsistent with the winner's curse theory.

Furthermore, it is the first study in shipping that examines predictability of likelihood of underpricing. The authors find market conditions, price revision, operating efficiency, and gearing to be significant factors. In particular, the shipping market sentiment is positively related to the probability of underpricing. Overall, their results are indicative of no information asymmetry in the shipping IPO market since the probability of underpricing can be predicted based on the publicly available information.

This paper considers a broader set of shipping-specific characteristics compared to previous studies. These factors are also the means for testing several underpricing theories: the information asymmetry argument, the investor sentiment theory, and ownership and control theories.

3 Hypotheses

3.1 Development of hypotheses

This paper focuses on investigating several IPO underpricing theories and factors, considered to be the most relevant for the shipping sector. First, the investor sentiment theory by Ljungqvist et al. (2006) may be a plausible explanation of underpricing in the shipping sector because this sector is more exposed to business cycles than others. The investor sentiment theory posits that underpricing is the result of investors' irrational behavior. More specifically, underpricing is claimed to be driven by overly-optimistic investors who push the price beyond the true value. The main prediction of this theory is price reversion to the fundamental value in the long-run. This theory has gained considerable empirical support in the literature. The inherent assumptions regarding investor sentiment and short-sale constraints also seem realistic. The former assumption is not surprising since IPO firms are typically young, informationally opaque companies and therefore hard to value. The latter assumption corresponds to IPO regulations in most countries.

The investor sentiment theory is tested by including market-specific variables in the regression

analysis, such as stock market sentiment, shipping market sentiment, and IPO frequency[2]. These variables are used as proxies for investors' optimism and, consequently, are expected to be positively related to IPO underpricing. The positive relationship between these variables and underpricing has been reported in earlier studies by Ritter (1984), Grammenos and Papapostolou (2012), and Merikas et al. (2009).

Hypothesis 1: Market-specific variables such as stock market sentiment, shipping market sentiment, and IPO frequency are positively related to IPO underpricing.

Another probable explanation of underpricing in the shipping sector is control consideration of the owners. There are two diametrically opposed ownership and control theories of underpricing: a managerial control theory (Brennan and Franks, 1997) and an agency cost theory (Stoughton and Zechner, 1998). Both theories share an assumption of the potential agency problem in IPO firms; however, they provide completely different predictions and reasons for underpricing.

The managerial control theory of Brennan and Franks states that firms underprice in order to generate excess demand for shares, which results in a dispersed ownership structure. Unlike large investors, small investors have no incentives to monitor, which allows the manager to retain the private benefits of control. Hence, the relationship between post-IPO ownership concentration and IPO underpricing should be negative. This prediction is supported by empirical evidence in Boulton, Smart, and Zutter (2010a). Moreover, the survey among CFOs of publicly listed firms by Brau and Fawcett (2006) reveals that, in the majority of cases, the motivation behind underpricing is a desire for a dispersed ownership structure, which is consistent with the managerial control theory. Underpricing, however, is not the only way to protect managers' private benefits of control. The manager can alternatively use takeover defenses or issue non-voting stock. Interestingly, firms that employ these types of protection are still underpriced (Field and Karpoff (2002), Aruaslan, Cook, and Kieschnick (2004)), which means that the managerial control theory is not the whole story.

In contrast to the Brennan and Franks theory, the agency cost theory proposed by Stoughton and Zechner assumes that monitoring, which is used to prevent the agency problem, is actually value-

[2]High IPO frequency indicates the hot period in the IPO market, while low frequency − the cold period.

enhancing for the firm and for the manager as well. To encourage monitoring, managers can allocate large stakes to investors, and compensate their illiquidity through underpricing. This is feasible due to the assumption of discretionary allocation of shares (while pro-rata allocation is assumed in the Brennan and Franks theory). Hence, the role of underpricing is to attract blockholders who engage in monitoring and thereby mitigate the agency problem.

This paper also hypothesizes that family-owned shipping firms have incentives to underprice more or less, depending on which theory is assumed to be valid. If the Brennan and Franks theory is true, then family firms are likely to underprice more in order to create dispersed ownership and retain private benefits of control (Chambers, 2012). The Stoughton and Zechner theory provides an opposite prediction, i.e., less underpricing in family firms where the agency problem is not a big concern[3]. Lower information asymmetry associated with family firms should also lead to lower underpricing. Consistent with the prediction of the agency cost theory and information asymmetry argument, Daugherty and Jithendranathan (2012) find that family firms experience less underpricing compared to non-family firms.

Hypothesis 2: Post-IPO ownership concentration and pre-IPO family ownership are related to IPO underpricing.

This paper also investigates relevance of the information asymmetry argument for underpricing by including firm age, current ratio, tangibility, total asset turnover, and a gearing ratio in the analysis. These factors impact the level of information asymmetry and can, therefore, be important determinants of IPO underpricing. Moreover, shipping firms typically have long histories, low liquidity, substantial tangibility, low total asset turnover, and high leverage. As these factors seem to be essential for shipping, their effect on IPO underpricing in this sector through the information asymmetry channel can be significant. Ritter (1984) argues that there is a positive relationship between ex-ante uncertainty and IPO underpricing.

As shipping firms have longer histories, more information is available to the public and they experience less uncertainty. Therefore, underpricing should be lower among shipping firms. The

[3]Family firms typically do not experience agency conflicts as there is usually no separation of ownership and management (Villalonga and Amit, 2006).

predicted negative relationship is confirmed by Su and Fleisher (1999), Loughran and Ritter (2002a), and Chahine (2008). High tangibility is another important feature of the shipping industry. As argued in Merikas et al. (2009), it results in lower information asymmetry, and thus less underpricing. However, shipping firms also tend to be highly-levered, which implies larger uncertainty (Chen, Firth, and Kim, 2004) and, consequently, more underpricing. The current ratio, which is a proxy for liquidity, is hypothesized to be negatively related to underpricing, based on the previous evidence. The total asset turnover is a measure of the operational efficiency of the firm, and was previously shown to be positively related to underpricing. Engelen (2003), Hauser, Yaari, Tanchuma, and Baker (2006), and Grammenos and Papapostolou (2012) provide supportive evidence for these predictions.

Hypothesis 3: Firm-specific factors such as firm age, current ratio, and tangibility are negatively related to IPO underpricing, while turnover and gearing are positively related.

The last theory to be tested is the partial adjustment theory of underpricing, which is one of the leading theories in the field. The transition from the fixed-price offerings with a pro-rata allocation rule towards bookbuilding IPOs with a discriminatory allocation of shares gave rise to a so-called bookbuilding theory of underpricing. The information revelation or partial adjustment theory of underpricing (Benveniste and Spindt, 1989) is based on the assumption that the underwriter is less informed than investors in a bookbuilding IPO setting. Consequently, investors with positive information might understate their demand for stock during the "road show" in an attempt to deflate the IPO price. In response, the underwriter can use underpricing as an incentive device for investors so that they reveal their private information truthfully. Due to underpricing, positive information received from investors is not fully, but partially incorporated into the final offer price (Hanley, 1993). This theory suggests that underpricing is beneficial for all parties involved in the IPO. The underwriter and the issuer become informed about the market valuation of the issue and partially adjust the offer price, while investors earn positive abnormal initial returns.

The price revision variable is commonly used to test the partial adjustment theory. An upward revision in the final offer price from the midpoint of the initial price range is indicative of high investor demand for stock. It follows from this theory that investors reveal positive information only if they are incentivized through underpricing, which is often accompanied by large share al-

locations. It is optimal for the issuer to rely more on share allocation reward to investors rather than underpricing, since the latter is costly. Importantly, underpricing is still a necessary condition for truth-telling from the investor side. Hence, a larger upward price revision implies higher underpricing. In other words, the more positive the information, the more underpricing is required.

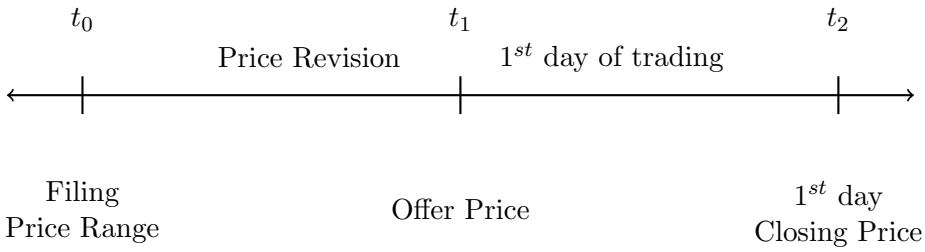
The price revision (PR) can be defined as a relative difference between the final offer price (P_{offer}) and the midpoint ($Midpoint$) of the initial filing price range:

$$PR_i = \frac{P_{offer,i}}{Midpoint_i} - 1 \tag{1}$$

The process of pricing the issue is illustrated on Figure 1, which is adopted from Grammenos and Papapostolou (2012).

Figure 1: **Initial public offering timeline**

This figure illustrates the process of pricing an IPO. At t_0, the issuer and the underwriter set a filing price range. Between t_0 and t_1, the underwriter gathers information from investors during the road show. At t_1, the final offer price is set. The first-day closing price is determined at t_2.



Aggarwal, Krigman, and Womack (2002) find support for a positive relationship between underpricing, price revision, and institutional allocations. Consistent with the partial adjustment theory by Benveniste and Spindt, the final hypothesis regarding the relationship between price revision and IPO underpricing is formulated.

Hypothesis 4: A price revision is positively related to IPO underpricing.

To summarize, shipping characteristics are considered in the analysis and essentially used for testing various underpricing theories (see Table 4). The partial adjustment theory is additionally tested as it has shown substantial explanatory power over IPO underpricing in previous studies.

Table 4: **The effect of shipping-specific factors on IPO underpricing**

This table links shipping-specific factors to the mainstream theories of underpricing. More specifically, the information asymmetry argument, the investor sentiment theory, and ownership and control theories can be tested by estimating the relationship between IPO underpricing and shipping-specific factors. The table also shows the predicted effects on underpricing for the respective factors.

Theory	**Factor**	**Effect on underpricing**
Information asymmetry	Firm age	↓
	Current ratio	↓
	Tangibility	↓
	Turnover	↑
	Gearing	↑
Investor sentiment theory	Pro-cyclicality	↑
Ownership and control theories	Pre-IPO family ownership	↑ / ↓
	Post-IPO ownership concentration	↑ / ↓

3.2 Potential determinants of IPO underpricing

For clarity, this paper classifies the potential determinants of IPO underpricing into three categories (see Table 5): (1) firm-specific factors, (2) deal-specific factors, and (3) market-specific factors. The majority of factors represent shipping characteristics and underpricing theories of interest. The offer size and return on assets (ROA) are added as control variables. The offer size is predicted to be negatively related to underpricing, as larger offerings signal better prospects of the firm and reduce uncertainty associated with an IPO. ROA is a measure of profitability and is expected to be negatively related to underpricing. A detailed description of all factors is provided in Appendix A.

Table 5: **Potential determinants of IPO underpricing**

This table provides a list of potential determinants of IPO underpricing. They can be grouped into three categories: firm-specific, deal-specific, and market-specific factors. Additionally, the expected signs of relationship with underpricing are specified for all factors. The expected signs are determined based on the empirical findings from the previous research and theoretical reasoning.

Factor	Researcher(s)	Expected sign
	Firm-specific factors	
Firm age	Su and Fleisher (1999), Loughran and Ritter (2002a), Chahine (2008), Merikas et al. (2009)	-
Current ratio	Grammenos and Papapostolou (2012)	-
Gearing	Grammenos and Papapostolou (2012)	+
Turnover	Grammenos and Papapostolou (2012)	+
Tangibility	Merikas et al. (2009)	-
Return on assets	Grammenos and Papapostolou (2012)	-
Pre-IPO family ownership	Boulton et al. (2010a)	+/-
Post-IPO ownership concentration	Boulton et al. (2010a)	+/-
	Deal-specific factors	
Price revision	Grammenos and Papapostolou (2012)	+
Offer size	Beatty and Ritter (1986), Smart and Zutter (2003)	-
	Market-specific factors	
Market sentiment	Ritter (1984), Grammenos and Papapostolou (2012)	+
Shipping sentiment	Grammenos and Papapostolou (2012)	+
Frequency	Ritter (1984), Grammenos and Papapostolou (2012)	+

4 Data

4.1 Sample

The data set contains 60 IPOs in the shipping sector globally over a period 2004-2015. Specifically, shipping firms from four leading stock exchanges are considered: NYSE, NASDAQ, London Stock Exchange, and Oslo Stock Exchange. The closing prices, market returns, and post-IPO ownership data are collected from DataStream. The IPO deal-related data are extracted from SDC Platinum. Founding dates, pre-IPO family ownership, and pre-IPO accounting data are gathered manually from firms' IPO prospectuses. The price revision variable is obtained only for 46 firms out of 60, i.e. bookbuilding IPOs, which reduces the sample for estimation involving this variable accordingly. In order to overcome a small sample problem, we additionally construct a control sample which consists of 60 non-shipping IPOs. Descriptive statistics for the control sample are provided in Appendix B.

4.2 Descriptive statistics

The summary statistics for the variables are provided in Table 6. The initial return is 2.8% on average, which is consistent with the previous research findings. As expected, the initial return does not seem normally distributed; specifically, it exhibits negative skewness and positive excess kurtosis. It is also evident from Figure 2 that the skewness occurs due to negative outliers. The variables for offer size and firm age are transformed into the logarithms to achieve normality. Other non-normally distributed variables, including initial return, cannot be log-transformed as they contain negative values.

Additionally, disaggregated summary statistics by year and stock exchange for initial return are presented in Tables 8 and 9 respectively. The number of IPOs is quite volatile over the sample period. Furthermore, the average initial return appears to be higher in years with a larger number of offerings. This may indicate "hot" and "cold" periods in the shipping IPO market. Similarly, there is some variation in initial returns across stock exchanges. As shown in Table 9, the LSE issues exhibit negative initial returns on average, while IPOs on three other stock exchanges are shown to be underpriced. The highest underpricing is detected on NASDAQ, then on OSE, and lastly on NYSE. However, even the underpricing of 6.8% on NASDAQ is significantly lower than

the general underpricing found in other studies.

Further, more detailed summary statistics for explanatory variables are presented conditional on the sign of initial return (see Table 7). For instance, it is evident that IPO underpricing appears when price revision is less negative. The fact that the price revision is negative on average even for the subsample of underpriced IPOs means that the price revision is not the only driver of underpricing. It also partially explains low underpricing among shipping firms where downward price revisions are prevalent.

Figure 2: **Distribution of initial return**

This figure illustrates the statistical distribution of initial return (approximated by the Epanechnikov kernel density function). The legend states the mean, the standard deviation, skewness, kurtosis, and the Jarque-Bera test p-value.

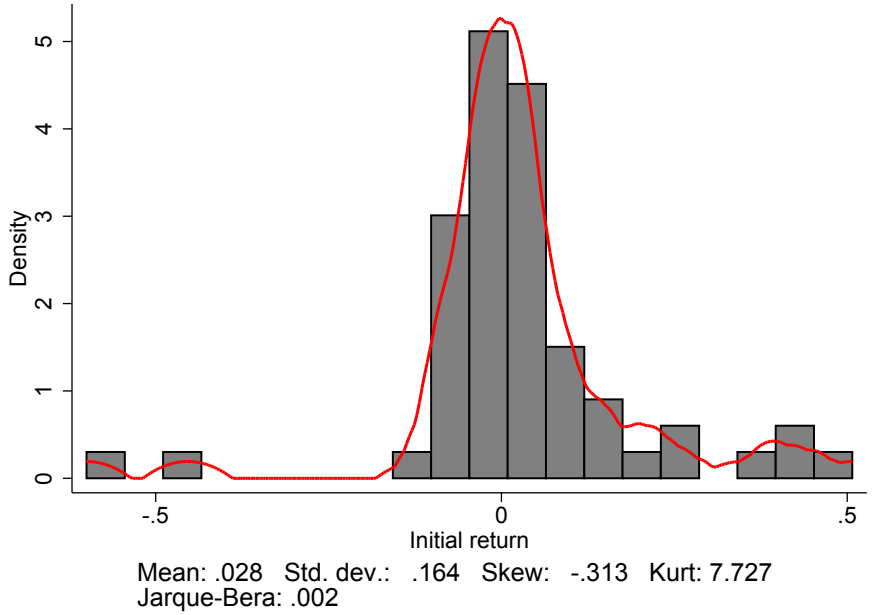


Table 6: **Summary statistics**

This table provides summary statistics for initial return and explanatory variables. Obs stands for the number of observations, Median, Min and Max − for median, minimum, and maximum values, respectively. Along with this statistics, the mean, standard deviation, skewness, and kurtosis are specified.

Variable	**Obs**	**Mean**	**Std. Dev.**	**Median**	**Min**	**Max**	**Skewness**	**Kurtosis**
IR	60	.028	.164	.007	-.6	.507	-.313	7.727
PR	46	-.072	.131	-.05	-.5	.143	-.842	4.007
Size	60	4.845	.879	4.993	1.982	7.129	-.884	4.816
Age	60	2.533	1.511	2.250	0	5.7	.335	2.076
CR	60	2.355	6.055	.932	.023	43.642	5.68	37.819
Tang	60	.734	.247	.811	.094	.991	-1.216	3.547
Gear	60	.622	.449	.641	0	3.179	2.892	18.590
Turn	60	.443	.802	.193	0	4.579	3.557	16.228
ROA	60	.059	.107	0.030	-.136	.519	2.311	9.819
OwnConc	60	.417	.497	0	0	1	.338	1.114
OutOwn	60	.322	.259	.35	0	.82	.160	1.756
Family	60	.367	.486	0	0	1	.553	1.306
Freq	60	7.433	2.807	8	1	11	-.539	2.325
MktSent	60	.039	.051	.035	-.059	.229	.678	4.715
ShipSent	60	.075	.101	.057	-.121	.334	.309	2.664

Table 7: **Summary statistics split by initial return**

This table provides summary statistics for explanatory variables conditional on the sign of initial return. The conditions $IR > 0$ and $IR < 0$ signify underpricing and overpricing accordingly. The number of observations (Obs), the mean, and the standard deviation are included.

	$IR > 0$			$IR < 0$		
	Obs	Mean	Std. Dev.	Obs	Mean	Std.Dev.
PR	25	-.015	.106	21	-.139	.126
Size	34	4.954	.799	26	4.703	.971
Age	34	2.558	1.518	26	2.500	1.530
CR	34	3.114	7.664	26	1.361	2.680
Tang	34	.740	.216	26	.727	.286
Gear	34	.663	.536	26	.568	.304
Turn	34	.466	.711	26	.414	.921
ROA	34	.070	.127	26	.046	.073
OwnConc	34	.471	.507	26	.346	.485
OutOwn	34	.354	.254	26	.281	.264
Family	34	.265	.448	26	.500	.510
Freq	34	7.735	2.767	26	7.038	2.863
MktSent	34	.036	.060	26	.044	.039
ShipSent	34	.057	.095	26	.097	.106

Table 8: **Summary statistics for initial return by year**

This table provides summary statistics by year for initial return. N stands for the number of observations, Min and Max − for minimum and maximum values, respectively. Along with this statistics, the mean, standard deviation, skewness, and kurtosis are specified.

Year	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Skewness**	**Kurtosis**
2004	4	-.076	.252	-.454	.072	-1.128	2.312
2005	11	.045	.117	-.075	.348	1.627	5.14
2006	9	.088	.183	-.089	.507	1.363	4.09
2007	9	.011	.272	-.6	.409	-.997	4.271
2008	4	-.035	.058	-.09	.028	.08	1.174
2010	5	-.036	.02	-.059	-.012	.031	1.425
2011	2	.022	.118	-.061	.106	0	1
2012	1	-.117	.	-.117	-.117	.	.
2013	8	.07	.146	-.017	.424	2.076	5.655
2014	6	.07	.108	-.005	.239	.812	1.819
2015	1	.009	.	.009	.009	.	.
Total	60	.028	.164	-.6	.507	-.313	7.727

Table 9: **Summary statistics for initial return by exchange**

This table provides summary statistics by stock exchange for initial return. N stands for the number of observations, Min and Max − for minimum and maximum values, respectively. Along with this statistics, the mean, standard deviation, skewness, and kurtosis are specified.

Exc	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Skewness**	**Kurtosis**
LSE	5	-.046	.314	-.6	.174	-1.408	3.142
NASDAQ	14	.068	.231	-.454	.424	-.232	3.224
NYSE	24	.015	.086	-.117	.239	.942	3.597
OSE	17	.034	.131	-.089	.507	2.933	11.403
Total	60	.028	.164	-.6	.507	-.313	7.727

A preliminary analysis of association between variables is performed by examining cross-correlations (see Table 10). The initial return is positively moderately correlated with the price revision and positively weakly correlated with the offer size, IPO frequency, post-IPO ownership concentration, and outsider ownership. It is also shown to be negatively weakly correlated with pre-IPO family ownership and market sentiment. The correlation with other explanatory variables is close to zero, which is suggestive of no relationship. Although correlation does not imply causation, it is still indicative of the underlying relation between variables. Furthermore, since explanatory variables are not strongly correlated with one another, a multicollinearity problem is not likely to arise.

There are several limitations to our data that need to be mentioned. First, the sample size is rather small, especially relative to the number of predictors in the model. One possibility is to consider a longer time period for the analysis. However, this is not feasible due to the unavailability of IPO prospectuses prior to 2004. Hence, extending a time period would lead to the loss of several independent variables that can be extracted only from prospectuses. Since all variables are important for hypothesis testing, this approach does not seem optimal. Another possibility is to estimate parsimonious models which include a limited number of predictors and therefore provide credible inference. We adopt the latter approach and select variables that should be included in the model based on the information criteria. Additionally, we perform a robustness check using a control sample of non-shipping IPOs. Second, the dependent variable, initial return, is not normally distributed due to several negative outliers. Applying standard methods to deal with outliers would definitely improve the normality of the distribution, but it would also increase the risk of losing important observations. Since outliers in this case are considered to be legitimate, they are assigned the same weight as other observations. For obtaining valid inference in the non-normality case, robust standard errors are used.

Table 10: **Cross-correlation table**

This table showcases the correlation coefficients among all variables. These cross-correlations are defined based on the casewise deletion method.

Variables	IR	PR	Size	Age	CR	Tang	Gear	Turn	ROA	OwnConc	OutOwn	Family	Freq	MktSent	ShipSent
IR	1.000														
PR	0.440	1.000													
Size	0.167	0.134	1.000												
Age	-0.029	-0.174	-0.251	1.000											
CR	0.023	0.108	-0.174	-0.061	1.000										
Tang	-0.013	0.260	0.361	-0.304	-0.010	1.000									
Gear	0.054	0.125	-0.189	0.214	-0.212	-0.084	1.000								
Turn	0.052	-0.127	-0.363	0.389	-0.108	-0.611	0.288	1.000							
ROA	-0.011	-0.090	-0.169	0.040	-0.083	-0.122	0.107	0.209	1.000						
OwnConc	0.270	0.240	0.043	-0.268	0.143	0.311	0.064	-0.111	-0.294	1.000					
OutOwn	0.227	0.304	0.031	-0.053	0.204	0.160	-0.111	-0.110	-0.137	0.263	1.000				
Family	-0.223	-0.274	-0.099	0.142	-0.170	0.091	-0.084	-0.100	0.268	-0.082	-0.044	1.000			
Freq	0.194	0.445	-0.104	-0.130	0.111	-0.027	0.034	0.039	0.102	0.075	0.022	-0.205	1.000		
MktSent	-0.176	0.010	0.134	0.214	-0.019	0.016	0.104	0.144	0.039	-0.137	-0.096	0.048	-0.240	1.000	
ShipSent	-0.021	0.007	0.090	0.080	-0.063	-0.017	0.164	0.068	-0.003	-0.023	-0.219	-0.125	-0.064	0.576	1.000

5 Results

5.1 Preliminary analysis

A univariate regression analysis is essential for testing the hypotheses developed in this paper. The univariate results can be used to confirm the existence and strength of the relationship between the variables of interest. However, they should be taken cautiously due to the possibility of the omitted variable bias. The univariate beta coefficients are derived from the correlations. However, the latter is purely a descriptive statistic of co-movement, while the former is a measure of the observed causal relation − as such, both measures tend to exhibit the same sign but not the exact numerical values. The results from the univariate regressions performed for all explanatory variables respectively are presented in Table 11.

Table 11: **Univariate estimation results**

This table shows univariate regression statistics − beta coefficients (Coefficient), robust standard errors (Std.Err.), and explanatory power (R^2). The significance levels of the beta coefficients are based on p-values and denoted with stars. The dependent variable is initial return. The explanatory variables are the potential determinants of underpricing outlined earlier.

Variable	**Coefficient**	**(Std. Err.)**	**R^2**
Price Revision	0.533***	(0.159)	0.193
Offer Size	0.031	(0.020)	0.028
Firm Age	-0.003	(0.011)	0.001
Current Ratio	0.001	(0.002)	0.001
Tangibility	-0.009	(0.067)	0.000
Gearing	0.020	(0.016)	0.003
Turnover	0.011	(0.015)	0.003
Return on Assets	-0.016	(0.111)	0.000
Ownership Concentration	0.089**	(0.042)	0.073
Outsider Ownership	0.144	(0.095)	0.051
Family Ownership	-0.075*	(0.039)	0.050
Frequency	0.011*	(0.006)	0.038
Market Sentiment	-0.560	(0.424)	0.031
Shipping Sentiment	-0.035	(0.176)	0.000

Significance levels : $*$: 10% $**$: 5% $***$: 1%

The results suggest that initial return is significantly and positively related to price revision, IPO frequency, and post-IPO ownership concentration. It is also marginally significantly and negatively related to pre-IPO family ownership. The relationship with other explanatory variables is found to be insignificant. The largest R^2 of 19.3% is achieved by the price revision, which is consistent with previous research and supportive of the partial adjustment theory. The other variables that yield noteworthy R^2 are post-IPO ownership concentration, post-IPO outsider ownership, pre-IPO family ownership, and lastly IPO frequency. These findings are consistent with the control motivation for underpricing. Specifically, it provides support for the prediction of the Stoughton and Zechner agency cost theory, as the sign of the relationship is positive with respect to post-IPO ownership concentration and negative with respect to pre-IPO family ownership. Furthermore, the marginal significance of IPO frequency is supportive of the investor sentiment theory. However, the multivariate regression analysis should be performed in order to obtain more accurate statistical inference. The multivariate analysis is preferred as it reduces likelihood of omitted variable bias.

5.2 Multivariate results

The multivariate regressions are estimated by the Ordinary Least Squares (OLS) using robust standard errors. Table 12 shows the restricted sample regression results for a set of multivariate models specified to test the four hypotheses outlined in Section 3. The results for the full sample which contains 60 shipping firms are similar to those obtained for the restricted sample with 46 shipping firms (see Table 13). Initial return is used as a dependent variable across all model specifications, while the main independent variables are specified in accordance with the hypotheses. The control variables for the model specifications are selected based on information criteria such as the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). The control variables selection for hypothesis testing is performed this way since it is not feasible to include all control variables in the model due to the low number of observations[4]. The robustness of the selected models is tested by adding stock exchange dummies and a dummy for the 2007-2008 financial crisis to each model specification[5].

The model specification for Hypothesis 1 includes the primary variables of interest – IPO

[4]The rule of thumb says that there should be 10-15 observations per predictor in the model. Otherwise, inference from regression estimation is unreliable.

[5]These dummies are included to account for exchange-specific and time-specific variation in underpricing.

Table 12: **Multivariate results for a restricted sample**

This table shows OLS estimation results for a set of multivariate models that are specified to test hypothesis 1 (H1), hypothesis 2 (H2), hypothesis 3 (H3), and hypothesis 4 (H4). Each hypothesis is tested in two model specifications: (1) a plain specification with control variables selected based on the information criteria, and (2) a specification with control variables, exchange dummies, and a crisis period dummy. Beta coefficients are reported together with significance levels and robust standard errors in parentheses. The significance levels of the coefficients are determined based on p-values. The regression statistics − number of observations, adjusted R^2, AIC, and BIC − are reported in the bottom panel.

	H1	H1 (with D)	H2	H2 (with D)	H3	H3 (with D)	H4	H4 (with D)
Frequency	0.002	-0.002						
	(0.006)	(0.009)						
Market Sentiment	-0.860	-0.728						
	(0.710)	(0.759)						
Shipping Sentiment	0.057	-0.011						
	(0.239)	(0.251)						
Price Revision	0.441***	0.491***	0.383***	0.407***	0.449***	0.469***	0.433***	0.455***
	(0.150)	(0.152)	(0.117)	(0.127)	(0.144)	(0.157)	(0.127)	(0.137)
Family Ownership	-0.073*	-0.079**	-0.091***	-0.088**	-0.105***	-0.098**	-0.096***	-0.092**
	(0.037)	(0.035)	(0.033)	(0.035)	(0.038)	(0.039)	(0.034)	(0.036)
Dummy_{NASDAQ}		-0.131		-0.148**		-0.126		-0.122*
		(0.079)		(0.070)		(0.089)		(0.066)
Dummy_{NYSE}		-0.186***		-0.208***		-0.196***		-0.186***
		(0.048)		(0.036)		(0.052)		(0.032)
Dummy_{OSE}		-0.146**		-0.148***		-0.137**		-0.141***
		(0.062)		(0.047)		(0.060)		(0.050)
Dummy_{Crisis}		0.008		0.008		0.023		0.020
		(0.046)		(0.047)		(0.058)		(0.046)
Ownership Concentration			0.041	0.061				
			(0.040)	(0.047)				
Outsider Ownership			0.028	-0.003				
			(0.088)	(0.074)				
Firm Age					-0.002	-0.014		
					(0.025)	(0.032)		
Current Ratio					-0.002	-0.003		
					(0.002)	(0.002)		
Tangibility					0.015	0.005		
					(0.079)	(0.100)		
Gearing					-0.018	-0.034		
					(0.059)	(0.064)		
Turnover					0.049	0.030		
					(0.067)	(0.063)		
Constant	0.105	0.290***	0.075*	0.242***	0.104	0.285**	0.107***	0.251***
	(0.068)	(0.095)	(0.040)	(0.040)	(0.067)	(0.134)	(0.032)	(0.040)
Observations	46	46	46	46	46	46	46	46
Adj. R^2	0.244	0.235	0.228	0.241	0.166	0.168	0.243	0.247
AIC	-46.387	-42.660	-46.301	-43.793	-40.220	-37.436	-49.007	-45.701
BIC	-35.415	-24.373	-37.158	-27.335	-25.591	-15.492	-43.521	-32.901

Table 13: **Multivariate results for a full sample**

This table shows OLS estimation results for a set of multivariate models that are specified to test hypothesis 1 (H1), hypothesis 2 (H2), and hypothesis 3 (H3). Each hypothesis is tested in two model specifications: (1) a plain specification with control variables selected based on the information criteria, and (2) a specification with control variables, exchange dummies, and a crisis period dummy. Beta coefficients are reported together with significance levels and robust standard errors in parentheses. The significance levels of the coefficients are determined based on p-values. The regression statistics − number of observations, adjusted R^2, AIC, and BIC − are reported in the bottom panel.

	H1	H1 (with D)	H2	H2 (with D)	H3	H3 (with D)
Frequency	0.008	0.010				
	(0.007)	(0.009)				
Market Sentiment	-0.500	-0.524				
	(0.560)	(0.544)				
Shipping Sentiment	0.136	0.106				
	(0.255)	(0.230)				
Ownership Concentration	0.079*	0.085*	0.082*	0.093*	0.101*	0.099*
	(0.040)	(0.043)	(0.042)	(0.050)	(0.052)	(0.055)
Dummy_{NASDAQ}		0.055		0.098		0.081
		(0.133)		(0.137)		(0.166)
Dummy_{NYSE}		0.044		0.035		0.035
		(0.121)		(0.121)		(0.147)
Dummy_{OSE}		0.092		0.079		0.073
		(0.125)		(0.131)		(0.142)
Dummy_{Crisis}		-0.040		-0.048		-0.044
		(0.055)		(0.055)		(0.068)
Outsider Ownership			0.108	0.078		
			(0.088)	(0.074)		
Family Ownership			-0.080**	-0.087**		
			(0.038)	(0.040)		
Return on Assets			0.228	0.351*		
			(0.150)	(0.206)		
Firm Age					0.003	-0.004
					(0.022)	(0.028)
Current Ratio					-0.000	-0.000
					(0.002)	(0.002)
Tangibility					-0.060	-0.075
					(0.098)	(0.105)
Gearing					0.006	0.014
					(0.034)	(0.047)
Turnover					0.004	0.003
					(0.022)	(0.025)
Constant	-0.058	-0.115	-0.026	-0.074	0.023	-0.009
	(0.063)	(0.148)	(0.053)	(0.135)	(0.070)	(0.178)
Observations	60	60	60	60	60	60
Adj. R^2	0.054	0.024	0.096	0.080	-0.019	-0.054
AIC	-45.127	-39.783	-47.827	-43.303	-38.878	-33.538
BIC	-34.655	-20.934	-37.355	-24.454	-24.218	-10.500

frequency, market sentiment, and shipping sentiment − and the control variables price revision and family ownership. Contrary to expectations and predictions of the investor sentiment theory, the variables IPO frequency, market sentiment, and shipping sentiment turn out to be insignificant. This finding implies no relationship between business cycles and IPO initial returns. The sentiment variables remain insignificant in a full sample estimation. Hence, the results provide no support for Hypothesis 1.

Hypothesis 2 is represented by a model that includes ownership concentration, outsider ownership, and family ownership, which are the variables of interest, and a control variable, price revision. The family ownership coefficient is found to be negative and highly significant, in line with our expectations. The coefficient ranges from -0.091 to -0.088, which suggests that family-owned firms are underpriced less compared to non-family owned firms. This finding is consistent with the hypothesis that family firms have fewer incentives to underprice as the agency conflict is not severe. However, ownership concentration and outsider ownership are shown to be insignificant, contrary to our expectations. Therefore, the restricted sample results only partially support the Stoughton and Zechner theory. The full sample results confirm significance of family ownership. In addition, ownership concentration becomes marginally significant. The positive coefficient on ownership concentration indicates that firms with post-IPO concentrated ownership tend to underprice more. The revealed positive relationship between post-IPO ownership concentration and IPO underpricing is consistent with the Stoughton and Zechner theory. Hence, there seems to be sufficient support for Hypothesis 2 in our sample.

Hypothesis 3 is specified with a model that includes firm-specific variables of interest − firm age, current ratio, tangibility, gearing, and turnover − and control variables price revision and family ownership. None of the firm-specific variables are found to be significant. This result is inconsistent with predictions of the information asymmetry theory and yields no support for Hypothesis 3. The results remain unchanged in a full sample estimation.

Hypothesis 4 is tested in a model that includes price revision as the main variable of interest and family ownership as a control variable. The price revision coefficient is found to be positive and highly significant. More specifically, the coefficient is 0.455, which suggests that the final offer price only partially adjusts to positive private information revealed by investors, which is consistent with the partial adjustment theory. Hence, there is strong evidence in favor of Hypothesis 4.

This hypothesis cannot be tested for a full sample, since price revision can be obtained only for bookbuilding IPOs.

Overall, the results appear to be robust with respect to sample size and model specifications. The partial adjustment theory is strongly supported in both restricted and full samples. Additionally, the Stoughton and Zechner agency cost theory seems to be relevant for pricing decisions in the shipping sector, as post-IPO ownership concentration is found to be positively related to IPO underpricing. The corroborating evidence also comes from the finding that family firms tend to be less underpriced than non-family firms. However, investor sentiment and information asymmetry do not seem to affect IPO underpricing in our sample.

5.3 Robustness check

The robustness check of the results obtained for the sample of shipping IPOs is performed by testing for differences in underpricing effects between shipping and non-shipping IPOs. A control sample of non-shipping IPOs is constructed based on the following matching criteria: (1) IPO exchange should be strictly matched, (2) IPO year should be strictly matched, and (3) IPO offer size should be within a defined range (fuzzy match). Non-shipping counterparts are mainly firms from manufacturing, materials, and transportation sectors, although other sectors are represented as well.

The average underpricing in a sample of non-shipping IPOs is 12% (see Appendix B). Evidently, underpricing is substantially higher among non-shipping firms. We hypothesize that the difference in underpricing levels might arise from sector differences. In order to spot any differences in effects on underpricing between the two samples, we perform a separate regression analysis for the sample of non-shipping IPOs and compare the obtained results with the results for the sample of shipping IPOs.

The univariate regression results for the control sample are reported in Table 14. Since IPO frequency and shipping sentiment values can be obtained only for shipping firms by definition, they are excluded from the analysis. A significant relationship in a univariate setting is found between initial return and the following variables: price revision (0.917), firm age (0.045), tangibility (-0.151), and gearing (-0.069). The price revision variable provides the highest R^2 of 40.7%. However, as discussed earlier, these results are purely correlations, which leads us to multivariate regression analysis.

Table 14: **Univariate estimation results**

This table shows univariate regression statistics − beta coefficients (Coefficient), robust standard errors (Std.Err.), and explanatory power (R^2). The significance levels of the beta coefficients are based on p-values and denoted with stars. The dependent variable is initial return. The explanatory variables are the potential determinants of underpricing outlined earlier.

Variable	**Coefficient**	**(Std. Err.)**	$\mathbf{R^2}$
Price Revision	0.917***	(0.130)	0.407
Offer Size	0.006	(0.019)	0.001
Firm Age	0.045**	(0.019)	0.047
Current Ratio	-0.004	(0.005)	0.004
Tangibility	-0.151*	(0.081)	0.063
Gearing	-0.069*	(0.037)	0.069
Turnover	0.020	(0.024)	0.019
Return on Assets	-0.030	(0.029)	0.006
Ownership Concentration	0.039	(0.051)	0.009
Outsider Ownership	-0.105	(0.074)	0.022
Family Ownership	-0.031	(0.073)	0.003
Market Sentiment	-0.241	(0.303)	0.006

Significance levels : $*$: 10% $**$: 5% $***$: 1%

The multivariate regressions are performed for both a restricted sample of 50 firms (see Table 15) and a full sample of 60 firms (see Table 16). The results fully support the partial adjustment theory as the coefficient on price revision is positive and highly significant across all model specifications. The coefficient on market sentiment is insignificant, hence there is no evidence in favor of the investor sentiment theory. Further, the ownership variables, ownership concentration and outsider ownership are found to be insignificant. While family ownership turns out to be marginally significant in the restricted sample, the effect disappears in the full sample. Hence, there is no support for the ownership and control theories of underpricing. Among firm-specific factors, gearing and firm age are shown to be significant. The coefficient on gearing is negative, which implies that highly-levered firms underprice less. The coefficient on firm age is positive and indicates that firms with longer histories exhibit higher underpricing. These findings contradict the predictions of the information asymmetry argument. The effects of other firm-specific factors are not stable across model specifications and therefore considered insignificant.

Overall, the results for the control sample are different from the results obtained for the sample of shipping IPOs in several regards. First, we find no support for the ownership and control theories

Table 15: **Multivariate results for a restricted sample**

This table shows OLS estimation results for a set of multivariate models that are specified to test hypothesis 1 (H1), hypothesis 2 (H2), and hypothesis 3 (H3). Each hypothesis is tested in two model specifications: (1) a plain specification with control variables selected based on the information criteria, and (2) a specification with control variables, exchange dummies, and a crisis period dummy. Beta coefficients are reported together with significance levels and robust standard errors in parentheses. The significance levels of the coefficients are determined based on p-values. The regression statistics − number of observations, adjusted R^2, AIC, and BIC − are reported in the bottom panel.

	H1	H1 (with D)	H2	H2 (with D)	H3	H3 (with D)	H4	H4 (with D)
Market Sentiment	-0.237	-0.393						
	(0.366)	(0.296)						
Price Revision	0.954***	0.777***	0.933***	0.768***	0.968***	0.777***	0.959***	0.788***
	(0.130)	(0.137)	(0.136)	(0.150)	(0.148)	(0.167)	(0.129)	(0.133)
Family Ownership	-0.129*	-0.135**	-0.120	-0.120	-0.148*	-0.117	-0.123	-0.122
	(0.071)	(0.066)	(0.076)	(0.074)	(0.088)	(0.081)	(0.078)	(0.074)
Gearing	-0.057***	-0.057**	-0.054**	-0.051**	-0.056**	-0.050**	-0.053**	-0.050**
	(0.021)	(0.025)	(0.022)	(0.024)	(0.023)	(0.024)	(0.021)	(0.022)
Current Ratio	-0.025**		-0.026**		-0.023**	0.002	-0.026***	
	(0.010)		(0.010)		(0.010)	(0.011)	(0.009)	
Firm Age		0.058***		0.055***	0.032	0.058***		0.056***
		(0.019)		(0.020)	(0.023)	(0.021)		(0.018)
Dummy_{NASDAQ}		0.000		0.000		0.000		0.000
		(.)		(.)		(.)		(.)
Dummy_{NYSE}		0.119**		0.124**		0.126**		0.125***
		(0.046)		(0.048)		(0.050)		(0.046)
Dummy_{OSE}		-0.081*		-0.075*		-0.079*		-0.075*
		(0.041)		(0.042)		(0.045)		(0.041)
Dummy_{Crisis}		-0.032		-0.022		-0.030		-0.029
		(0.038)		(0.050)		(0.045)		(0.041)
Ownership Concentration			0.043	0.019				
			(0.051)	(0.051)				
Outsider Ownership			-0.034	-0.033				
			(0.070)	(0.080)				
Tangibility					0.026	0.008		
					(0.079)	(0.070)		
Turnover					-0.005	0.003		
					(0.010)	(0.009)		
Constant	0.237***	0.036	0.226***	0.026	0.159**	0.009	0.232***	0.023
	(0.046)	(0.051)	(0.051)	(0.051)	(0.077)	(0.074)	(0.045)	(0.050)
Observations	50	50	50	50	50	50	50	50
Adj. R^2	0.444	0.584	0.437	0.565	0.433	0.551	0.453	0.583
AIC	-41.435	-53.477	-39.945	-50.419	-38.749	-48.195	-43.088	-54.118
BIC	-29.963	-36.269	-26.561	-31.299	-23.453	-27.163	-33.528	-38.822

Table 16: **Multivariate results for a full sample**

This table shows OLS estimation results for a set of multivariate models that are specified to test hypothesis 1 (H1), hypothesis 2 (H2), and hypothesis 3 (H3). Each hypothesis is tested in two model specifications: (1) a plain specification with control variables selected based on the information criteria, and (2) a specification with control variables, exchange dummies, and a crisis period dummy. Beta coefficients are reported together with significance levels and robust standard errors in parentheses. The significance levels of the coefficients are determined based on p-values. The regression statistics − number of observations, adjusted R^2, AIC, and BIC − are reported in the bottom panel.

	H1	H1 (with D)	H2	H2 (with D)	H3	H3 (with D)
Market Sentiment	-0.307	-0.509				
	(0.272)	(0.327)				
Gearing	-0.091**	-0.096**	-0.085**	-0.090**	-0.077**	-0.078**
	(0.036)	(0.037)	(0.035)	(0.036)	(0.037)	(0.038)
Turnover	0.059**	0.048**	0.056**	0.047*	0.056**	0.048*
	(0.023)	(0.022)	(0.023)	(0.024)	(0.025)	(0.026)
Return on Assets	-0.140**	-0.100*	-0.140**	-0.099	-0.129**	-0.097
	(0.059)	(0.055)	(0.061)	(0.062)	(0.058)	(0.065)
Family Ownership	-0.115	-0.105	-0.098	-0.089		
	(0.076)	(0.063)	(0.078)	(0.066)		
Firm Age	0.048**	0.059***	0.046**	0.060***	0.032	0.050**
	(0.019)	(0.021)	(0.019)	(0.022)	(0.021)	(0.022)
Dummy_{NASDAQ}		0.039		0.037		0.027
		(0.040)		(0.041)		(0.057)
Dummy_{NYSE}		0.107**		0.110**		0.102
		(0.049)		(0.049)		(0.065)
Dummy_{OSE}		-0.119***		-0.105**		-0.123*
		(0.039)		(0.044)		(0.063)
Dummy_{Crisis}		-0.033		-0.008		-0.017
		(0.040)		(0.043)		(0.044)
Ownership Concentration			0.054	0.024		
			(0.053)	(0.050)		
Outsider Ownership			-0.114	-0.095		
			(0.070)	(0.071)		
Current Ratio					-0.002	0.003
					(0.007)	(0.008)
Tangibility					-0.052	-0.050
					(0.090)	(0.088)
Constant	0.021	0.001	0.026	-0.010	0.056	0.004
	(0.038)	(0.039)	(0.043)	(0.042)	(0.072)	(0.044)
Observations	60	60	60	60	60	60
Adj. R^2	0.158	0.367	0.162	0.342	0.124	0.322
AIC	-32.107	-45.923	-31.546	-42.850	-29.770	-41.836
BIC	-17.447	-22.885	-14.791	-17.717	-15.110	-18.799

in the sample of non-shipping IPOs. This conforms to our expectations, as insignificant effect is supposedly the result of little variation in ownership concentration and family ownership in a sample of non-shipping firms. Second, the price revision coefficient is considerably larger for non-shipping firms, and implies nearly full adjustment of the final offer price to investors' private information.

In order to test whether the differences in effects on underpricing between the two samples are significant, we additionally perform the analysis for a combined sample, which consists of both shipping and non-shipping IPOs. A larger sample provides higher statistical power and therefore more credible inference. In addition to standard regressors, which are used to test hypotheses, we include respective interaction terms between a shipping firm dummy and variables of interest in the regression models.

Table 17 shows the regression results for the models that include interaction terms between the shipping dummy and continuous variables. Model (1) indicates that the effect of market sentiment on underpricing is not significantly different between the two samples as the coefficient on interaction term is insignificant. Model (2) shows that the outsider ownership effect on underpricing is significantly larger for shipping firms compared to non-shipping firms. Models (3)-(7) test for differences in effects of firm-specific factors on underpricing. The results show that the two interaction terms turn out to be significant. The coefficient on the interaction term between shipping and firm age is negative and significant, which implies that the effect of age on underpricing is significantly smaller for shipping firms. While the coefficient on the interaction term between shipping and gearing is positive and significant, which indicates that the effect of gearing is significantly larger for shipping firms. Finally, Model (8) presents the model with the interaction term between shipping and price revision. As the coefficient on the interaction term is negative and significant, the effect of price revision is significantly smaller for shipping firms.

Table 18 presents the regression results for the models that include interactions between two dummies and therefore cannot be interpreted in a standard way. To determine whether the effects are significantly different between the two samples, we create two dummies manually for each model: (1) a dummy equal to 1 if the shipping dummy is 1 and the tested dummy is 1, and (2) a dummy equal to 1 if the shipping dummy is 0 and the tested dummy is 1. By comparing the coefficients for these two dummies, we can infer whether they are significantly different from each other. For this purpose we conduct the Wald-test and report p-values in Table 18. Model (1) shows the effect

Table 17: **Multivariate results for a combined sample (1)**

This table shows the regression results for multivariate models with interaction terms between a shipping dummy and tested variables. Beta coefficients are reported together with significance levels and robust standard errors in parentheses. The significance levels of the coefficients are determined based on p-values. The regression statistics − number of observations, adjusted R^2, AIC, and BIC − are reported in the bottom panel.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ShipDummy	-0.074*	-0.160***	0.008	-0.103***	-0.135**	-0.136***	-0.076*	-0.065*
	(0.041)	(0.052)	(0.047)	(0.038)	(0.053)	(0.039)	(0.040)	(0.034)
MktSent	-0.239							
	(0.303)							
ShipDummy × MktSent	-0.321							
	(0.521)							
OutOwn		-0.105						
		(0.074)						
ShipDummy × OutOwn		0.249**						
		(0.121)						
Age			0.045**					
			(0.019)					
ShipDummy × Age			-0.051*					
			(0.026)					
CR				-0.004				
				(0.006)				
ShipDummy × CR				0.005				
				(0.006)				
Tang					-0.151*			
					(0.081)			
ShipDummy × Tang					0.142			
					(0.105)			
Gear						-0.069*		
						(0.037)		
ShipDummy × Gear						0.089**		
						(0.040)		
Turn							0.020	
							(0.024)	
ShipDummy × Turn							-0.010	
							(0.028)	
PR								0.917***
								(0.131)
ShipDummy × PR								-0.384*
								(0.206)
Constant	0.124***	0.142***	0.025	0.129***	0.169***	0.151***	0.099***	0.139***
	(0.025)	(0.032)	(0.037)	(0.031)	(0.034)	(0.031)	(0.032)	(0.023)
Observations	120	120	120	120	120	120	120	96
Adj. R^2	0.056	0.073	0.066	0.042	0.075	0.079	0.051	0.354
AIC	-69.544	-71.746	-70.846	-67.804	-71.990	-72.545	-69.019	-86.408
BIC	-58.394	-60.596	-59.696	-56.654	-60.840	-61.395	-57.869	-76.151

of the shipping dummy on underpricing. Evidently, underpricing tends to be significantly lower in the shipping sector. Models (2) and (3) test for the difference in effects of family ownership and ownership concentration between the two samples. Significant coefficients for the tested variables are obtained only for shipping IPOs, which is consistent with previous results. Even though the effects of these variables are shown to be significant for shipping IPOs and insignificant for non-shipping IPOs, the Wald-test implies that there is no significant difference between the coefficients (p-value is larger than 0.05).

Table 18: **Multivariate results for a combined sample (2)**

This table shows the regression results for multivariate models with interaction terms between a shipping dummy and tested variables. Beta coefficients are reported together with significance levels and robust standard errors in parentheses. The significance levels of the coefficients are determined based on p-values. The regression statistics − number of observations, adjusted R^2, AIC, BIC, and the Wald test p-values − are reported in the bottom panel.

	(1)	(2)	(3)
ShipDummy	-0.092***	-0.068*	-0.117***
	(0.033)	(0.040)	(0.041)
ShipDummy=1 × Family		-0.075*	
		(0.039)	
ShipDummy=0 × Family		-0.031	
		(0.073)	
ShipDummy=1 × OwnConc			0.089**
			(0.042)
ShipDummy=0 × OwnConc			0.039
			(0.051)
Constant	0.120***	0.124***	0.108***
	(0.025)	(0.027)	(0.031)
Observations	120	120	120
Adj. R^2	0.056	0.061	0.074
AIC	-71.529	-70.292	-71.967
BIC	-65.954	-59.142	-60.817
Wald-test (Prob > F)		0.590	0.451

To conclude, the results from estimating two separate regressions are equivalent to the results for the combined sample, which confirms the validity of our findings for the shipping sector despite a small sample size. However, we do not find evidence for the notion that the effects of family ownership and ownership concentration on underpricing are significantly different for shipping and non-shipping IPOs.

5.4 Discussion

This paper examines a wider range of shipping-specific factors and underpricing theories compared to previous shipping IPO studies. In particular, we test the partial adjustment theory, the investor sentiment theory, the information asymmetry argument, and two conflicting ownership and control theories. The first three mentioned theories are considered as they have proved to be important in both the shipping and the general IPO literature. The ownership and control theories are additionally tested as they are regarded as plausible explanations of underpricing in the shipping sector, due to concentrated or family ownership. Since these theories have not been extensively tested in the literature yet, and have not been considered as explanations of underpricing in the shipping sector, investigation of these theories is an important contribution of this paper. The managerial control theory by Brennan and Franks and the agency cost theory by Stoughton and Zechner provide opposite empirical predictions regarding the relationship between post-IPO ownership concentration and IPO underpricing. Hence, empirical testing is necessary in order to reveal the true underlying relationship between the two.

This paper provides supportive evidence for the agency cost theory of Stoughton and Zechner, since post-IPO ownership concentration is shown to be positively related to underpricing. Moreover, pre-IPO family ownership is found to be negatively related to underpricing, i.e., family firms tend to underprice less. This finding corroborates the agency story, as family firms do not often experience agency conflicts and, consequently, have less incentive to underprice. Hence, low underpricing in the shipping sector can be partially explained by family ownership or the highly-concentrated ownership structure prevalent among shipping firms. The results are also supportive of the partial adjustment theory. Moreover, the price revision has the highest explanatory power over underpricing among explanatory variables. Since price revision has been shown to be mostly negative for our sample of shipping IPOs, there should be little to no underpricing according to the partial adjustment theory. Lastly, contrary to our expectations and previous research findings, investor sentiment variables and firm-specific variables, used to test the information asymmetry argument, are found to be insignificant. Therefore, the results provide no support for the investor sentiment theory and information asymmetry argument.

The findings of this paper contribute to the IPO literature in several ways. First, shipping

characteristics such as post-IPO ownership concentration and pre-IPO family ownership are found to be significant in explaining underpricing. The coefficient signs are consistent with the predictions of the Stoughton and Zechner theory, which in turn renders null the Brennan and Franks theory. Moreover, the low underpricing "puzzle" in the shipping sector can be partially explained by the Stoughton and Zechner theory. This finding accentuates the importance of accounting for sector-specific factors when explaining IPO underpricing. Second, the price revision is found to be highly significant, consistent with the partial adjustment theory and previous literature. Finally, the investor sentiment theory and information asymmetry argument do not seem to be relevant for underpricing in shipping.

6 Conclusion

This paper provides additional insights into the IPO underpricing "puzzle" in the global shipping sector. The observed underpricing in shipping is rather low compared to the typical levels reported for other sectors and the general IPO market. This paper suggests that shipping-relevant factors and underpricing theories can partially explain this empirical regularity. Among shipping-specific factors, post-IPO ownership concentration and pre-IPO family ownership turn out to be significant. However, other shipping firm-specific characteristics, such as firm age, current ratio, tangibility, gearing, and turnover, are found to be insignificant.

This paper also considers several underpricing theories that seem to be relevant to shipping specifics or have gained substantial empirical support in the previous literature. Specifically, we test the partial adjustment theory, the investor sentiment theory, the information asymmetry argument, the agency cost theory, and the managerial control theory. Consistent with previous research, the partial adjustment theory is able to explain a significant amount of underpricing in global shipping. Moreover, the downward price revisions prevalent among shipping firms are consistent with low underpricing in shipping. The investor sentiment theory and information asymmetry argument, contrary to expectations, are not supported by the results of this paper. Hence, low underpricing among shipping firms cannot be justified by business cycle fluctuations or low information asymmetry in this sector. Importantly, this paper provides strong evidence in favor of the Stoughton and Zechner agency cost theory, which claims that underpricing is a solution to the agency problem in

the issuer's firm. The corroborating evidence also comes from the significant negative relationship between pre-IPO family ownership and IPO underpricing. Put differently, family firms typically do not experience severe agency problems, and therefore underprice less, which is fully consistent with the Stoughton and Zechner theory of underpricing. This result can partially explain the lower underpricing observed in the shipping sector, as most shipping firms are family-owned. The results obtained for the shipping sector have also proven to be robust to sample size and model specifications. Furthermore, the regression results for a control sample of non-shipping IPOs and a combined sample support the notion of significant differences in underpricing and effects on underpricing between shipping and non-shipping IPOs.

The findings of this paper can be useful for any parties involved in IPO decision-making in the shipping sector. For example, investors can exploit profitable short-selling opportunities due to larger underpricing expected from non-family shipping firms. Furthermore, this paper has significant importance for general IPO literature as it suggests potential relevance of sector-specific factors and theories to IPO underpricing by showing that shipping-specific factors do matter for underpricing in the shipping sector. An example of the shipping sector presents support for a notion that there could be sector-specific explanations of underpricing in other sectors as well. Moreover, the results for the shipping sector might be also relevant for sectors with similar characteristics. The investigation of idiosyncratic sector characteristics that could affect IPO underpricing in different sectors and testing their relevance is left to future research.

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A Explanatory variables

Table 19: **List of explanatory variables**

This table lists potential determinants of IPO underpricing or initial return that are used as explanatory variables. The short names, full names, and descriptions of the variables are provided.

Variable name short	**Variable name long**	**Description of variable**
PR	Price Revision	The relative difference between the offer price and the midpoint of the initial price range
Size	Offer Size	A logarithm of the offer size, defined as a number of offered shares times an offer price
Age	Firm Age	A logarithm of firm age at IPO date (in years)
CR	Current Ratio	The ratio of current assets to current liabilities (a measure of liquidity)
Tang	Tangibility	The ratio of tangible assets to total assets of a firm
Gear	Gearing	A proxy for indebtedness of a firm, measured by a ratio of long-term debt to total capital of a firm
Turn	Turnover	The ratio of freight revenue to total assets of a firm
ROA	Return on Assets	The ratio of net income to total assets of a firm
Family	Family Ownership	A dummy variable which is equal to 1 for family-owned firms
OwnConc	Ownership Concentration	A dummy variable which is equal to 1 for firms with non-zero post-IPO ownership concentration, measured by a fraction of institutional holdings in a firm
OutOwn	Outsider Ownership	Post-IPO outsiders' holdings in a firm, which are determined as the residual after subtracting free float and family holdings from total holdings
Freq	Frequency	The total number of shipping IPOs in the year of an IPO
MktSent	Market Sentiment	The cumulative local market return over the last three months before an IPO
ShipSent	Shipping Sentiment	The cumulative local shipping market return over the last three months before an IPO

B Descriptive statistics for a control sample

Figure 3: **Distribution of initial return**

This figure illustrates the statistical distribution of initial return (approximated by the Epanechnikov kernel density function). The legend states the mean, standard deviation, skewness, kurtosis, and Jarque-Bera test p-value.

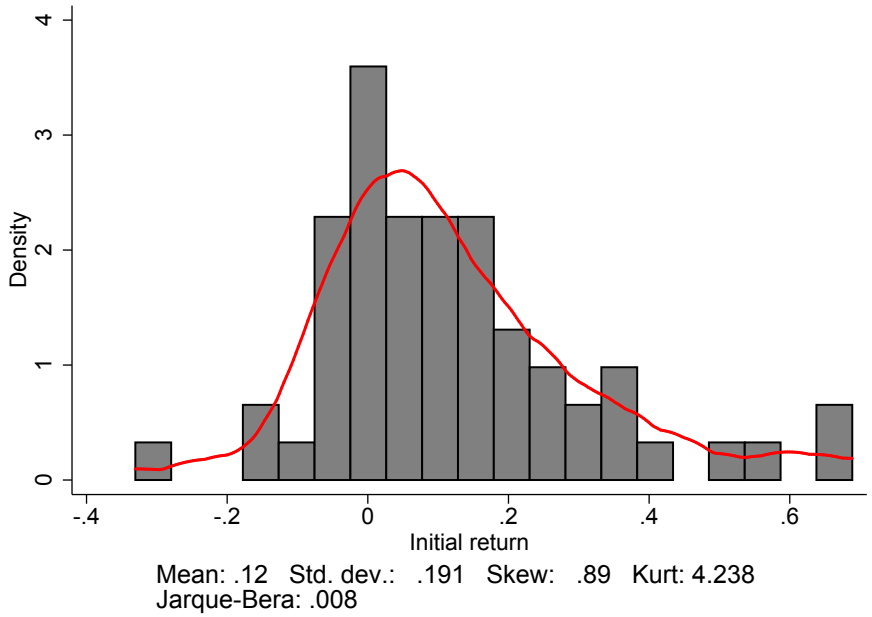

Table 20: **Summary statistics**

This table provides summary statistics for initial return and explanatory variables. Obs stands for the number of observations, Median, Min, and Max − for median, minimum, and maximum values respectively. Along with these statistics, the mean, median, standard deviation, skewness, and kurtosis are specified.

Variable	Obs	Mean	Std. Dev.	Median	Min	Max	Skewness	Kurtosis
IR	60	.12	.191	.083	-.331	.689	.890	4.238
PR	50	-.008	.141	0	-.568	.268	-1.159	6.544
Size	60	4.935	1.023	5.188	1.226	6.776	-1.369	5.132
Age	60	2.091	.912	2.367	.288	3.73	-.611	2.280
CR	60	2.161	2.644	1.414	.043	16.912	3.637	18.624
Tang	60	.323	.319	.178	0	.929	.608	1.877
Gear	60	.451	.725	.381	-1.166	4.151	2.345	12.944
Turn	60	1.024	1.301	.704	0	8.211	3.283	17.275
ROA	60	.024	.507	.025	-1.319	3.169	3.571	26.911
OwnConc	60	.317	.469	0	0	1	.788	1.621
OutOwn	60	.208	.27	.060	0	.8	1.001	2.492
Family	60	.117	.324	0	0	1	2.388	6.703
MktSent	60	.015	.063	.027	-.216	.232	-.565	6.837

Table 21: **Summary statistics for initial return by year**

This table provides summary statistics by year for initial return. N stands for the number of observations, Min and Max − for minimum and maximum values respectively. Along with these statistics, the mean, median, standard deviation, skewness, and kurtosis are specified.

Year	N	Mean	Median	Std. Dev.	Min	Max	Skewness	Kurtosis
2004	4	.176	.213	.131	0	.277	-.588	1.742
2005	11	.189	.107	.214	-.034	.689	1.263	3.634
2006	9	.107	.125	.084	-.012	.235	-.144	1.856
2007	9	.105	.099	.145	-.064	.365	.359	2.097
2008	4	.128	.161	.240	-.167	.357	-.286	1.463
2010	5	-.003	.023	.057	-.102	.038	-1.292	2.953
2011	2	.164	.164	.700	-.330	.659	0	1
2012	1	.2	.2	.	.2	.2	.	.
2013	8	.172	.042	.245	-.040	.546	.642	1.665
2014	6	.024	.042	.111	-.161	.162	-.559	2.462
2015	1	-.047	-.047	.	-.047	-.047	.	.
Total	60	.120	.083	.191	-.330	.689	.890	4.238

Table 22: **Summary statistics for initial return by exchange**

This table provides summary statistics by stock exchange for initial return. N stands for the number of observations, Min and Max − for minimum and maximum values respectively. Along with these statistics, the mean, standard deviation, skewness, and kurtosis are specified.

Exc	N	Mean	Median	Std. Dev.	Min	Max	Skewness	Kurtosis
LSE	5	.072	.050	.055	.017	.156	.636	1.970
NASDAQ	14	.154	.151	.128	-.055	.409	.219	2.590
NYSE	24	.201	.159	.227	-.167	.689	.696	2.634
OSE	17	-.008	-.012	.131	-.330	.288	-.180	4.503
Total	60	.120	.083	.191	-.330	.689	.890	4.238

Table 23: **Cross-correlation table**

This table showcases the correlation coefficients among all variables. These cross-correlations are defined based on the casewise deletion method.

Variables	IR	PR	Size	Age	CR	Tang	Gear	Turn	ROA	OwnConc	OutOwn	Family	MktSent
IR	1.000												
PR	0.638	1.000											
Size	0.034	-0.003	1.000										
Age	0.216	0.124	0.038	1.000									
CR	-0.060	0.163	-0.152	-0.306	1.000								
Tang	-0.251	-0.359	0.196	-0.263	0.049	1.000							
Gear	-0.263	-0.223	0.199	0.046	-0.207	0.241	1.000						
Turn	0.139	0.218	-0.067	0.070	-0.075	-0.118	0.078	1.000					
ROA	-0.079	-0.132	-0.076	-0.062	0.043	0.026	-0.028	0.704	1.000				
OwnConc	0.096	0.060	0.046	0.120	0.186	-0.127	-0.087	0.060	0.157	1.000			
OutOwn	-0.149	-0.234	0.231	0.005	0.038	0.196	-0.066	-0.032	0.119	0.375	1.000		
Family	-0.052	0.175	0.149	0.329	-0.145	-0.097	-0.072	-0.089	-0.156	-0.024	0.018	1.000	
MktSent	-0.079	-0.001	0.214	-0.154	0.241	0.207	-0.150	0.069	0.162	-0.076	0.209	-0.195	1.000