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CORPORATE GOVERNANCE AND IPO UNDERPRICING: A MULTI-LEVEL KNOWLEDGE-BASED VIEW

Abstract

Prior studies of IPO underpricing, mostly using agency theory and single-country samples, have generally fallen short. In this study, we employ the knowledge-based view (KBV) to explore underpricing across 17 countries. We find that agency indicators are insignificant predictors, that board of director knowledge limits underpricing, and external knowledge both substitutes for and complements internal board knowledge. This third finding suggests that future KBV studies should consider how internal and external knowledge states interact with each other. Our study offers new insights into the antecedents of underpricing and extends our understanding of comparative governance and the KBV of the firm.

Keywords: IPO Underpricing, Corporate Governance, Knowledge-Based View, Cross-National Sample, Multi-Level Models

Word count (abstract): 100

Since the 1970s, it has been observed that IPOs are routinely underpriced (sold at a discount) at their initial offering, which represents a systematic failure of the marketplace and directly challenges standard economic theory (Ibbotson, 1975). IPO underpricing appears pervasive across capital markets throughout the world, with IPO underpricing in a sample of 49 countries ranging, on average and by country, from 3.5 to 56 percent (Boulton, Smart and Zutter, 2010).

The dominant explanation for underpricing has been based on the assumption that asymmetric information creates a moral hazard due to a principal-agent and/or principal-principal conflict (Ritter, 2003). However, this traditional line of thinking has received relatively limited empirical support (Ritter and Welch, 2002; Daily et al., 2003). In addition, most prior work has ignored differences in the environment external to the firm to explain underpricing, as home-country characteristics have repeatedly been shown to influence IPO outcomes (Doidge, Karolyi and Stultz, 2011).

In this study, we take a fresh theoretical perspective by framing our investigation using the knowledge-based view (KBV) of the firm (Grant, 1996) within a cross-national sample of firms. Specifically, we explore the notion that the knowledge possessed by the board of directors directly influences the level of underpricing experienced by "entrepreneurial threshold firms" entering public equity markets (Zahra and Filatotchev, 2004). In addition, we explore the idea that the specific environment in which firms operate can provide firms with more or less knowledge (Reus *et al*., 2009), thereby influencing the impact of the board on IPO underpricing.

By examining both the direct effect of board knowledge and the interaction effect between board knowledge and knowledge external to the firm on IPO underpricing, our study provides key new insights on board-governance effectiveness. In addition, this study is responsive to recent calls to consider cross-national differences regarding governance behaviors

and outcomes (Moore *et al*., 2012). Therefore, ours is the first multi-level study to apply the KBV to a cross-national sample of firms to better understand IPO underpricing differences.

A KNOWLEDGE-BASED VIEW OF IPO UNDERPRICING

The KBV focuses on key knowledge workers operating inside the firm to explain organizational outcomes. The theory and research have repeatedly shown that the overall state of knowledge varies by firm, and that a greater extent of firm knowledge tends to be associated with desirable firm outcomes (Grant, 1996). Because the IPO process involves the assembly and distribution of new knowledge and information as the firm attempts to attract new investors and convey its "true" value to public-market investors (Ritter and Welch, 2002), it may be a useful framework to explore the determinants of underpricing outcomes.

The few empirical studies utilizing the KBV to explain IPO outcomes seem to support the validity of this theoretical framework in the exploration of IPO's outcomes. For example, Bach, Judge and Dean (2008) found that its predictions were helpful in explaining long-term IPO performance for computer firms going public for the first time in the United States. More recently, Arend, Patel and Park (2014) demonstrated that KBV predictions are fairly well supported in explaining moderate and long-term IPO outcomes for high-technology manufacturing firms based in the USA.

Based on this recent and encouraging empirical support for the KBV with respect to IPO outcomes, we focus on the potential influence of board knowledge on IPO underpricing in this study. Board members are key decision-makers in the IPO process and have a major influence on its eventual outcomes (Sanford, 2012). Moreover, previous studies have provided empirical support regarding the significant role of board knowledge in affecting a number of firm outcomes. For example, Filatotchev *et al*. (2003) empirically demonstrated that board knowledge was positively associated with firm restructuring in transition economies. More recently,

Barroso, Villegas and Perez-Calero (2011) showed that board knowledge was positively associated with international diversification of Spanish firms. And most relevant to this study, Bedard, Coulombe and Courteau (2008) found that board knowledge was negatively associated with IPO underpricing in Canadian firms.

Internal board knowledge and IPO underpricing

While top management, working in concert with external advisors, often does most of the work related to going public, it is the board's responsibility to understand the information presented, to challenge underlying assumptions and, ultimately, to direct the overall process and decide on the offering price and specific timing of the IPO. In other words, a broad coalition of managers and advisors all contribute to determining the initial offering price (Pollock, Porac and Wade, 2004), but it is the board of directors which is central to this process, and the focus of this study.

> One of the key handbooks on undertaking an IPO describes the board's role as follows:
>
> The board's fiduciary duties and oversight responsibilities naturally extend to the IPO process. Among other things, the board—directly or, for some matters, through committees—must make the threshold decision to pursue an IPO; select the managing underwriters; ensure that appropriate policies, controls, and procedures are in place; establish an appropriate governance structure; approve various matters related to the IPO; reassess compensation programs in the context of becoming a public company; oversee the preparation of the registration documents; and authorize the filing of, and sign them (Westenberg, 2011:10-8).

A knowledgeable board that skillfully manages this process is expected to enhance the firm's absorptive capacity – its ability to value, assimilate and apply new knowledge (Cohen and Levinthal, 1990) – with respect to the process of going public. Zahra and George (2002) argued that absorptive capacity is a set of knowledge creation routines by which firms acquire, assimilate, transform and exploit knowledge to produce a more dynamic organizational capability. Because boards of directors have both economic and legal incentives to optimize the IPO process, we would expect them to use their knowledge to minimize or eliminate

underpricing. Therefore, the collective knowledge assembled within the board should improve the effectiveness of the overall IPO process, which is generally considered to be a successful offering of stocks to public equity markets with minimal or nonexistent underpricing.

Previous KBV literature has suggested that knowledge can be characterized in two ways – its breadth and its depth (Bierly and Chakrabarti, 1996). In this case, the board's breadth of knowledge refers to the extent to which its collective set of experiences and expertise spans multiple domains. For example, boards with relatively broad sets of knowledge would be expected to exercise skill in managing the overall IPO process by selecting the most competent underwriters, allowing dissenting opinions within the boardroom to be aired, resolving conflicts in a timely fashion, and ultimately choosing the most appropriate offering price.

In contrast, the depth of knowledge refers to the extent to which the board possesses highly sophisticated and specialized expertise regarding the technical aspects of the IPO process. For example, boards with relatively deep knowledge would be expected to exercise skill in navigating the technicalities of the new offering by bringing in legal, accounting, and financial expertise to bear on boardroom deliberations.

In sum, boards of directors that possess a broad and/or deep knowledge base are expected to expand the firm's absorptive capacity with respect to the IPO process. This enhanced absorptive capacity should translate into a better managed IPO process, a more accurate offering price and therefore lower levels of underpricing. In contrast, boards lacking broad and/or deep levels of knowledge are expected to have more difficulty in managing the IPO process and assessing the firm's true value. This lack of knowledge should translate into a lower offering price, and hence higher underpricing in order to attract potential investors and to avoid risk of partial subscription or selling of shares. This suggests the following two relationships:

Hypothesis 1a: The extent of general knowledge (i.e., knowledge breadth) possessed by the IPO firm's board of directors will be negatively associated with IPO underpricing.

Hypothesis 1b: The extent of technical knowledge (i.e., knowledge depth) possessed by the IPO firms' board of directors will be negatively associated with IPO underpricing.

Internal and external knowledge's interactive effect on IPO underpricing

The KBV is a theory of the firm, so its primary focus has been on the knowledge and learning occurring *within* the firm to influence organizational outcomes. However, knowledge workers within the firm often seek knowledge *external* to its boundaries, integrating that external knowledge with their internal knowledge to inform strategic choices (Grant, 1996). Hence, the KBV emphasizes that internal knowledge must be considered within the context of the external knowledge circulating within the firm's environment (Nonaka, 1994; Reus et al., 2009).

Based on KBV and absorptive capacity literatures, we would expect that boards of directors with relatively broad and deep levels of knowledge are in a better position to take advantage of useful knowledge external to the firm than boards of directors with relatively low levels of knowledge (Zahra and George, 2002). In other words, as boards expand the absorptive capacity of the firm, the KBV predicts that these more knowledgeable boards will be in a better position to be aware of, assimilate, and apply any or all relevant knowledge from the external environment in order to govern the corporation well (Zahra and Filatotchev, 2004). We therefore expect that internal knowledge is *complementary* with external knowledge as boards direct the IPO process.

With respect to IPO underpricing, this suggests that the breadth or depth of knowledge operating within the board should enable the board to capitalize on the breadth or depth of knowledge external to the firm. Specifically, boards possessing a relatively broad range of general knowledge and/or a relatively deep technical knowledge about the IPO event should be

better positioned to take advantage of extensive knowledge external to the firm. For example, a board with a broad range of knowledge would be expected to operate with directors broadly knowledgeable about business in general, such as its overall understanding of the economy. If these directors operated in an environment with relatively extensive information on the overall economy, they should be better able to make decisions that enhance the IPO offering.

Similarly, a board operating with relatively deep understanding of the technicalities associated with the IPO event operating within an external environment with relatively extensive information on the legal, accounting and financial aspects associated with IPOs should be better positioned to make decisions that enhance the IPO offering. In sum, this literature and logic suggests that the state of knowledge within the board should complement the state of knowledge in the external environment. More formally:

Hypothesis 2a: The breadth of general knowledge possessed by the IPO firm's board of directors will be more negatively associated with IPO underpricing when there is more extensive general and IPO-specific knowledge available in the environment in which the firm operates.

Hypothesis 2b: The depth of technical knowledge possessed by the IPO firm's board of directors will be more negatively associated with IPO underpricing when there is more extensive general and IPO-specific knowledge available in the environment in which the firm operates.

RESEARCH METHODS

Data collection procedures

The most common source of IPO data is the SDC Platinum database, provided by Thomson-Reuters. However, due to considerable problems with its accuracy (see Ritter, 2012) and the absence of several important firm-level indicators required by our study, we resolved to hand-

collect our own dataset with a wide range of country experts intimately familiar with the environment of their designated economy. When the country experts and corresponding sample of countries had been selected, we utilized the annual editions of the *EurIPO Fact Books* (Paleari *et al*., 2006; Paleari *et al*., 2007; Paleari *et al*., 2008) to identify IPOs for these countries. Our study period ranges from 2006–2008 and covers both hot and cold market conditions that have been shown to influence IPO processes (Derrien, 2005).

Data were collected through careful reading and analysis of IPO prospectuses by the country experts. All IPOs require a prospectus providing a general overview for potential investors to consider. Each prospectus contained the following two sets of information: (1) firm characteristics, (e.g., founding date, financial trends and offering price); and (2) details on key top managers and all board members, (e.g., age, ownership stakes, functional background and tenure with the firm).

In order to guide data-gathering and ensure consistency, the project leaders developed a data-collection template that was distributed to all participating country experts. As Aggarwal *et al*. (2009) observed, there are important but subtle differences in governance measures throughout the world, and our research team was able to deliberate on these differences and reconcile them in a systematic fashion. The country experts collected and coded the firm-level variables according to this template. In several instances, country-specific queries raised by country experts were discussed and resolved by the project leaders in order to reflect country-specific peculiarities and ensure data consistency. Overall, this process yielded a complete data set of 978 IPO firms from 17 countries representing over 60 percent of global GDP.

Variables and measures

In this study, we had one dependent variable - IPO underpricing. Consistent with our earlier literature and logic, board knowledge was measured in terms of its breadth and depth (Bierly and

Chakrabarti, 1996). Similarly, and based on prior research, we also distinguish between the two dimensions of breadth and depth for external knowledge (Barro and Lee, 2001; Ritter and Welch, 2002). These dependent and independent measures, as well as our controls, mainly borrowed from agency theory and previous research done using U.S. samples, are listed in Table 1. The descriptive statistics and bi-variate correlations for all our measures are listed in Table 2.

[Insert Tables 1 & 2 about here]

Analytical method

We used hierarchical linear modeling (HLM) as implemented in Stata 13.1 to test our hypotheses. This technique is appropriate because our observations are embedded in two hierarchically-nested levels of analysis – country and industry – that may be sources of non-independence among observations (Raudenbush and Bryk, 2002). The ICC(1) intra-class correlation coefficient is 0.28 at country level ($p < 0.001$) and 0.11 at industry level ($p < 0.01$), suggesting that the most important source of non-independence is the country level; we took this into account by specifying our model as a 2-level hierarchical model with observations nested in countries and controls for industries at the 2-digit ISIC 4 level.

EMPIRICAL RESULTS

Table 3 presents our 2-level HLM regression results. Model 1 contains only our control variables. The primary indicators for this base model are board, firm, industry, national and timing control measures. Notably, none of the agency predictors are systematically related to IPO underpricing. Model 2 shows the entire array of control measures, along with the two direct effects hypothesized by the KBV. All indicators of model fit improve modestly, and consistent with H1a and H1b, *board knowledge breadth* and *board knowledge depth* are both negatively associated with IPO underpricing.

[Insert Table 3 about here]

In Model 3, we regressed our controls, main effects and interaction effects of board and external knowledge breadth and depth. Indicators of fit improve significantly. Notably, all four interactions are statistically significant, but three are statistically significant opposite to the hypothesized direction. The only interaction demonstrating a complementary relationship was between *board knowledge depth* and *external knowledge depth*, though only marginal ($p < .10$). In sum, our data provide limited support for the complementary relationship proposed by the KBV in H2b. In contrast, our data predominantly suggest a substitution relationship between internal and external knowledge with respect to IPO underpricing. Furthermore, we conducted several robustness tests using alternative national indicators, a variety of model specifications, and multiple tests to rule out endogeneity concerns. Our findings were robust, and specific details can be obtained by contacting the authors directly.

DISCUSSION AND CONCLUSIONS

This study uses the KBV to describe and explain IPO underpricing across multiple levels of analysis for a broad cross-national sample of firms based in developed and emerging economies. Our results provide relatively strong support for its predictions related to board knowledge being inversely related to IPO underpricing. Specifically, both the breadth and depth of board knowledge were found to directly suppress IPO underpricing above and beyond our wide array of control variables.

Traditional knowledge-based literature and logic argues that “more knowledge is better” (Zahra and George, 2002). As a result, we hypothesized a complementary relationship between board knowledge and external knowledge and tested this prediction. Notably, all four of our interactions were significant, but three were in the opposite direction hypothesized, and the hypothesized relationship that was supported was only marginally significant. Specifically, it appears that boards with less knowledge benefit more from extensive external knowledge to

overcome their knowledge gaps and to direct the IPO process with less underpricing. In contrast, boards with more extensive internal knowledge may overestimate their own knowledge and may not fully utilize external knowledge sources. These substitution effects directly challenge traditional absorptive capacity logic within the KBV which argues for complementary effects.

However, our findings are consistent with recent KBV studies, which have revealed that the specific relationship between external and internal knowledge depends on the nature of the situation. Specifically, Fernhaber *et al*. (2009) found that new ventures with limited internationally-experienced top management benefited most from external international knowledge sources, suggesting a substitution relationship, contrary to traditional absorptive capacity arguments. Furthermore, Xu, Wu and Cavusgil (2013) showed that external knowledge often substitutes for internal knowledge when the firm is pursuing radical innovation. Overall, this literature and our data seem to suggest that when a firm is confronted by non-routine and complex situations, external knowledge can and often does substitute for internal knowledge.

The only instance where we found a complementary relationship between internal and external knowledge was with board knowledge depth and external knowledge depth. This finding suggests that the depth dimension of knowledge within the board coupled with the depth dimension of knowledge external to the firm is the only area where a complementary relationship between internal and external knowledge-sourcing may exist. In other words, it takes deep knowledge within the board in order to access and utilize deep knowledge in the external environment. While this finding was only marginally significant, its implications are interesting and significant for future KBV research because it highlights different interactive effects between the breadth and depth of knowledge internal and external to the firm.

In sum, we found that with respect to IPO underpricing, more knowledge is not always better when considering interaction between internal and external sources of knowledge. Our

data suggest that when a firm is confronted by a non-routine complex decision, such as entering public equity markets, only the depth of internal knowledge is complementary with the depth of external knowledge. In contrast, all other interactions between internal and external knowledge lead to substitution outcomes. While this is speculative, it may be that less knowledgeable boards are often more highly motivated to search out and rely on external knowledge than more knowledgeable boards are (Menon and Pfeffer, 2003).

Conclusions and Implications

The primary contribution of our study is to help demystify the IPO underpricing market anomaly by utilizing a new theoretical perspective and analyzing a broad sample of firms in a wide variety of economies using multi-level modeling techniques. Consistent with Lubatkin *et al*. (2005), we find that predictors based on the most popular theoretical framework for exploring underpricing, agency theory, have relatively little explanatory leverage in a cross-national context. Furthermore, we show that most of the variables found to be salient predictors of underpricing in the U.S. IPO market (i.e., prior growth, issue size, leverage, profitability, VC ownership) do not have much explanatory power in our cross-national sample.

In contrast, our results suggest that KBV predictions regarding the extent of knowledge possessed by boards of directors are more powerful in explaining first-day IPO returns for a more globally-representative set of firms. In particular, our results indicate that broad and deep knowledge possessed by the board of directors may enable the board to more properly manage the IPO process and accurately price the IPO prior to going public. Our findings also suggest that the external environment can often substitute for internal board knowledge, and that the joint knowledge impact varies in terms of breadth and depth considered. As such, our findings reveal that KBV dynamics often vary from economy to economy, depending on the knowledge possessed by the board and the extent of knowledge circulating within the overall economy.

Consequently, previous KBV and underpricing insights generated just within the U.S. context may not be generalizable to other economies.

In addition, we make an important methodological contribution to empirical research on IPO underpricing in particular, and cross-national research on corporate governance more generally. To our knowledge, this is the first study exploring multi-level explanations of IPO underpricing using hierarchical linear modeling (HLM) techniques in a cross-national sample. While Engelen and Van Essen (2010) used HLM to examine underpricing, their theoretical focus was exclusively on the effects of national legal frameworks on IPO outcomes. The vast majority of prior cross-national studies of IPO underpricing (e.g., Banerjee *et al*., 2011; Boulton *et al*., 2010) applied ordinary least square (OLS) techniques to nested data in which individual observations are subject to both industry- and country-level effects. This approach likely violates the IID assumption of OLS, which may artificially reduce the standard errors of the estimates and inflate confidence levels (cf. Raudenbush and Bryk, 2002). Consequently, the statistical significance of these OLS-based findings may be in doubt. Using HLM, this paper takes into account these methodological issues and may set a standard for future research.

Our study also makes important contributions to the literature on international corporate governance. First, our findings add empirical evidence to the argument that agency explanations may be rather limited in the global economy (Lubatkin *et al*., 2005), as this perspective largely reflects governance peculiarities and the institutional context of established Anglo-American firms with dispersed ownership (Filatotchev and Boyd, 2009). If neoclassical economic assumptions are relaxed, the theoretical contribution of agency theory becomes rather restricted (Aguilera and Williams, 2009; Judge, Gaur and Muller-Kahle, 2010). Clearly, there will always be monitoring and control issues to which boards must attend. However, our study reveals that traditional structural proxies for monitoring and controlling the firm were inconsequential for

explaining IPO underpricing in a cross-national context. At the very least, agency theorists should consider using alternative measures which more closely approximate actual board monitoring and control activities rather than the traditional structural proxies (Finkelstein and Mooney, 2003).

Second, our study suggests that the KBV may be a useful alternative perspective for explaining corporate governance processes and outcomes. The KBV argues that firms with more extensive knowledge are advantageously positioned to perform in a knowledge-based global economy (Grant, 1996; Kogut and Zander, 1992; Zahra and Filatotchev, 2004). Our results show that this is not always the case, but it would be interesting to see if they can be extended also to other corporate governance outcomes in more mature and established firms.

Third, our study strongly supports scholars arguing that national context influences corporate governance practices and outcomes; and that the Anglo-American governance environment is quite different from elsewhere (e.g., Judge *et al*., 2010; Li and Samsell, 2009; Zattoni and Cuomo, 2008). In addition, our findings break new ground by exploring how the state of internal knowledge interacts with external knowledge to influence governance outcomes. As such, our study lends further support to the notion that country does indeed matter when attempting to understand organizational outcomes (Makino, Isobe and Chan, 2004).

These empirical insights have a number of important practical implications. They show that board knowledge can have a substantive direct impact on IPO outcomes. Specifically, an increase in the board knowledge breadth by one standard deviation from the mean in an environment with external knowledge breadth one standard deviation below the mean changes underpricing from a mean of .31 (underpricing) to -.04 (overpricing). This elimination of underpricing represents millions of dollars to pre-IPO investors for each IPO. As such, treating

the board as “window dressing” may not be a very practical decision (Chen, Hambrick and Pollock, 2008).

A final practical implication of our analysis reveals that IPO underpricing is influenced at both the firm and national levels. Notably, the value of board knowledge appears to be most significant for less-developed economies, counter to Crossland and Hambrick's executive discretion research (2011). Clearly, we have just scratched the surface of our understanding on how cross-national corporate governance mechanisms interact to yield firm-specific outcomes in a globally-representative set of firms (Judge, 2009). The KBV warrants further studies to learn whether our findings hold in other time-periods using more refined measures of internal and external knowledge in other cross-national contexts.

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Table 1. Variables and measures employed in this study

Variable	Measure and Recent Supporting Literature	Source of data
IPO underpricing	Square root of the percentage price change from offer price to price at end of first trading day after adding constant. (End of First-day Market Price – Initial Offering Price) / Initial Offering Price (Arthurs *et al*., 2008).	EurIPO database and local stock market exchange data
Board knowledge breadth	Board Experience: Average age of directors on the board at time of the IPO event (Thompkins and Hendershott, 2012)	IPO prospectus
Board knowledge depth	Board Technical Expertise: The proportion of those on the board possessing technical expertise relative to IPO (i.e. law, accounting, or finance) was computed relative to overall board membership (McDonald and Westphal, 2010).	IPO prospectus
External knowledge breadth	Educational Attainment: National index comprised of mean number of years of schooling for adults and children normalized on a 0 to 1 scale (Barro and Lee, 2001)	UN Human Development Project
External knowledge depth	IPO Activity: Number of IPOs issued during year of IPO by economy (Ritter and Welch, 2002)	Thomson Reuters Datastream & market exchange data
Board Ownership	Proportion of shares held by directors relative to overall shares outstanding (Howton *et al*.,2001)	IPO prospectus
CEO Duality	Coded 1 if CEO is also chairman of board, 0 otherwise (Chahine and Tohmé, 2009)	IPO prospectus
Outsider Proportion	Proportion of outside directors on board relative to all members of board (Certo *et al*., 2001).	IPO prospectus
Issue Size	Log transformation of total market proceeds earned at IPO event, US$ (Jain and Kini, 2000).	EurIPO database
IPO Age	Log transformation of difference in years between IPO firm's founding date and date of IPO (Daily *et al*., 2003).	IPO prospectus
IPO Leverage	Log transformation of debt-to-equity ratio at time of IPO (Eckbo and Norli, 2005)	Company financial statements
IPO Growth	Previous three years of sales growth registered by pre-IPO firm (Florin *et al*., 2003)	Company financial statements
IPO Profitability	Average three years of return-on-assets by pre-IPO firm (Florin *et al*., 2003)	Company financial statements
Family Ownership	Proportion of shares held by family members (Bruton *et al*., 2010)	IPO prospectus
Venture Capital Ownership	Proportion of shares held by venture-capital investors (Bruton *et al*., 2010)	IPO prospectus
Bank Ownership	Proportion of shares held by banks (Bruton *et al*., 2010)	IPO prospectus
Government Ownership	Proportion of shares held by governmental entities (Bruton *et al*., 2010)	IPO prospectus
Primary Industry	Dummy variables provided for 62 two-digit ISIC classifications (Shi *et al*., 2013)	IPO prospectus
Market Returns	Total annual general stock-market returns for year of IPO by economy (Baker and Wurgler, 2007)	Thomson Reuters Datastream and local market exchange data
Market Volatility	Standard deviation of total annual general stock-market returns for year of IPO by economy (Baker and Wurgler, 2007)	Thomson Reuters Datastream and local market exchange data
Market Capitalization	Total stock-market capitalization for year of IPO by economy, in US$ (Baker and Wurgler, 2007)	Thomson Reuters Datastream and local market exchange data
Year	Two binary variables: IPO in 2006 and IPO in 2007 (Engelen and van Essen, 2010).	EurIPO database

Table 2. Correlation matrix for IPO underpricing and its predictors in 17 countries (N = 978)

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. IPO Underpricing[a]	1.120	0.229	-													
2. Board ownership	27.80	25.25	-0.04	-												
3. CEO duality	0.389	0.488	-0.01	0.20	-											
4. Outsider proportion	65.40	20.48	0.01	-0.12	-0.22	-										
5. IPO age[b]	1.901	1.084	-0.12	0.08	0.09	0.14	-									
6. IPO growth[b]	4.521	0.947	-0.11	0.06	0.13	0.03	0.09	-								
7. IPO issue size[b]	4.993	1.983	-0.05	-0.04	-0.02	0.16	0.04	-0.04	-							
8. IPO leverage[b]	0.558	0.95	-0.04	-0.06	0.07	-0.09	0.14	0.06	0.03	-						
9. IPO profitability	-0.178	5.942	0.01	-0.01	0.02	-0.03	0.06	0.01	0.01	0.00	-					
10. Bank ownership	1.348	6.546	-0.10	-0.13	-0.06	0.06	0.01	-0.03	-0.03	-0.01	-0.04	-				
11. Family ownership	13.30	22.40	-0.05	0.34	0.21	-0.24	0.28	0.14	-0.06	0.22	0.04	-0.08	-			
12. Government ownership	1.419	9.018	0.07	-0.17	-0.08	0.08	0.04	-0.04	0.07	0.03	-0.01	-0.03	-0.10	-		
13. Venture capital ownership	5.621	12.63	-0.11	0.20	0.00	0.30	0.15	0.07	0.07	-0.11	-0.08	-0.03	-0.18	-0.07	-	
14. Stock market capitalization	6,218	7,272	-0.07	0.24	0.09	0.38	0.15	0.08	0.12	-0.23	-0.01	-0.09	-0.24	-0.08	0.58	-
15. Stock market returns	0.147	0.488	0.16	-0.07	-0.10	0.03	0.05	-0.11	0.11	0.06	0.01	-0.01	-0.05	0.01	-0.07	-0.02
16. Stock market volatility	0.128	0.115	0.33	-0.13	0.07	-0.05	-0.01	0.11	-0.11	0.11	0.03	-0.06	0.18	0.16	-0.28	-0.43
17. IPO in 2006	0.414	0.493	-0.05	-0.04	-0.04	0.02	-0.04	-0.11	0.11	-0.02	0.01	-0.08	-0.11	-0.03	0.06	0.10
18. IPO in 2007	0.377	0.485	-0.03	0.08	-0.04	0.02	0.07	-0.01	-0.02	0.01	-0.03	0.11	0.01	-0.05	0.04	0.12
19. Board knowledge breadth	51.00	5.414	-0.23	-0.04	-0.02	0.14	0.22	0.11	0.05	0.04	0.05	0.08	0.04	0.05	0.06	0.16
20. Board knowledge depth	0.497	0.252	-0.21	0.00	0.00	-0.03	-0.07	-0.12	0.12	-0.11	0.00	0.10	-0.16	-0.05	0.11	0.09
21. External knowledge breadth	0.776	0.161	-0.32	0.12	-0.11	0.19	-0.05	-0.04	0.07	-0.36	-0.02	0.09	-0.36	-0.13	0.39	0.53
22. External knowledge depth	62.09	47.86	-0.22	0.10	0.00	-0.02	-0.26	0.00	-0.01	-0.16	-0.05	-0.06	-0.31	-0.16	0.22	0.52

	15	16	17	18	19	20	21
16. Stock market volatility	-0.43	-					
17. IPO in 2006	0.43	-0.39	-				
18. IPO in 2007	0.19	-0.31	-0.65	-			
19. Board knowledge breadth	-0.04	-0.15	0.00	0.05	-		
20. Board knowledge depth	-0.04	-0.29	0.06	0.04	-0.06	-	
21. External knowledge breadth	-0.21	-0.54	0.08	0.06	0.13	0.30	-
22. External knowledge depth	0.07	-0.63	0.38	0.00	0.13	0.25	0.44

Notes: [a] -Square root of (underpricing + 1);
[b] - Log transformation + 1;
Correlations >= .07 are significant at least at .05 level.

Table 3. Multilevel regression of board knowledge and external knowledge impact on IPO underpricing

	Model 1		Model 2		Model 3	
Variable	**βeta**	**Standard Error**	**βeta**	**Standard Error**	**βeta**	**Standard Error**
Constant	0.985***	0.085	0.988***	0.084	1.013***	0.086
Controls:						
Board ownership	-0.000	0.007	-0.002	0.007	-0.002	0.007
CEO duality	-0.023†	0.013	-0.022†	0.013	-0.026*	0.012
Outsider proportion	-0.010	0.007	-0.008	0.007	-0.006	0.007
IPO age	-0.018*	0.007	-0.015*	0.007	-0.017*	0.007
IPO growth	-0.001	0.006	-0.002	0.006	-0.003	0.006
IPO issue size	-0.009	0.006	-0.007	0.006	-0.009	0.006
IPO leverage	0.004	0.007	0.003	0.007	0.005	0.007
IPO profitability	0.000	0.006	0.001	0.005	0.001	0.005
Bank ownership	-0.002	0.006	-0.000	0.006	0.000	0.006
Family ownership	0.016†	0.009	0.016†	0.009	0.015†	0.009
Government ownership	-0.013†	0.007	-0.011†	0.007	-0.007	0.007
Venture capital ownership	0.006	0.008	0.007	0.008	0.007	0.007
Stock-market capitalization	0.007	0.032	0.013	0.031	0.011	0.034
Stock-market returns	0.011	0.0133	0.014	0.013	0.021	0.013
Stock-market volatility	0.097***	0.025	0.093***	0.025	0.084**	0.026
IPO in 2006	0.153**	0.057	0.137*	0.056	0.097	0.063
IPO in 2007	0.176**	0.054	0.160**	0.054	0.128*	0.057
Industry dummies	Yes		Yes		Yes	
Firm-level predictors:						
Board knowledge breadth (BKB)			-0.016*	0.007	-0.017**	0.006
Board knowledge depth (BKD)			-0.018**	0.013	-0.021**	0.007
National-level predictors:						
External knowledge breadth (EKB)					-0.020	0.028
External knowledge depth (EKD)					0.013	0.019
Interaction effects:						
BKB x EKB					0.015*	0.007
BKD x EKB					0.031***	0.008
BKB x EKD					0.017**	0.006
BKD x EKD					-0.011†	0.007
N	978		978		978	
Pseudo R^2	0.300		0.312		0.358	
Log Likelihood	353.7		359.6		376.5	
Wald Chi-Square	167.3		181.2		222.7	
P ≥ Chi-squared change	0.000		0.000		0.000	

Notes: IPO Underpricing was transformed using square root plus constant to avoid kurtosis and skewness problems; Issue Size, IPO Age and IPO Leverage were log-transformed to assure normality; Industry dummies for 62 ISIC industries are included and specific details on coefficients can be provided upon request.
Pseudo-R^2 calculated as: 1 - (residual variance) / (variance of square root of underpricing).
*** p < .001; ** p < .01; * p < .05; † p < .10