Underwriter networks and the 2012 JOBS Act

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Abstract

Using a difference-in-differences framework, I examine the impact of the 2012 Jumpstart Our Business Startups (JOBS) Act on underwriter network centrality as measured by Degree, Betweenness, Closeness, and Eigenvector. The Act has resulted in greater information asymmetry which suggests a greater role for underwriter centrality. However, the desire to avoid collaboration coupled with greater efficiency in underwriter hiring after the Act point to a reduced role for underwriter centrality. Which effect dominates? Based on a sample of US IPOs from 2001 to 2019 I find that Degree, Closeness, and Eigenvector have reduced for emerging growth companies (EGCs) following the Act. However, there is no impact on Betweenness. My results are robust to measuring centrality over different periods and using various specifications including propensity score matching. I also find that the proportions of IPO co-managers and co-manager shares relative to the entire underwriting syndicate have reduced following the Act. Finally, my results show that, after the Act, a co-manager on the IPO is less likely to become a book manager in the first SEO.

1. Introduction

On one hand, the underwriting syndicate performs a risk-sharing function (Chowdhry & Nanda, 1996; Mandelker & Raviv, 1977; Wilson, 1968) and being connected to more underwriters provides greater assurance that an issuing firm's shares will be sold to investors. Furthermore, a bank's information-production capacity depends on investment in developing and

maintaining investor and client networks (Pichler & Wilhelm, 2001).[1]

However, according to Eccles and Crane (1988), collaboration among banks is not easy because investment in network development involves efforts that overlap with one another and are difficult to monitor. Thus, banks have a strong incentive to free ride on each other in the preparation of an offering (Pichler & Wilhelm, 2001). According to Corwin and Schultz (2005), lead underwriters (a.k.a., book managers) may set a lower bound on their fees, thus restricting co-managers. Moreover, being a co-manager in an initial public offering (IPO) increases the underwriter's chances of becoming a book manager in the first follow-on offering by the same issuer. Corwin and Schultz (2005) provide anecdotal evidence from an underwriter suggesting that lead managers prefer to have no co-managers. Ljungqvist et al. (2009, Table 9) also find that banks are more likely to be a lead manager if they have been a co-manager for the issuer in the past.

In this paper, I use a natural experiment to examine the desirability or otherwise of underwriter networks. Specifically, I examine the impact of the 2012 Jumpstart Our Business Startups (JOBS) Act (henceforth, "JOBS Act", "JOBS", and "Act" will be used interchangeably) on underwriter network centrality. The Act, which came into force on April 5, 2012, allows Emerging Growth Company (EGC) firms to "test-the-waters" with prospective investors before filing an initial prospectus with the Securities and Exchange Commission (SEC). The Act's provisions also allow firms to reduce the scope of executive compensation and financial statement information, postpone the application of new or revised accounting standards, and delay compliance related to auditor attestation on internal controls with the Sarbanes-Oxley Act (a.k.a., SOX). As a consequence, information uncertainty increases resulting in greater underpricing (Barth et al., 2017). Chemmanur et al. (2020) find that greater underwriter centrality reduces information asymmetry between the firm and investors and, thereby, underpricing for seasoned equity offerings (SEOs). The greater information asymmetry associated with the Act should result in increased underwriter centrality.

Before the Act, all firms were required to file an initial prospectus with the SEC prior to soliciting indications of interest and this prospectus typi-

[1] Chemmanur and Fulghieri (1994) argue that an underwriter's role in an equity issue is to produce noisy information about a firm which the underwriter then conveys to investors by making use of its reputation as a certifying mechanism.

cally contained the names of at least the book managers and co-managers on the IPO. Thus, the initial prospectus simultaneously contained a lot of previously privately-held and potentially sensitive information about the firm, the expected proceeds the firm hoped to obtain from the IPO, and the names of at least the key underwriters of the IPO. Presumably, the underwriters, through their reputation, backed the expected proceeds the firm hoped to raise before embarking on the bookbuilding process to gauge investor interest.

Since no disclosure in terms of an initial prospectus is required before "testing-the-waters", the Act allows for the possibility that an individual underwriter is solicited by an IPO firm. If the underwriter is unable to underwrite a significant portion of the expected proceeds based on feedback from its own institutional investors, another underwriter can be approached to assist or replace the first underwriter to underwrite the issue. If the two underwriters are still unable to underwrite a significant portion of the proceeds that the firm hopes to raise, a third underwriter could be approached to assist or replace one or both the other underwriters. This process continues until at least a sufficiently large portion of the expected proceeds has been underwritten. A more gradual and possibly more optimal assimilation of the underwriting syndicate of an IPO will result. The risk sharing function problem for a given IPO is solved because the underwriter network evolves based on each underwriter's solicitation from its own institutional investors. Furthermore, this reduces the possibility that some underwriters are unnecessarily included and mitigates the competitive threat that they could pose in future offerings. The greater efficiency in underwriter hiring after the Act should result in lower underwriter centrality. Thus, while information asymmetry has increased after the Act which suggests a greater role for underwriter centrality, underwriter desire to minimize collaboration coupled with greater underwriter hiring efficiency points to a decrease in underwriter centrality after the Act. Which effect dominates?

Using a sample of IPOs from the United States (US) from 2001 to 2019 and a difference-in-differences framework, I find that underwriter network centrality of the managing syndicate (i.e., book managers and co-managers), as measured by Degree, Closeness, and Eigenvector has reduced for EGC firms after the Act. However, another measure, Betweenness, is not statistically significant. I conclude that the importance of underwriter networks for IPOs as highlighted in Bajo et al. (2016) and Chuluun (2015) has greatly reduced after the passing of the Act. I include a number of specifications in the

difference-in-differences analyses including measuring underwriter centrality from one- to five-calendar years before the year of the IPO, using propensity score matching, and accounting for three time periods (rather than two; i.e., before and after the Act) because the centrality measures are calculated based on prior years and, therefore, the centrality measure for an IPO after the Act could extend to the period before the Act. My results are robust to these different specifications and centrality measurement periods.

More specifically, how have book managers and co-managers been impacted? Using a generalized linear model (GLM), I find that the proportion of book managers and the proportion of shares underwritten by book managers have not significantly changed. However, the proportion of co-managers and the proportion of shares underwritten by co-managers have significantly reduced after the passing of the Act. There has been no change in the gross spread after the Act. Taken together, these results suggest that co-managers are playing a smaller role in syndicates after the Act.

Finally, I examine the impact of the Act on the probability of being a book manager on the first SEO after the IPO. Consistent with Corwin and Schultz (2005), I find that an IPO co-manager is highly likely to become a book manager in the same issuer's SEO. However, using triple difference-in-differences, an EGC IPO co-manager is less likely to become a book manager in the same issuer's SEO after the Act. Also, for sample firms not impacted by the Act, an IPO co-manager is more likely to become a book manager on the SEO if there is a book manager change. Corwin and Schultz (2005) also find a positive relation, although their sample period is prior to the Act. After the Act, however, an IPO co-manager is unlikely to become a book manager on the SEO if there is a book manager change. These results suggest that the Act has reduced the competitive threat that book managers face from co-managers, possibly due to greater efficiency in underwriter hiring.

To my knowledge, my paper is the first one to examine the impact of the JOBS Act on underwriter network centrality. The ability to prospect institutional investors before filing a prospectus after the Act indicates that the underwriting syndicate will more efficiently reflect the underwriting needs of the IPO. As a result, the true value of underwriter networks is revealed. Furthermore, a smaller underwriter network could result in underwriter oligopolies in line with Liu and Ritter (2011) who argue that issuers are not only concerned about IPO proceeds but also non-price dimensions such as underwriter quality, industry expertise, and coverage from reputed analysts, which only a limited number of underwriters are able to provide. Also, my findings show

that the underwriter centrality measures are fairly consistent across 1- to 5-year periods. Therefore, computing underwriter centrality for a period longer than the prior year is not really necessary. The next section examines the impact of the Act on underwriter networks. Section 3 presents the underwriter centrality measures while the data and identification strategy are discussed in Section 4. Section 5 discusses the results when centrality is measured over one year while Section 6 does the same for 2- to 5-years. Section 7 focuses on book managers, co-managers, and the gross spread, while Section 8 examines book manager choice in the SEO. Section 9 concludes.

2. Impact of the JOBS Act on underwriter networks

Underwriters perform several roles such as issuer certification, share distribution, and after-market support. Bajo et al. (2016, p. 379) postulate that "the lead underwriter transmits noisy information about the IPO firm to potential investors through a network of investment banks connected to it, with each investment bank having repeated interactions with a set of institutional investors who may potentially invest in the IPO". Investors are assumed to pay attention to or recognize this information. Since it can be costly to obtain information from other investment banks, it is also assumed that, when considering a prospective IPO, an institutional investor will pay attention to an investment bank with which it has had prior dealings. According to Bajo et al. (2016, p. 380), the above theory suggests that "a more central lead IPO underwriter will be connected to a greater number of institutions (through its investment banking network)" which will result in more institutions paying attention to the information from a particular IPO and more efficient dissemination about the firm going public to these institutions.[2]

2.1. Information asymmetry

The JOBS Act, which came into being on April 5, 2012, created a new category of issuer called the Emerging Growth Company (EGC) for whom

[2]Other papers that examine networks in a financial context include Hochberg et al. (2007) - impact of venture capital networks on fund performance, Engelberg et al. (2012) - connection of banks and firms through interpersonal links, Larcker et al. (2013) - corporate board member connections across firms, and El-Khatib et al. (2015) - Chief Executive Officer (CEO) connections related to acquisitions.

mandatory disclosures were reduced in order to encourage them to go public as access to capital was not easy following the financial crisis of 2008-09. According to Barth et al. (2017, p. 25), the Act's provisions allow EGCs to i) file draft registration statements confidentially with the SEC, ii) reduce the scope of executive compensation and information on financial statements, iii) delay the application of new or revised accounting standards, and iv) delay compliance with Section 404(b) of the Sarbanes-Oxley Act (a.k.a., SOX) which relates to auditor attestation on internal controls. The reduction in mandatory disclosures increased information uncertainty which resulted in greater underpricing for these firms.

Chemmanur et al. (2020) find that SEO lead underwriters with greater underwriter centrality are associated with lower information asymmetry - smaller analyst forecast errors, smaller analyst forecast dispersion, and smaller bid-ask spreads.[3] More central lead underwriters are also associated with less negative announcement effects, smaller offer price revisions, smaller SEO discounts and underpricing, higher immediate post-SEO equity valuations, greater post-SEO long-run stock returns, and greater institutional investor participation. By contrast, in the IPO context, Bajo et al. (2016) find that more central lead IPO underwriters are able to induce institutional investors to pay greater attention to the firms that they take public which results in larger absolute values of IPO offer price revisions, greater IPO and secondary market valuations, and higher IPO underpricing. Chuluun (2015) also finds that more central IPO lead underwriters are associated with larger IPO offer price revisions and underpricing. According to Chemmanur et al. (2020), the contrasting findings for IPOs and SEOs occur because, for lead underwriters, the key economic role in IPOs is one of information extraction while that for SEOs is information dissemination.

Even if information extraction dominates, information dissemination remains a key role for underwriters of IPOs, compounded by the fact that the Act has resulted in greater information asymmetry as a result of reduced disclosures. Greater underwriter centrality could help to mitigate this information asymmetry. Therefore, underwriter centrality should increase after the Act.

[3]The theoretical literature on the role played by financial intermediaries to mitigate asymmetric information associated with an equity issue is examined by Booth and Smith II (1986), Chemmanur and Fulghieri (1994), and Titman and Trueman (1986).

2.2. Underwriter hiring efficiency

Corwin and Schultz (2005) discuss the process of hiring underwriters that was prevalent before the Act was passed. Typically, a firm approaches a lead underwriter based on the latter's reputation, research support, industry knowledge, prior relationships with the firm, and other factors. Competition among underwriters can be fierce for large IPOs because of the potential to earn higher fees. If there is a competition to be lead underwriter, some underwriters may become co-managers because their share distribution system complements that of the lead. Lead underwriters may advise the firm on including co-managers.

Before the Act, firms could not solicit indications of interest from institutional investors without filing an initial prospectus (typically S-1) which included, among other things, details about the firm going public including sensitive information that could be useful to competitors, the expected proceeds from the IPO, and the names of the underwriters of the IPO at the time. The underwriters listed in the initial prospectus play a crucial role in backing the firm-specific information and amount of capital that the firm hopes to raise from the IPO. After the initial prospectus is filed, the firm is permitted to solicit indications of interest from investors. This ex ante disclosure of the underwriting syndicate prior to bookbuilding is not ideal as it could be the case that there are more underwriters than required and, as stated earlier, book managers do not particularly like to include co-managers. The potentially inflated underwriting syndicate also results in exaggerating the importance of underwriter networks (i.e., connections between underwriters because of their joint involvement in raising capital).

By contrast, after the Act, underwriter hiring should be more efficient thus placing less importance on underwriter networks. Consider a firm that approaches a prospective lead underwriter (a.k.a., book manager) to take it public and discloses to the underwriter information about the firm including the amount it would like to raise from the IPO. The choice of lead could be based on several factors including past involvement such as the same underwriter having raised money for the firm in a debt offering. With the ability to "test-the-waters" prior to disclosure, the underwriter approaches its institutional investors to gauge the demand for the firm's shares.[4] If demand

[4]Dambra et al. (2015, Table 8 Panel A) find that more than two-thirds of firms take advantage of "testing-the-waters" and 90 percent of firms choose to file their initial regis-

is good and the underwriter is well equipped to accept a significant part of the underwriting risk then, theoretically at least, there is no need to approach another underwriter to take on the role of joint book manager or co-manager. IPOs typically involve non-managing underwriters and these underwriters could be chosen to absorb the remaining shares that the lead does not wish to underwrite. This arrangement would suit the lead underwriter well as non-managing underwriters are less likely to be a threat in future offerings as they play a much smaller role.

If, on the other hand, the lead underwriter approached by the firm is unable to underwrite a significant portion of the offering then another underwriter is approached who then proceeds to contact its set of institutional investors to gauge demand. This second underwriter could complement (or even replace) the first underwriter to ensure that a large portion of the offering is underwritten with non-managing underwriters being invited to commit to the remaining shares. If two managers are not sufficient, a third could be invited and this process continues with the managing underwriters committing to a large portion of the offering and the non-managing underwriters appointed to underwrite the remaining shares. Once the underwriting team is in place and the firm and underwriters are reasonably confident about the prospects of the IPO the firm proceeds to file an initial prospectus with the SEC disclosing information about the firm, expected proceeds, and underwriters for the first time. The post-Act environment allows for greater efficiency in underwriter hiring which should lower underwriter centrality.

To illustrate the impact of the Act on underwriter networks, consider the two IPOs in Appendix A. Both firms would have been eligible for the benefits of the Act, based on revenues (see definition of "EGC" in Appendix B). However, LinkedIn Corporation filed its first S-1 on January 27, 2011, before the Act. So, it would not be eligible to "test-the-waters" prior to this filing to gauge institutional investor interest.[5] The S-1 clearly shows the names of five underwriters although the number of shares that they were expected to underwrite is not revealed. Thus, LinkedIn chose five underwriters before obtaining indications of interest from institutional investors.

Next, consider the first S-1 filed by Twitter Incorporation on October 3, 2013, after the Act. The Act permitted Twitter to gauge investor interest

tration statements confidentially with the SEC.

[5]LinkedIn went public on May 18, 2011.

prior to filing the S-1. If the IPO did not attract investor interest then the firm could have abandoned its IPO and not have to file an S-1. Twitter's S-1 reveals seven underwriters. It is not unreasonable to expect that the ability to "test-the-waters" before filing the S-1 would result in greater efficiency in underwriter hiring. All seven underwriters are also listed in the final IPO prospectus, the first five as book managers and the remaining two as co-managers. The same applies to LinkedIn where all five underwriters are also listed in the final IPO prospectus, the first three as book managers and the remaining two as co-managers. While both LinkedIn and Twitter, major social media platforms, were very likely well-known to prospective investors before they went public, this may not be the case for most IPOs.

3. Underwriter centrality measures

3.1. Degree centrality

Adapting the Social Network Analysis (SNA) literature to IPO underwriters, the degree is simply the number of other underwriters that a given underwriter is connected to (Freeman, 1978).[6] Assume Y is the adjacency matrix of a binary network, then $Y_{ij} = 1$ if there is a connection from underwriter i to underwriter j and $Y_{ij} = 0$ if there is no connection from underwriter i to underwriter j. Since the degree depends on the size of the network, it must be standardized (i.e., divided by N-1, where N is the number of underwriters in the network).

$$Degree_i = \frac{1}{N-1} \sum_{j=1}^{n} Y_{ij} \tag{1}$$

3.2. Betweenness centrality

Betweenness centrality (Brandes, 2008; Freeman, 1977) reflects the fact that an important underwriter helps to connect other underwriters. Betweenness of an underwriter is the number of shortest paths among all other underwriters that pass through a given underwriter. When two underwriters are connected to each other by more than one shortest path, then each path is considered proportionally. Underwriters with high betweenness centrality

[6]Grund (2015, Chapter 14) discusses the four centrality measures and associated Stata code used in this paper.

matter a lot for the connections between other underwriters. They have a big influence on whatever is transferred through a network.

$$Betweenness_i = \frac{1}{\frac{(N-1)(N-2)}{2}} \sum_{s \neq i \neq t} \frac{\sigma_{st}(i)}{\sigma_{st}} \tag{2}$$

where σ_{st} is the total number of shortest paths from underwriter s to underwriter t and $\sigma_{st}(i)$ is the number of those paths that pass through underwriter i. To standardize, divide by (N-1)(N-2) $\div$ 2.

3.3. Closeness centrality

This measure is based on the distance between underwriters. An underwriter with high closeness centrality is close to other underwriters (i.e., it can reach other underwriters in only a few steps). By contrast, an underwriter with low closeness centrality is far away from other underwriters. Let d(i,j) be the shortest distance between underwriters i and j. Multiplying by N-1 provides the standardized value.

$$Closeness_i = (N-1) \sum_{j \neq j \in V} d(i,j) \tag{3}$$

3.4. Eigenvector centrality

As discussed in Bajo et al. (2016), a limitation of Degree is that an underwriter may be well connected to other underwriters but those underwriters themselves may not be well connected to other underwriters. Eigenvector centrality overcomes this limitation by examining the relative importance of the underwriter/s that a given underwriter is connected to. Thus, an underwriter who is connected to more central underwriters will have a higher eigenvector score.

$$Eigenvector_i = \frac{1}{\lambda} \sum t \in M(i)C(t) \tag{4}$$

where $M(i)$ is the set of network neighbours of underwriter i, $C(t)$ is the eigenvector centrality of the other nodes, and λ is a constant. Note that eigenvector centrality is only defined for connected networks. As a result, it does not exist for an underwriter that is not connected to any other underwriter. For example, assume that there is only one underwriter (say Underwriter A) on one or several IPOs and Underwriter A does not underwrite jointly with at least one other underwriter on a different IPO during the eigenvector centrality computation period. In this case, eigenvector centrality is not defined for Underwriter A for that period.

3.5. Implications of the JOBS Act

If the Act has resulted in a more efficient and possibly smaller underwriting syndicate, then there is less opportunity for a given underwriter to be connected to other underwriters which will result in a smaller network. As a result, Degree should reduce. The smaller network will also mean that there is less opportunity to connect other underwriters, hence Betweenness should be lower. Closeness will also reduce as more steps are required to reach other underwriters. Finally, the smaller network implies that a given underwriter is less likely to be connected to another underwriter who is well connected and so Eigenvector will be lower. On the other hand, the greater information asymmetry following the Act should result in a larger underwriter syndicate and thus greater underwriter centrality. As a consequence, Degree, Betweenness, Closeness, and Eigenvector centrality should be greater after the Act.

4. Data description and identification strategy

4.1. Sample

To examine the impact of the 2012 JOBS Act on underwriter centrality, I obtain a sample of completed US IPOs from Thomson ONE for the period 2001 to 2019. I keep only firm-commitment offerings of common shares and exclude real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. I also exclude IPOs with a launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 (i.e., when the Act came into force). Consistent with Chaplinsky et al. (2017, Appendix B), I do not consider firms with issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive) as these firms retroactively qualified for EGC status. Note, however, that although the IPOs associated with the above periods are excluded from the final sample because of their close proximity to the date the Act came into force, they are included in all underwriter-related computations including centrality measures, market share, and number count (including shares underwritten).

Stock return data is obtained from Center for Research in Security Prices (CRSP) and accounting information is obtained from Compustat. More specifically, the CRSPSift interface (including the CRSP/Compustat Merged Database) is used to obtain the data. Common shares are represented by share codes 10 and 11 in CRSP.

The focus of the paper is on managing underwriters, so I only include book managers (Thomson ONE underwriter role code BM), joint book managers (JB), joint-lead managers (JL), and co-managers (CM) to compute the underwriter centrality measures. Thomson ONE has two other underwriter classifications: global lead (GL) and syndicate member (SD). Global lead is prevalent when international offerings are involved and, in such cases, the underwriter is either already classified as the book manager or joint book manager. Syndicate members are essentially non-managing underwriters and are only included in this study to compute the proportions of book managers and co-managers (including shares). Thomson ONE only has data on the final list of IPO underwriters and all underwriter-related variables used in this study are based on this list. An implicit assumption is that, at least as far as the managing underwriters are concerned, those listed in the S-1 are essentially the same as the ones in the final prospectus, as was the case for the two examples in Appendix A. This assumption is important because the final prospectus is filed after the bookbuilding process has been completed. If more underwriters are added after the initial S-1 filing, then they are more likely to be non-managing underwriters. Several underwriter mergers occur during the sample period. In such cases, the merged underwriting firm takes on a new life for the purpose of computing the underwriter's centrality measure and market share.

4.2. Identification strategy

I have argued that greater information asymmetry is likely to result in larger underwriter syndicates and thus greater underwriter centrality. However, fear of competition suggests smaller syndicates and lower centrality. The 2012 JOBS Act has elements of both and my intention is to examine which effect dominates. As mentioned in Section 4.1, I only include managing underwriters as they are the most important members of the underwriting syndicate and thus play a crucial role in reducing information asymmetry while at the same time pose a competitive threat to each other.

At the core of this paper, the dependent variable is the relevant underwriter centrality measure; Degree, Betweenness, Closeness, and Eigenvector. Using a difference-in-differences framework, I regress each measure on an EGC indicator that equals one for issuers with less than $1 billion in pre-IPO annual revenue before April 12, 2017 and less than $1.07 billion (the inflation-adjusted amount) in pre-IPO annual revenue from April 12, 2017 until the end of the sample period and zero otherwise, a post-JOBS Act

indicator that equals one if the IPO occurred after April 5, 2012 and zero otherwise, and an interaction variable of the two which is the variable of interest.[7] This interaction variable between the EGC and post-JOBS Act indicators captures the differential post-Act change in EGCs relative to the control group of non-EGCs. Because this coefficient isolates the changes in EGC behavior while controlling for changes in other firms, it identifies the post-Act change in EGC outcomes after accounting for any broad market changes that do not specifically target EGCs. The difference-in-differences framework helps to control for unobservable time and group characteristics that confound the effect of the treatment on the outcome variable. Specifically, I estimate the following equation:

$$\begin{aligned} &\textit{Underwriter centrality measure}_i \textit{ (i.e., Degree, Betweenness, Closeness, Eigenvector)} \\ &\quad = \beta_0 + \beta_1 EGC_i + \beta_2 Post - JOBS_i + \beta_3 Post - JOBS_i \times EGC_i \\ &\qquad + \textit{Industry FEs} + \textit{Year FEs} + \textit{Controls} + \epsilon_i. \end{aligned} \quad (5)$$

I control for observable differences in firm, IPO, and market characteristics and include industry and year (based on IPO issue date) fixed effects. For the industry fixed effects, I use the Fama-French 17 industry classifications and create an additional industry for biotechnology if the Global Industry Classification Standard (GICS) equals 352010. Thus, I use 18 industry classifications in total. Dambra et al. (2015) find that biotechnology and pharmaceutical firms benefit from the Act, especially because of the "testing-the-waters" provision due to high proprietary disclosure costs. All variable definitions are in Appendix B.

4.3. Underwriter centrality mean upto 5 years prior

Each IPO has at least one managing underwriter. For each managing underwriter involved in an IPO, each of the four centrality measures is calculated for up to five calendar years prior to the year of the IPO. For example, for a 2010 IPO and assuming centrality is measured one year before the IPO, each managing underwriter's Degree is calculated based on the same underwriter's connections during 2009. If the same underwriter does not manage a single 2009 IPO, then it is not considered for the 2010 IPO. Using the

[7]Note that, technically, "EGC" refers to only firms after the Act that satisfy the revenue criterion but, in my study, the treatment variable, EGC, refers to all firms that satisfy the revenue criterion, including firms that went public before the Act.

same 2010 IPO, a 5-year prior period would involve calendar years 2005-09 to compute Degree. For the surviving underwriters on the 2010 IPO, the average Degree is taken and that value represents Degree for that IPO. The same procedure applies to each IPO and the other three centrality measures.

Table 1 shows the mean of the four centrality measures calculated from one year to five years before the IPO, indicated in the respective column. The results show that the average Degree is 0.41 when measured upto three years prior and marginally rises to 0.43 for 4- and 5-years prior. Average Betweenness and Eigenvector are 0.05 and 0.14 respectively for upto five years prior. Average Closeness only varies between 0.54 and 0.56. Essentially, this implies that, at the firm level, the underwriter centrality measures are fairly stable for upto five years.

4.4. Mean comparison for EGC and non-EGC firms pre- and post-JOBS Act

The t-test of difference in means of variables for the sample based on the 1-year prior centrality measure are in Table 2. The pre- and post-Act periods are compared separately for EGC and non-EGC firms. The underwriter centrality measures are mostly higher for non-EGC firms as compared to EGC firms. For both EGC and non-EGC firms, Degree and Closeness are significantly higher and Eigenvector significantly lower in the post-Act period as compared to the pre-Act period. There is no significant difference in Betweenness for EGC firms but it is significantly lower for non-EGC firms in the post-Act period.

Note that the centrality measure means are higher than those in Chuluun (2015) and Bajo et al. (2016). One possible reason is that the sample period in those papers begin in 1970 and 1980 respectively while my sample period begins in 2001. Corwin and Schultz (2005) show that the average numbers of book managers and co-managers per issue increased every year between 1997 and 2002. The average number of book managers and co-managers per issue in my sample (from 2002 to 2019) is 5.79 (not tabulated) which is higher than that reported by Corwin and Schultz (2005, Table 1 Panel A) (which is 3.05 by adding the average numbers of book managers and co-managers per issue). Given a relatively stable population of underwriters, as the number of book managers and co-managers per issue increases, underwriters become more connected and centrality should increase.

To correspond with the underwriter centrality measures, underwriter market share is also calculated for 1-5 years prior to the year of the IPO. Using the 1-year prior measure, average underwriter market share in the post-Act

period is significantly lower for both EGC (2.5 percent) and non-EGC firms (3 percent) as compared to the pre-Act period. 61 percent of EGC firms are VC-backed post-Act versus 51 percent pre-Act. Less than eight percent of non-EGC firms are VC-backed. Interestingly, the reverse is true for private equity with very high percentages of non-EGC firms having private equity backing as compared to EGC firms. For the EGC cohort, post-Act IPO firms are significantly younger in age as compared to pre-Act IPO firms (13 versus 19 years). Non-EGC firms are much older with an average age of at least 45 years.

Post-Act EGC IPOs raise significantly more in IPO proceeds (162 million dollars), have higher assets (478 million dollars), and have lower leverage (22 percent) as compared to pre-Act EGC IPOs. The respective numbers are much larger for non-EGC firms although the difference is not significant between pre- and post-Act IPOs. Return on assets is negative, on average, for EGC IPOs and significantly lower post-Act. Also, 72 percent of EGC firms are unprofitable post-Act as compared to 48 percent pre-Act. For non-EGC firms, return on assets is positive, on average, and fewer firms are unprofitable. As per Dambra et al. (2015, Table 8 Panel B), "testing-the-waters" is significantly higher for firms with research and development expenditure. For the EGC cohort, post-Act IPOs have significantly greater research and development expenditures as a percentage of assets (40 percent) as compared to pre-Act IPOs (22 percent). By contrast, the non-EGC cohort has comparatively smaller research and development expenditures (less than 2 percent). Finally, post-Act IPO firms are likely to go public when market conditions are less favourable compared to pre-Act IPOs and this applies to both EGC and non-EGC firms.

5. Difference-in-differences for 1-year centrality

5.1. Base model

In Table 3, each of the four centrality measures is the dependent variable and the variable of interest is the interaction term EGC $\times$ Post-JOBS and t-statistics are reported in parentheses using White (1980) robust standard errors. The interaction term is highly negatively significant for Degree, Closeness, and Eigenvector (at the 1 percent level) indicating that underwriter centrality has reduced for EGC firms after the passing of the Act. The point estimates suggest that the interaction term eliminates much of the increased centrality for EGC firms. For example, in the case of Degree,

the coefficient of EGC is +0.0339 while that of EGC × Post-JOBS is -0.0389, so the positive effect of EGC firms is essentially eliminated after the passing of the Act. The same holds true for Closeness and Eigenvector, although to a lesser extent.[8] Focusing on the Degree regression, the difference in predicted values for EGC and non-EGC firms before the Act is .0339 while that after the Act is -.005. Thus, there has been a reduction in degree of -.0389 (with a 95 percent confidence interval between -.0563 and -.0214) following the Act. These findings are consistent with the argument that underwriters prefer not to collaborate and the Act has made underwriter hiring efficient by permitting indications of interest to be solicited before filing a prospectus.

The interaction term in the Betweenness regression, however, is insignificant. The coefficients of some of the independent variables in this regression have opposite signs or are insignificant as compared to those for the other three measures. For example, the natural logarithm of the proceeds raised in the IPO has a significant negative sign indicating that Betweenness is lower when IPO proceeds are higher. By contrast, this variable is significantly positive for the other three measures. Betweenness is associated with an underwriter that helps to connect other underwriters. Apparently, the ability to connect other underwriters is less important for a large IPO. Also, venture capital backing (+), research and development expenditure as a proportion of assets (+), return on assets (+), and the pre-IPO market return (-) are highly significant for the other three measures but are insignificant for Betweenness. Thus, Betweenness seems to be different from the other three centrality measures. Regarding the other control variables, IPO firms with greater underwriter market share have greater underwriter centrality. Greater leverage and private equity backing result in higher Eigenvector centrality. However, leverage is negatively correlated with Betweenness. Finally, firm assets are positively correlated with Degree and Closeness. The adjusted R-square is at least 78 percent in three of the four models (the exception being Betweenness).

5.2. PERIOD = 0, 1, 2

Since the underwriter centrality measures are calculated using data from the previous calendar year, I account for the fact that post-Act IPOs from

[8]The interaction term for these three measures continues to be negatively significant if standard errors are clustered only on industry and both industry and IPO year.

2012 use centrality measures from 2011 (i.e., before the Act). Bajo et al. (2016, Section 6.8) encounter a similar issue with respect to the repeal of the Glass-Steagall Act which occurred in 1999. Since their centrality measures are captured five calendar years prior to the IPO year, they define a variable, GS (Glass-Steagall), which takes values of 0 for IPOs upto 1999, 1 for IPOs from 2000 to 2004 (reflecting the fact that at least part of the centrality measurement period occurs before GS), and 2 for IPOs from 2005 onwards (the entire centrality measurement period occurs after GS as the 2000-04 period would be used to compute centrality). Thus, the "clean" periods before and after GS takes values of 0 and 2 respectively while the "overlapping" period takes a value of 1. In a similar vein and consistent with my centrality measure, I create a new continuous variable, PERIOD, that takes a value of 0 for IPOs upto 2011, 1 for IPOs in 2012 (since, as stated earlier, I only include 2012 IPOs that went public after April 5, 2012 and, therefore, the centrality measure would be captured for 2011 IPOs (i.e., prior to the Act)), and 2 for IPOs from 2013 onwards.

The results of the interaction term, EGC $\times$ PERIOD, can be seen in Table 5 Panel A. The regression also includes the individual components of the interaction term and the same control variables from Table 3 including industry and year fixed effects. t-statistics are reported in parentheses using White (1980) robust standard errors. The interaction term continues to be highly negatively significant (at the 1 percent level) for Degree, Closeness, and Eigenvector, and insignificant for Betweenness.

5.3. Propensity score matching

It is possible that factors unrelated to the Act affect the coefficients of interest. Therefore, in order to rule out this possibility, I use propensity score matching (PSM) by making pre- and post-Act IPOs similar across several factors. This mitigates the concern that, instead of the Act, differences between pre- and post-Act issuers affect underwriter centrality. Because EGC and non-EGC firms are fundamentally different by definition (i.e., EGC firms have lower revenues than non-EGC firms), it is appropriate to perform the matching for each cohort separately. Thus, as in Dambra et al. (2018), I match EGC firms post-Act with EGC firms pre-Act and non-EGC firms post-Act with non-EGC firms pre-Act.

The matching is done using a logit regression that predicts the probability of the IPO occurring in the post-Act period. Somewhat similar to Dambra et al. (2018, Table 3), the independent variables are Ln(Assets), Ln(1+Age),

Leverage, Return on assets, Unprofitable, RD/Assets, Ln(Proceeds), Venture Capital, Private Equity, and the 18 industry dummies described earlier. I use nearest neighbor matching without replacement to match each EGC (non-EGC) post-Act IPO with a single EGC (non-EGC) pre-Act IPO in the same industry based on the propensity score obtained from the logit regression using a caliper of 0.2.[9] This process results in pre- and post-Act issuers that are similar across the above factors and minimizes the possibility that factors other than the Act influence underwriter centrality.

In Table 4, I present the t-test of difference in means for the matched variables pre- and post-Act for the EGC and non-EGC cohorts. The EGC cohort has 450 firms each pre- and post-Act thus resulting in a total of 900 firms while the non-EGC cohort has 49 firms each pre- and post-Act thus resulting in a total of 98 firms. The lack of significance as evidenced by the absence of significance stars for any of the variables indicates that, at least as far as these factors are concerned, there are no significant differences thus making it highly likely that the effect on centrality is primarily due to the Act.

While all the independent variables shown in Table 3 are included in the regression, Table 5 Panel B only shows the results of the interaction term EGC $\times$ Post-JOBS. Note that the sample size is 998 (the sum of 900 and 98 from Table 4). Consistent with earlier results, the interaction term is highly negatively significant (at the 1 percent level) in the Degree, Closeness, and Eigenvector regressions but insignificant for Betweenness. As was the case for Table 3, the point estimates suggest that the interaction term eliminates much of the increased centrality for EGC firms. For Degree, the coefficient of EGC is +.0394 (unreported) while that of EGC $\times$ Post-JOBS is -.0486, so the positive effect of EGC firms is more than eliminated after the passing of the Act. For Closeness and Eigenvector, the positive effect is almost entirely eliminated. Focusing on the Degree regression, the difference in predicted values for EGC and non-EGC firms before the Act is .0394 while that after the Act is -.0092. Thus, there has been a reduction in degree of -.0486 (with a 95 percent confidence interval between -.0667 and -.0305) following the Act. This is further evidence that underwriter centrality has reduced for EGC firms after the passing of the Act.

[9]Thanks to Thorsten Doherr for the -ultimatch- command in Stata.

6. Measuring underwriter centrality over 2- to 5-years

Recall from Table 1 that the means of the centrality measures are fairly stable across periods. Thus, a 1-year measure should be almost indistinguishable from a 5-year measure. Nevertheless, Bajo et al. (2016) and Chuluun (2015) measure underwriter centrality over 5- and 4-years respectively. So, as a robustness check, I rerun my regressions after measuring centrality for periods of 2-, 3-, 4-, and 5-years before the year of the IPO. Note that the same control variables and industry and year fixed effects used in Table 3 are included in all three specifications below, although only the result of the interaction term, the variable of interest, is displayed and t-statistics are reported in parentheses using White (1980) robust standard errors.

6.1. Base model

Focusing first on the base model, the interaction term EGC × Post-JOBS is highly negatively significant for Degree, Closeness, and Eigenvector at the 1 percent level upto and including the 4-year measure and at the 5 percent level for the 5-year measure while Betweenness continues to be insignificant (see Table 6). Note that the sample size drops as the centrality measurement period increases. For example, for the 5-year centrality measure, the sample period used for estimation can only begin in 2006 as the previous five years (i.e., 2001-05) would be used to compute the measure. Thus, the sample size for the 5-year measure would be smaller than, for example, the sample size for the 2-year measure as the IPO sample for the latter would begin in 2003 (to capture the prior two calendar years, 2001 and 2002).

6.2. PERIOD = 0, 1, 2

Similar to the procedure for the 1-year measure examined in Table 5 Panel A, the variable, PERIOD, equals 1 if the IPO occurs after the Act but the centrality measure period (or part thereof) strays into the pre-Act period. For example, for an IPO in 2013 and assuming the 5-year measure, centrality would be captured based on the period 2008-12 and PERIOD would take a value of 1 since both the pre- and post-Act periods are included in the measure. The results can be seen in Table 7. For Degree, Closeness, and Eigenvector, the interaction term is negatively significant at the 5 percent level or better for the 2- to 4-year centrality measures and at the 10 percent level or better for the 5-year measure. Betweenness remains insignificant.

6.3. Propensity score matching

As a further robustness check, I use propensity score matching for centrality measured over 2- to 5-years. I use the same matching procedure described in Section 5.3 including matching variables and caliper. Similar to Table 4, I conduct a t-test of difference in means for the matched variables for EGC and non-EGC firms. My unreported findings reveal that none of the matched variables for both cohorts are significantly different from each other at the 10 percent level or better for any of the four periods. The sample size is contingent on both the centrality measurement period and the ability to find a suitable match.

In Table 8, the interaction term is negatively significant (at the 5 percent level or better) for Degree, Closeness, and Eigenvector, and insignificant for Betweenness. To conclude, after using three different specifications and for centrality measurement periods upto 5 years, I continue to find strong evidence that underwriter centrality has reduced following the Act.[10]

7. Book managers, co-managers, and gross spread

The results thus far indicate that the Act has reduced the centrality of the managing underwriters of the syndicate, thereby reflecting reduced collaboration among underwriters possibly resulting from the efficiency in underwriter hiring as a result of the ability to solicit investors before filing a prospectus. Since the managing underwriters are sub-classified as book managers or co-managers it is particularly interesting to examine how the Act has affected their presence on the underwriting syndicate both in terms of numbers and shares since, as stated earlier, book managers typically do not like including co-managers. Specifically, I examine the proportions of book managers and co-managers relative to the entire underwriting syndicate and the proportions of shares underwritten by both cohorts relative to all shares underwritten by the entire syndicate. If co-managers are likely to pose a threat to book managers in future offerings as posited by (Corwin & Schultz, 2005), then it is reasonable to expect that book managers would prefer fewer co-managers. The efficiency associated with managing underwriter hiring after the Act could also influence compensation by way of the gross

[10]I tried winsorizing the four centrality measures at the 99 percent level, and leverage, return on assets, RD/Assets, and Buy-and-hold return (EW) at the one percent and 99 percent levels. The results are qualitatively similar.

spread. The non-managing underwriters in the syndicate play a relatively less important role in the IPO.

To test these conjectures, I next examine the impact of the Act on the proportions of book managers and co-managers (including shares underwritten) and the gross spread. Some of these variables have missing data and a few observations from the original sample are dropped as a result. For the remaining observations, I essentially re-create a matched sample using the same procedure described in Section 5.3 based on the sample used for the 1-year centrality measure since it has the largest sample size as compared to the other centrality measurement periods. Somewhat consistent with Corwin and Schultz (2005, Table 2), I include control variables for underwriter market share, venture capital dummy, natural logarithm of and actual IPO proceeds (latter scaled down to 1 percent), a dummy that equals one if the IPO shares are listed on the New York Stock Exchange (or any of its variants (e.g., NYSE Arca)) or American Stock Exchange and zero otherwise, and standard deviation of stock returns following the IPO. I also include the matched variables as regressors and the industry and year fixed effects described earlier. I use a generalized linear model (GLM) with a logit link as the dependent variables are all proportions.

The variable of interest is the interaction term EGC $\times$ Post-JOBS. In Table 9, the dependent variable in the first column is the proportion of IPO book managers. The interaction variable is positive but not significant at conventional levels indicating that after the passing of the Act the proportion of book managers has not significantly changed. In the second column, the dependent variable is the share proportion of book managers. The interaction term is positive but marginally insignificant (at the 10 percent level). The difference in predicted values for EGC and non-EGC firms before the Act is -.0187 while that after the Act is .02489. Thus, there has been an increase in the proportion of book manager shares of .0436 (with a 95 percent confidence interval between -.0129 and .1001) following the Act.

In Column 3, the coefficient on the interaction term is negatively significant (at the 10 percent level). The difference in predicted values for EGC and non-EGC firms before the Act is -.0101 while that after the Act is -.0765. Thus, there has been a reduction in the proportion of book managers of -.0664 (with a 95 percent confidence interval between -.1434 and .0106) following the Act. Furthermore, in the fourth column, the interaction term is negatively significant (at the 10 percent level). The difference in predicted values for EGC and non-EGC firms before the Act is .0182 while that after

the Act is -.0299. Thus, there has been a reduction in the proportion of book manager shares of -.0481 (with a 95 percent confidence interval between -.1058 and .0097) following the Act. Co-managers have experienced a drop both in relative numbers and shares after the Act. This is clear evidence that underwriter hiring efficiency after the Act has resulted in a co-manager squeeze, possibly stemming from the fact that book managers do not like including co-managers. Finally, the dependent variable in the final column is the gross spread. The interaction term is positive but insignificant indicating no significant change in the gross spread after the Act.

As regards the main control variables, a greater underwriter market share results in a greater proportion of book managers and book manager shares and the opposite for co-managers and co-manager shares. Larger (in terms of proceeds raised) IPOs have a smaller proportion of book managers and a larger proportion of co-managers. Venture capital-backed firms have a smaller proportion of book manager shares, a larger proportion of co-managers and co-manager shares, and a higher gross spread.[11]

8. Book manager choice in Seasoned Equity Offering

Corwin and Schultz (2005) find that a co-manager in an IPO is likely to become a book manager in the SEO. The results in Table 9 show that the proportion of co-managers has significantly reduced for EGC IPOs after the Act which could mean that co-managers are less likely to become book managers in the SEO. However, if the co-managers have sufficient power, they could exert that power in order to be appointed as book managers in the SEO. To examine this possibility, for my IPO sample, I consider the first SEO after the IPO between 2002 and 2019. Consistent with previous studies, book managers are represented by the Thomson ONE underwriter role code BM and joint book managers (JB) while co-managers are represented by joint-lead managers (JL) and co-managers (CM). I run a probit model where the dependent variable equals one if the underwriter is chosen as a book manager for the SEO, and zero otherwise. As in Corwin and Schultz (2005), each observation for each SEO contains each underwriter that is included in at least one IPO or SEO during the sample period. All variables are defined

[11] As in Corwin and Schultz (2005, Table 7), I tried including the number of co-managers as an independent variable in the gross spread regression. This variable has a negative but insignificant sign and EGC $\times$ Post-JOBS remains insignificant.

in Appendix B. I include year fixed effects and standard errors are clustered at the firm level.

A book manager in an IPO is highly likely to become the book manager of the SEO (Table 10 Column 1). Similarly, an IPO co-manager is more likely to become a book manager of the SEO. These findings are consistent with Corwin and Schultz (2005). In Column 2, EGC and Post-JOBS are introduced. The focus of interest is the triple difference-in-differences of EGC $\times$ Post-JOBS $\times$ CM IPO. The coefficient is negative but marginally insignificant (at the 10 percent level) indicating that after the Act an EGC IPO co-manager is less likely to become a book manager in the SEO. The difference in predicted probabilities for EGC and non-EGC firms before the Act when the underwriter is and is not a co-manager in the IPO is .0402 while that after the Act is -.0092. Thus, there has been a reduction of -4.94 percent in the predicted probability of becoming an SEO because of the Act.

In Columns 3 and 4, an additional independent variable, BM change, is included which equals one if a book manager on the IPO is not selected as a SEO book manager. The cohort not affected by the Act (i.e., EGC $\times$ Post-JOBS = 0) and the cohort affected by the Act (i.e., EGC $\times$ Post-JOBS = 1) are examined separately in Columns 3 and 4 respectively. The interest is now on the interaction term, CM IPO $\times$ BM change. For the cohort not affected by the Act, the coefficient is highly positively significant (at the 1 percent level) indicating that an IPO co-manager is likely to become a book manager in the SEO if there is a change in book manager. This finding is consistent with that in Corwin and Schultz (2005, Table 8). The difference in predicted probabilities when the underwriter is and is not a co-manager in the IPO and there is no book manager change is .0484 while that when there is a book manager change is .06. So, there has been an increase in the predicted probability of becoming an SEO of 1.16 percent.

However, after the Act, the coefficient is negative but insignificant. The difference in predicted probabilities when the underwriter is and is not a co-manager in the IPO and there is no book manager change is .055 while that when there is a book manager change is .029. So, there has been a reduction in the predicted probability of becoming an SEO of -2.6 percent. Similar to the findings in Column 2, this is more evidence that book managers are less threatened by co-managers becoming book managers in the SEO after the Act. In terms of the control variables, higher SEO underwriter market share increases the probability of becoming the book manager of the SEO. There is some evidence that the higher the natural logarithm of SEO proceeds, the

lower the likelihood of becoming the book manager of the SEO.

9. Conclusion

The 2012 JOBS Act has resulted in greater information asymmetry for emerging growth companies (EGCs) following the Act which greater underwriter centrality should help to counter. The counter argument is that underwriters do not like competition as other underwriters could steal their business and the Act has made underwriter hiring more efficient. As a consequence, underwriter centrality should be lower after the Act. Which effect dominates? Using a difference-in-differences framework, I examine the impact of the Act on underwriter network centrality as measured by Degree, Betweenness, Closeness, and Eigenvector. Using a sample of US IPOs from 2001 to 2019 I find that Degree, Closeness, and Eigenvector have reduced following the Act. However, there is no impact on Betweenness. Thus, it appears that the Act has made underwriter hiring more efficient which has resulted in underwriters avoiding unnecessary collaboration. My results are robust to measuring centrality over different periods and using various specifications including propensity score matching. The underwriter centrality measures themselves are fairly stable across periods ranging from one to five years.

While there has been no significant change in the proportion of book managers and proportion of shares underwritten by book managers after the Act, the corresponding proportions for co-managers have reduced. However, there has been no change in the gross spread after the Act. These results suggest that, while the compensation to underwriters has not changed, co-managers are playing a smaller role in syndicates. Finally, my results show that, after the Act, a co-manager on the IPO is less likely to become a book manager in the first SEO. Underwriter competition appears to trump information asymmetry in the determination of underwriter networks.

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Table 1: Mean of Underwriter Centrality measures from 1-year to 5-years prior

	(1)	(2)	(3)	(4)	(5)
Degree	0.41	0.41	0.41	0.43	0.43
Betweenness	0.05	0.05	0.05	0.05	0.05
Closeness	0.54	0.54	0.55	0.55	0.56
Eigenvector	0.14	0.14	0.14	0.14	0.14
Observations	1527	1478	1429	1297	1180

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. Column (1) is based on the 1-year prior underwriter centrality measure, hence only IPOs from 2002 to 2019 are included. Column (2) is based on the 2-years prior underwriter centrality measure, hence only IPOs from 2003 to 2019 are included. Column (3) is based on the 3-years prior underwriter centrality measure, hence only IPOs from 2004 to 2019 are included. Column (4) is based on the 4-years prior underwriter centrality measure, hence only IPOs from 2005 to 2019 are included. Column (5) is based on the 5-years prior underwriter centrality measure, hence only IPOs from 2006 to 2019 are included. Degree, Betweenness, Closeness, and Eigenvector are measures of IPO underwriter (book managers and co-managers only) centrality as described in Section 3. The table shows the means of the four centrality measures.

Table 2: Mean comparison for EGC and non-EGC firms pre- and post-JOBS

	EGC		non-EGC	
	Pre-JOBS	Post-JOBS	Pre-JOBS	Post-JOBS
Degree	0.368	0.436***	0.473	0.513***
Betweenness	0.049	0.047	0.058	0.051**
Closeness	0.510	0.565***	0.565	0.602***
Eigenvector	0.144	0.132***	0.164	0.155***
Market share	0.029	0.025***	0.039	0.030***
Venture Capital	0.514	0.611***	0.029	0.078
Private Equity	0.303	0.179***	0.586	0.733**
Age	18.584	13.055***	45.529	48.044
Proceeds	121.084	162.369***	1006.115	800.804
Assets	313.750	478.495***	6430.082	12075.675
Leverage	0.263	0.224*	0.442	0.497
Return on assets	-0.235	-0.570***	0.037	0.016
Unprofitable	0.475	0.720***	0.286	0.344
RD/Assets	0.215	0.401***	0.012	0.015
Buy-and-hold return (EW)	0.056	0.031***	0.066	0.045**
Observations	1367		160	

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. The sample used in this table is based on the 1-year prior underwriter centrality measure, hence only IPOs from 2002 to 2019 are included. There are 1367 Emerging Growth Company (EGC) firms of which 673 occur Pre-JOBS and 694 Post-JOBS. There are 160 non-EGC firms of which 70 occur Pre-JOBS and 90 Post-JOBS. Degree, Betweenness, Closeness, and Eigenvector are measures of IPO underwriter (book managers and co-managers only) centrality as described in Section 3. All other variables are defined in Appendix B. The table shows the means of the variables for each sub-group. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively, of difference in means between Pre-JOBS and Post-JOBS for EGC and non-EGC firms.

Table 3: Base model: 1-year centrality

	Degree	Betweenness	Closeness	Eigenvector
EGC	0.0339***	0.000921	0.0222***	0.00948***
	(3.80)	(0.38)	(5.01)	(3.70)
Post-JOBS	0.0408**	-0.00237	-0.0517***	0.00632
	(2.54)	(-0.57)	(-7.66)	(1.22)
EGC × Post-JOBS	-0.0389***	-0.00200	-0.0196***	-0.00901***
	(-4.37)	(-0.75)	(-4.83)	(-3.55)
Market share	7.668***	1.364***	2.888***	2.472***
	(40.29)	(26.80)	(30.79)	(37.78)
Buy-and-hold return (EW)	-0.0859***	-0.0116	-0.0488***	-0.0310***
	(-2.89)	(-1.35)	(-3.49)	(-3.18)
Ln(Assets)	0.00316*	0.0000480	0.00368***	0.000691
	(1.67)	(0.09)	(3.36)	(1.13)
Ln(1+Age)	-0.00162	0.000496	-0.000870	-0.000637
	(-0.73)	(0.78)	(-0.72)	(-0.88)
Leverage	0.00622	-0.00186*	0.00391	0.00292**
	(1.41)	(-1.73)	(1.25)	(2.05)
Return on assets	0.00988***	-0.000881	0.00878***	0.00416***
	(3.33)	(-1.04)	(3.13)	(3.76)
Unprofitable	-0.00285	-0.00150	0.000372	-0.000634
	(-0.77)	(-1.19)	(0.19)	(-0.49)
RD/Assets	0.00886**	-0.00107	0.0104***	0.00381***
	(2.24)	(-1.08)	(3.14)	(2.81)
Ln(Proceeds)	0.0125***	-0.00282***	0.00668***	0.00457***
	(4.26)	(-3.23)	(4.17)	(4.64)
Venture Capital	0.0259***	0.00127	0.0173***	0.0115***
	(4.50)	(0.71)	(4.57)	(6.00)
Private Equity	0.00733	0.000371	0.00293	0.00454***
	(1.39)	(0.24)	(1.09)	(2.69)

Constant	0.103***	0.0357***	0.396***	0.0362***
	(3.89)	(4.14)	(27.32)	(4.14)
Observations	1527	1527	1527	1527
Adjusted R^2	0.807	0.468	0.861	0.780
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. The sample used in this table is based on the 1-year prior underwriter centrality measure, hence only IPOs from 2002 to 2019 are included. The table itself shows the results of OLS regressions. The dependent variables, Degree, Betweenness, Closeness, and Eigenvector are measures of IPO underwriter (book managers and co-managers only) centrality as described in Section 3. All other variables are defined in Appendix B. The regressions include industry and year fixed effects. t-statistics using White (1980) robust standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

Table 4: Mean comparison for EGC and non-EGC firms pre- and post-JOBS (Matched sample)

	EGC		non-EGC	
	Pre-JOBS	Post-JOBS	Pre-JOBS	Post-JOBS
Ln(Assets)	4.688	4.702	7.639	7.775
Ln(1+Age)	2.463	2.469	3.424	3.543
Leverage	0.251	0.274	0.506	0.485
Return on assets	-0.346	-0.422	0.031	0.027
Unprofitable	0.596	0.616	0.245	0.265
RD/Assets	0.274	0.305	0.010	0.013
Ln(Proceeds)	4.495	4.523	5.881	5.987
Venture Capital	0.542	0.547	0.041	0.041
Private Equity	0.253	0.253	0.714	0.714
Observations	900		98	

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. Based on the 1-year prior underwriter centrality measure, only IPOs from 2002 to 2019 are included. Using this sample, a propensity score matched sample is obtained, the procedure for which is described in Section 5.3. After the matching, the EGC cohort has 450 firms each pre- and post-JOBS Act thus resulting in a total of 900 firms while the non-EGC cohort has 49 firms each pre- and post-JOBS Act thus resulting in a total of 98 firms. All variables are defined in Appendix B. The table shows the means of the variables for each sub-group. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively, of difference in means between Pre-JOBS and Post-JOBS for EGC and non-EGC firms.

Table 5: Other specifications: 1-year centrality

	Degree	Betweenness	Closeness	Eigenvector
Panel A: PERIOD = 0, 1, 2				
EGC × PERIOD	-0.0193***	-0.000934	-0.00977***	-0.00448***
	(-4.31)	(-0.70)	(-4.77)	(-3.52)
Observations	1527	1527	1527	1527
Adjusted R^2	0.807	0.468	0.861	0.780
Panel B: Propensity score matching				
EGC × Post-JOBS	-0.0486***	-0.00379	-0.0254***	-0.0112***
	(-5.26)	(-1.34)	(-5.63)	(-4.08)
Observations	998	998	998	998
Adjusted R^2	0.820	0.446	0.858	0.802

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. The sample used in this table is based on the 1-year prior underwriter centrality measure, hence only IPOs from 2002 to 2019 are included. The matching procedure used to obtain the sample in Panel B is described in Section 5.3. The table itself shows the results of OLS regressions. The dependent variables, Degree, Betweenness, Closeness, and Eigenvector are measures of IPO underwriter (book managers and co-managers only) centrality as described in Section 3. All other variables are defined in Appendix B. Although only the results of the interaction term are shown, the regressions include the same independent variables as in Table 3, including industry and year fixed effects, with the exception that PERIOD replaces Post-JOBS in Panel A. t-statistics using White (1980) robust standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

Table 6: Base model: 2-5 year centrality

	Degree	Betweenness	Closeness	Eigenvector
Panel A: 2-year centrality				
EGC × Post-JOBS	-0.0353***	-0.00132	-0.0185***	-0.00783***
	(-3.84)	(-0.49)	(-4.38)	(-3.03)
Observations	1478	1478	1478	1478
Adjusted R^2	0.820	0.471	0.866	0.796
Panel B: 3-year centrality				
EGC × Post-JOBS	-0.0372***	-0.00159	-0.0194***	-0.00842***
	(-4.04)	(-0.57)	(-4.57)	(-3.27)
Observations	1429	1429	1429	1429
Adjusted R^2	0.835	0.479	0.870	0.818
Panel C: 4-year centrality				
EGC × Post-JOBS	-0.0282***	0.000632	-0.0159***	-0.00716***
	(-3.07)	(0.29)	(-3.62)	(-2.73)
Observations	1297	1297	1297	1297
Adjusted R^2	0.861	0.516	0.884	0.830
Panel D: 5-year centrality				
EGC × Post-JOBS	-0.0263**	0.00173	-0.0131**	-0.00658**
	(-2.38)	(0.69)	(-2.55)	(-2.16)
Observations	1180	1180	1180	1180
Adjusted R^2	0.863	0.516	0.880	0.838

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. Panel A is based on the 2-years prior underwriter centrality measure, hence only IPOs from 2003 to 2019 are included. Panel B is based on the 3-years prior underwriter centrality measure, hence only IPOs from 2004 to 2019 are included. Panel C is based on the 4-years prior underwriter centrality measure, hence only IPOs from 2005 to 2019 are included. Panel D is based on the 5-years prior underwriter centrality measure, hence only IPOs from 2006 to 2019 are included. The table itself shows the results of OLS regressions. The dependent variables, Degree, Betweenness, Closeness, and Eigenvector are measures of IPO underwriter (book managers and co-managers only) centrality as described in Section 3. All other variables are defined in Appendix B. Although only the results of the interaction term are shown, the regressions include the same independent variables as in Table 3, including industry and year fixed effects. t-statistics using White (1980) robust standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

Table 7: PERIOD = 0, 1, 2: 2-5 year centrality

	Degree	Betweenness	Closeness	Eigenvector
Panel A: 2-year centrality				
EGC × PERIOD	-0.0189***	0.000416	-0.0100***	-0.00460***
	(-3.98)	(0.29)	(-4.46)	(-3.41)
Observations	1478	1478	1478	1478
Adjusted R^2	0.820	0.471	0.866	0.796
Panel B: 3-year centrality				
EGC × PERIOD	-0.0202***	-0.00200	-0.00977***	-0.00517***
	(-3.87)	(-1.33)	(-4.14)	(-3.52)
Observations	1429	1429	1429	1429
Adjusted R^2	0.835	0.479	0.870	0.818
Panel C: 4-year centrality				
EGC × PERIOD	-0.0131**	-0.000680	-0.00685***	-0.00438***
	(-2.55)	(-0.55)	(-2.79)	(-2.83)
Observations	1297	1297	1297	1297
Adjusted R^2	0.860	0.516	0.884	0.830
Panel D: 5-year centrality				
EGC × PERIOD	-0.0145**	0.000174	-0.00585*	-0.00456**
	(-2.29)	(0.12)	(-1.96)	(-2.53)
Observations	1180	1180	1180	1180
Adjusted R^2	0.863	0.516	0.880	0.838

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. Panel A is based on the 2-years prior underwriter centrality measure, hence only IPOs from 2003 to 2019 are included. Panel B is based on the 3-years prior underwriter centrality measure, hence only IPOs from 2004 to 2019 are included. Panel C is based on the 4-years prior underwriter centrality measure, hence only IPOs from 2005 to 2019 are included. Panel D is based on the 5-years prior underwriter centrality measure, hence only IPOs from 2006 to 2019 are included. The table itself shows the results of OLS regressions. The dependent variables, Degree, Betweenness, Closeness, and Eigenvector are measures of IPO underwriter (book managers and co-managers only) centrality as described in Section 3. All other variables are defined in Appendix B. Although only the results of the interaction term are shown, the regressions include the same independent variables as in Table 3, including industry and year fixed effects, with the exception that PERIOD replaces Post-JOBS. t-statistics using White (1980) robust standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

Table 8: Propensity score matching: 2-5 year centrality

	Degree	Betweenness	Closeness	Eigenvector
Panel A: 2-year centrality				
EGC × Post-JOBS	-0.0389***	-0.000379	-0.0219***	-0.00939***
	(-4.06)	(-0.13)	(-4.51)	(-3.24)
Observations	960	960	960	960
Adjusted R^2	0.824	0.454	0.862	0.812
Panel B: 3-year centrality				
EGC × Post-JOBS	-0.0445***	-0.00182	-0.0238***	-0.00999***
	(-4.60)	(-0.60)	(-4.98)	(-3.43)
Observations	920	920	920	920
Adjusted R^2	0.835	0.471	0.861	0.828
Panel C: 4-year centrality				
EGC × Post-JOBS	-0.0363***	0.000298	-0.0201***	-0.00819***
	(-3.75)	(0.10)	(-4.10)	(-2.82)
Observations	774	774	774	774
Adjusted R^2	0.869	0.524	0.887	0.843
Panel D: 5-year centrality				
EGC × Post-JOBS	-0.0303**	-0.000227	-0.0167***	-0.00691**
	(-2.51)	(-0.07)	(-2.78)	(-1.98)
Observations	632	632	632	632
Adjusted R^2	0.861	0.568	0.883	0.844

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. Panel A is based on the 2-years prior underwriter centrality measure, hence only IPOs from 2003 to 2019 are included. Panel B is based on the 3-years prior underwriter centrality measure, hence only IPOs from 2004 to 2019 are included. Panel C is based on the 4-years prior underwriter centrality measure, hence only IPOs from 2005 to 2019 are included. Panel D is based on the 5-years prior underwriter centrality measure, hence only IPOs from 2006 to 2019 are included. The matching procedure used to obtain the samples in Panels A-D is described in Section 6.3. The table itself shows the results of OLS regressions. The dependent variables, Degree, Betweenness, Closeness, and Eigenvector are measures of IPO underwriter (book managers and co-managers only) centrality as described in Section 3. All other variables are defined in Appendix B. Although only the results of the interaction term are shown, the regressions include the same independent variables as in Table 3, including industry and year fixed effects. t-statistics using White (1980) robust standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

Table 9: Book managers, co-managers and gross spread

	BM prop	BM share prop	CM prop	CM share prop	Gross spread
EGC	0.0331	-0.0814	-0.0442	0.0826	0.0392*
	(0.27)	(-0.77)	(-0.33)	(0.76)	(1.79)
Post-JOBS	1.904***	1.038***	0.654**	-0.711**	-0.0233
	(7.05)	(3.61)	(2.25)	(-2.44)	(-0.64)
EGC × Post-JOBS	0.218	0.265	-0.286*	-0.287*	0.0189
	(1.37)	(1.63)	(-1.67)	(-1.75)	(0.73)
Market share	14.49***	5.756**	-6.996**	-4.891**	0.460
	(5.25)	(2.47)	(-2.43)	(-2.12)	(1.47)
NYSEAMEX	-0.0541	-0.0252	0.0809	0.0357	0.0120
	(-0.86)	(-0.41)	(1.21)	(0.58)	(1.57)
Standard deviation	0.298	1.667	-1.995	-1.765	0.208
	(0.13)	(0.57)	(-0.80)	(-0.60)	(0.57)
.01 x Proceeds	0.00266	0.00604	-0.0118**	-0.00845	-0.0180***
	(0.72)	(0.94)	(-2.55)	(-0.98)	(-3.29)
Ln(Assets)	0.0360	0.0340	-0.0415	-0.0400	-0.0142***
	(1.29)	(1.35)	(-1.39)	(-1.56)	(-4.25)
Ln(1+Age)	-0.0349	-0.0550*	0.00573	0.0485	0.00619
	(-0.88)	(-1.70)	(0.14)	(1.49)	(1.23)
Leverage	-0.0557	-0.0293	0.0822	0.0346	0.00186
	(-0.81)	(-0.47)	(1.18)	(0.55)	(0.21)
Return on assets	-0.0950*	-0.0362	0.0582	0.0389	0.00682
	(-1.80)	(-0.79)	(1.12)	(0.83)	(0.90)
Unprofitable	-0.195***	-0.0879	0.139**	0.0798	-0.0196**
	(-3.00)	(-1.51)	(1.96)	(1.36)	(-2.01)
RD/Assets	-0.0885	-0.0448	0.0712	0.0489	0.00306
	(-1.61)	(-0.97)	(1.32)	(1.02)	(0.38)
Ln(Proceeds)	-0.281***	-0.00346	0.216***	0.00226	-0.0197
	(-5.55)	(-0.07)	(3.89)	(0.04)	(-1.55)

Venture Capital	-0.145	-0.173**	0.162*	0.191**	0.0219**
	(-1.59)	(-2.26)	(1.78)	(2.50)	(2.05)
Private Equity	0.0331	-0.0481	0.0196	0.0722	0.00916
	(0.40)	(-0.67)	(0.23)	(1.02)	(0.96)
Observations	964	964	964	964	964
AIC	965.7	835.5	1012.3	831.5	453.3
BIC	1199.5	1069.3	1246.2	1065.4	687.1
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. Based on the 1-year prior underwriter centrality measure, only IPOs from 2002 to 2019 are included. Using this sample, a propensity score matched sample described in Section 7 is obtained. All variables are defined in Appendix B. The regressions include industry and year fixed effects. t-statistics using White (1980) robust standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

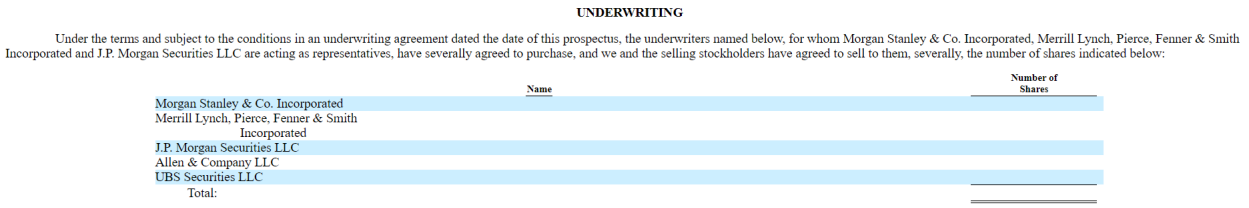
Table 10: Book manager choice in Seasoned Equity Offering

	(1)	(2)	(3)	(4)
BM IPO	2.674***	2.671***	2.972***	2.750***
	(43.95)	(43.60)	(24.13)	(28.44)
CM IPO	1.057***	0.590**	0.929***	1.018***
	(16.75)	(2.05)	(10.95)	(6.99)
Market share SEO	12.59***	12.71***	14.49***	11.74***
	(18.45)	(18.33)	(13.95)	(12.16)
Ln(Proceeds SEO)	-0.0283	-0.0292	-0.0945***	-0.0374
	(-1.61)	(-1.47)	(-3.38)	(-1.54)
Standard deviation	-0.445	-0.364	-3.697	0.430
	(-0.54)	(-0.45)	(-1.49)	(0.60)
EGC		0.0767		
		(0.48)		
Post-JOBS		0.190		
		(0.99)		
EGC × Post-JOBS		-0.160		
		(-0.90)		
EGC × CM IPO		0.541*		
		(1.82)		
Post-JOBS × CM IPO		0.464		
		(1.44)		
EGC × Post-JOBS × CM IPO		-0.562		
		(-1.58)		
BM change			-0.933***	-0.337***
			(-6.81)	(-4.65)
CM IPO × BM change			0.919***	-0.0463
			(4.82)	(-0.19)
Constant	-2.648***	-2.763***	-1.683***	-2.283***
	(-22.31)	(-12.44)	(-4.66)	(-15.86)

Year FE	Yes	Yes	Yes	Yes
Observations	52835	52229	25131	27229
Pseudo R^2	0.554	0.556	0.593	0.549

The full sample consists of completed firm-commitment US IPOs from 2001 to 2019 of common shares (CRSP share codes 10 and 11) and excludes IPOs with launch date (i.e., filing date) before and issue date (i.e., date of going public) after April 5, 2012 and issue dates between November 9, 2011 and April 5, 2012 (both dates inclusive). Also excluded are real estate investment trusts (REITs), American Depositary Receipts (ADRs), units, blank-check companies, leveraged buyouts, closed-end funds, open-end funds, trusts, special-purpose vehicles, and self-underwritten offerings. The sample used in this table consists of firms from the IPO sample whose first SEO occurred from 2002 to 2019. The table itself shows the results of a probit regression model where the dependent variable equals one if the underwriter is chosen as book manager for the SEO, and zero otherwise. As in Corwin and Schultz (2005), each observation for each SEO contains each manager that is included in at least one IPO or SEO during the sample period. The regression includes year fixed effects and standard errors are clustered at the firm level. All variables are defined in Appendix B. ***, **, * indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

Appendix A. Examples of EGC IPO underwriters listed in first S-1 filing before and after JOBS Act

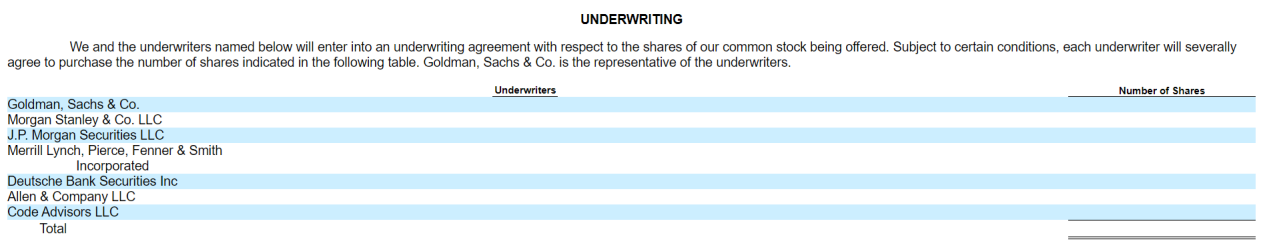


UNDERWRITING

Under the terms and subject to the conditions in an underwriting agreement dated the date of this prospectus, the underwriters named below, for whom Morgan Stanley & Co. Incorporated, Merrill Lynch, Pierce, Fenner & Smith Incorporated and J.P. Morgan Securities LLC are acting as representatives, have severally agreed to purchase, and we and the selling stockholders have agreed to sell to them, severally, the number of shares indicated below:

Name	Number of Shares
Morgan Stanley & Co. Incorporated	
Merrill Lynch, Pierce, Fenner & Smith Incorporated	
J.P. Morgan Securities LLC	
Allen & Company LLC	
UBS Securities LLC	
Total:	

Figure A.1: LinkedIn Corporation - S-1 filing date January 27, 2011 (source: Securities and Exchange Commission (SEC) website)



UNDERWRITING

We and the underwriters named below will enter into an underwriting agreement with respect to the shares of our common stock being offered. Subject to certain conditions, each underwriter will severally agree to purchase the number of shares indicated in the following table. Goldman, Sachs & Co. is the representative of the underwriters.

Underwriters	Number of Shares
Goldman, Sachs & Co.	
Morgan Stanley & Co. LLC	
J.P. Morgan Securities LLC	
Merrill Lynch, Pierce, Fenner & Smith Incorporated	
Deutsche Bank Securities Inc	
Allen & Company LLC	
Code Advisors LLC	
Total	

Figure A.2: Twitter Incorporated - S-1 filing date October 3, 2013 (source: SEC website)

Appendix B. Data definitions

Data obtained from Thomson ONE, unless otherwise stated

Variable name	**Variable definition**
JOBS Act	
EGC	=1 if pre-IPO annual revenue (from Compustat) is less than $1 billion before April 12, 2017 and less than $1.07 billion (the inflation-adjusted amount) from April 12, 2017 until the end of the sample period, 0 otherwise
Post-JOBS	=1 if IPO issue date is after April 5, 2012, 0 otherwise
Pre-JOBS	if IPO issue date is on or before April 5, 2012
PERIOD	=0, 1, or 2 based on the centrality measurement period. For the 1-year centrality measure, it takes a value of 0 for IPOs upto 2011, 1 for IPOs in 2012, and 2 for IPOs from 2013 onwards. For the 2-year centrality measure, it takes a value of 0 for IPOs upto 2011, 1 for IPOs in 2012 and 2013, and 2 for IPOs from 2014 onwards. For the 3-year centrality measure, it takes a value of 0 for IPOs upto 2011, 1 for IPOs from 2012 to 2014, and 2 for IPOs from 2015 onwards. For the 4-year centrality measure, it takes a value of 0 for IPOs upto 2011, 1 for IPOs from 2012 to 2015, and 2 for IPOs from 2016 onwards. For the 5-year centrality measure, it takes a value of 0 for IPOs upto 2011, 1 for IPOs from 2012 to 2016, and 2 for IPOs from 2017 onwards.
Other variables	
Age	Number of years between year the IPO firm was founded (from Professor Jay Ritter's website) and year it went public
Assets	Total assets in fiscal year ending before the IPO in millions of dollars (from Compustat)
BM change	=1 if IPO book manager is not selected as a SEO book manager, 0 otherwise

BM IPO	= 1 if IPO book manager, 0 otherwise
BM prop	Number of book managers divided by total number of underwriters of IPO firm
BM share prop	Number of shares underwritten by book managers divided by total number of shares underwritten by all underwriters of IPO firm
Buy-and-hold return (EW)	CRSP equal-weighted buy-and-hold return for 90 calendar days before the IPO (from CRSP)
CM IPO	= 1 if IPO co-manager, 0 otherwise
CM prop	Number of co-managers divided by total number of underwriters of IPO firm
CM share prop	Number of shares underwritten by co-managers divided by total number of shares underwritten by all underwriters of IPO firm
Gross spread	Underwriting discounts and commissions per share divided by offer price
Leverage	Total long-term debt divided by total assets in fiscal year ending before the IPO (from Compustat)
Market share	Each IPO underwriter's share of IPO proceeds divided by total of all underwriters' proceeds in the t calendar years before the calendar year of the IPO, where t=1, 2, 3, 4, or 5 and corresponds to the same period as the underwriter centrality measure. The average is taken when there is more than one underwriter.
Market share SEO	Each underwriter's market share for IPOs and SEOs in the calendar year prior to the year of the SEO
NYSEAMEX	=1 if the IPO shares are listed on the New York Stock Exchange (or any of its variants (e.g. NYSE Arca) as listed in Thomson ONE or American Stock Exchange, 0 otherwise
Private Equity	=1 if IPO firm is backed by private equity, 0 otherwise
Proceeds	Amount raised in the IPO (excluding overallotment option) in millions of dollars
Proceeds SEO	Amount raised in first SEO after IPO in millions of dollars

RD/Assets	Research and development expenses divided by total assets, zero when missing, in fiscal year ending before the IPO (from Compustat)
Return on assets	Net income divided by total assets in fiscal year ending before the IPO (from Compustat)
Standard deviation	Continuously compounded equal-weighted daily returns from days 21 through 125 after the IPO (from CRSP)
Unprofitable	=1 if Net income is negative, 0 otherwise (from Compustat)
Venture Capital	=1 if IPO firm is backed by venture capitalists, 0 otherwise