The Review of Financial Studies

Market Discipline in the Direct Lending Space

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Using the exclusion of business development companies (BDCs) from stock indexes, this paper studies the effectiveness of market discipline in the direct lending space. Amid share sell-offs by institutional investors, a drop in BDCs' valuations limits their ability to raise new equity capital. Following this funding shock, BDCs do not adjust their capital structure. At the same time, they are reducing the risk exposure of their portfolios. We document a greater reduction in risk for BDCs subject to stronger market discipline from their debtholders. BDCs pass through the capital shock to their portfolio firms by reducing their investment intensity. (*JEL* G23, G32)

Received April 1, 2022; editorial decision August 9, 2023 by Editor Gregor Matvos.

How efficient are market forces in governing financial intermediaries? With the number of unregulated financial intermediaries on the rise, it is important to assess the effectiveness of market discipline as a regulatory tool and, more specifically, to study how a financial intermediary subject to market discipline

We thank Editor Gregor Matvos, the Associate Editor, two anonymous referees, discussants Laura Blattner, Sergey Chernenko, Steven Kaplan, and Evren Ors for their valuable and thorough feedback. We also thank Paul Ehling, Tim Eisert, Christian Eufinger, Chester Spatt, and Adam Winegar, as well as seminar and conference participants at BI Norwegian Business School, Fox Business School, Tepper Business School, Tilburg University, Showcasing Women in Finance (EU), Early-Career Women in Finance Conference (ECWFC), MoFiR Workshop on Banking, NBER Summer Institute, Private Equity Research Virtual Symposium, European Winter Meeting of the Econometric Society, Villanova Webinars in Financial Intermediation, European Winter Finance Conference (EWFC), SFS Cavalcade, Young Scholars Nordic Finance Workshop, SKEMA-ESSEC Finance Workshop, IPC Spring Research Symposium, and European Finance Association Meetings (EFA). Jong Hyun Kim provided excellent research assistance. Financial support from the Young Scholars Interdisciplinary Forum (Temple University), BI Open Research Funds, and the Center for Asset Pricing Research (BI) is gratefully acknowledged. Davydiuk also received financial support from an NSF grant [2018854] and Rosen an NSF grant [2018973]. All remaining errors are ours. Send correspondence to Tetiana Davydiuk, tetianav.davydiuk@jhu.edu.

The Review of Financial Studies 37 (2024) 1190–1264

https://doi.org/10.1093/rfs/hhad081 Advance Access publication October 31, 2023

responds to a funding shock. Because of the high opacity of the sector and the lack of reliable data, the academic literature provides few insights into these questions.[1] At the same time, extensive evidence on funding shocks to traditional banks may not be suitable to study the role of market discipline in governing nonbank institutions.[2] Specifically, deposit insurance, implicit government bailout guarantees, and existing regulatory infrastructure make investors and the cost of funding they provide less sensitive to risks in the banking sector, thereby leading to the failure of market discipline for banks.[3] Hence, the question of whether risk-taking of a financial institution can be disciplined by investors' oversight rather than by regulation remains open.

In this paper, we study the role of market discipline exerted by creditors in the direct lending space. Under market discipline, we understand that debt is priced fairly by debtholders, who take into account the leverage and portfolio risk choices of a financial intermediary. Therefore, the intermediary's creditors have the ability to influence its investment decisions by increasing funding cost in response to excessive leverage and risk-taking. In this context, we put forward the novel lending model of business development companies (BDCs), a type of direct lender that specializes in funding middle-market firms.[4] BDCs commonly rely on public capital markets to finance their investment activities with their debt primarily being held by informed and risk-sensitive investors. BDCs face a regulatory constraint of 50% on their equity-to-assets ratio. They, however, maintain substantial capital buffers. In addition, BDCs are required by regulation to disclose their allocations in their Securities and Exchange Commission (SEC) filings, putting them into the spotlight of market investors. For these reasons, the BDC sector is a natural setting to study whether market forces can discipline the investment decisions of a financial intermediary following a funding shock. Moreover, in light of the recent shift from intermediation by traditional banking institutions toward shadow banks, the novel lending model of BDCs and its resilience to funding shocks is important to study in itself.

In our analysis, we exploit a contractionary equity funding shock caused by the exclusion of BDCs from the S&P and Russell indexes in 2014. The immediate consequence of this event is the retraction of institutional investors passively tracking stock indexes, subsequently leading to a drop in BDCs'

1 Benmelech, Meisenzahl, and Ramcharan (2016) study the impact of a liquidity shock on captive leasing companies; Jiang et al. (2020) draw comparison between banks and shadow banks operating in the mortgage market; and Aldasoro, Doerr, and Zhou (2022) study the response of nonbanks to crisis episodes through the lens of syndicated lending.

2 Berger, Molyneux, and Wilson (2020) review this strand of literature in detail.

3 Existing studies document the failure of market discipline for banks due to the too-big-to-fail problem, the reliance on deposit insurance, or rise in their complexity (see, e.g., Flannery 2012; Bliss 2014; Acharya, Anginer, and Warburton 2016; Flannery and Bliss 2019; Correa and Goldberg 2020).

4 Even though BDCs could be classified as shadow banks, we separate them from this class of financial intermediaries and refer to BDCs as direct lenders throughout the paper.

valuations and limiting their ability to raise new equity. We argue that this shock is exogenous since the 2014 index reconstitution event is a delayed and unintended consequence of the 2006 regulatory changes in the SEC disclosure requirements on "Acquired Fund Fees and Expenses" (AFFE) for registered funds. In what follows, we refer to this contractionary shock as the *AFFE shock*. Altogether, this index exclusion event constitutes an equity funding shock to BDCs, allowing us to study the role of market discipline in governing their investment and capital structure decisions.

The AFFE shock creates cross-sectional variation in the BDCs' ability to raise equity in the capital markets depending on their level of mutual fund ownership before the index exclusion. We thus define the treated group as BDCs with preshock mutual fund ownership above the median level and use a difference-in-differences methodology to assess the outcomes of the treated and control groups before and after the shock. To validate the shock, we first document that treated BDCs experience a 3–5 percentage points larger decline in the level of mutual fund ownership than the control group. The magnitude of the drop is economically significant: treated BDCs lose nearly one-third of their total mutual fund investor base relative to the preshock level. We further show that this reduced interest from institutional investors impedes the flow of equity capital into BDCs. Specifically, treated BDCs exhibit on average 12%–16% lower growth of book equity than the control group. This effect is driven by the limited ability of treated BDCs to issue new equity.

We develop a stylized quantitative model as the economic framework for our empirical analysis. In the model, BDCs are subject to both market discipline exerted by creditors through fairly priced debt and capital requirements imposed by the regulator. This theoretical framework allows us to understand to what extent each mechanism—*market discipline* or *capital regulation*—drives the BDCs' adjustments of capital structure and portfolio risk following the equity shock. For this purpose, we formulate a set of model predictions which we test in the data. First, we document limited substitution from equity into debt financing for treated BDCs after the AFFE shock. Second, we find that treated BDCs shift from riskier instruments, such as equity and subordinated debt deals, and toward safer investments in senior debt. This flight-to-quality behavior of BDCs resembles the response of traditional banking institutions to funding shocks.[5] While either capital regulation or market discipline by itself can generate the flight-to-quality response to the shock, both economic mechanisms are necessary to rationalize the lack of substitution from equity into debt funding. In the setting with no capital requirements, BDCs would have issued new debt after reducing their portfolio risk without facing higher debt costs. In the setting with no market discipline, BDCs would have increased

[5] See, for example, DeYoung, Gron, Torna, and Winton (2015); Chen, Hanson, and Stein (2017); Acharya, Berger, and Roman (2018); Liberti and Sturgess (2018); Dou (2020); Dewachter, Mulier, Ongena, and Schepens (2019).

their capital buffers to avoid higher future equity issuance costs when their net worth approaches the level of capital requirements. In the presence of both mechanisms, the effect of market discipline is countervailed by the effect of capital regulation, thereby yielding no change in the BDCs' capital structure.

To provide further evidence that market discipline plays an important role in shaping the BDCs' decisions, we estimate a triple difference specification by comparing BDCs with a low and high degree of the creditors' oversight. For this purpose, we exploit the fact that BDCs can receive debt funding in the form of debentures sponsored by the Small Business Administration (SBA). We argue that debenture debt is less risk-sensitive relative to, for example, corporate bonds because ultimate investors hold a pooled set of debentures under the SBA guarantees. We can therefore proxy the degree of market discipline based on the share of debenture debt in the BDCs' debt funding. We document that treated BDCs with a low share of debenture debt (i.e., those facing a high degree of market discipline) reduce the share of the subordinated debt investments by 8–11 percentage points more than treated BDCs subject to a low degree of market discipline after the shock. We also observe a 6–11 percentage points larger increase in the share of the senior debt investments. These findings are in line with the model prediction that a higher share of fairly priced debt leads to a larger reduction in BDCs' portfolio risk in response to the shock.

Provided BDCs do not recover the losses in equity financing by raising new debt, we find that treated BDCs have a 29%–33% lower investment growth than control BDCs following the index exclusion. To disentangle the capital supply and demand effects, we additionally estimate the firm-level difference-in-differences specification following the identification approach of Khwaja and Mian (2008). Using the within-firm analysis, we document that portfolio firms receive 32% less funding from treated BDCs compared to control ones following the index exclusion. Novel to the literature on the stock index reconstitution events, the AFFE shock allows us to assess the importance of BDCs' access to public capital markets to sustain the growth in their investment activities.[6] Finally, we investigate who bears the costs of BDCs' funding disruption using firm-level employment data from the U.S. Department of Labor (DOL). We document that treated portfolio firms, that is, those funded by the treated BDCs prior to the shock, exhibit a 2.8–4.7 percentage points higher growth in employment compared to control firms.[7] Both treated and

[6] Relative to existing studies on the index reconstitution events (see, e.g., Harris and Gurel 1986; Shleifer 1986; Chen, Noronha, and Singal 2004; Becker-Blease and Paul 2010), our study is unique in its size and scope since it involves the simultaneous exclusion of the 32 BDCs. Our results on the adjustments in capital structure and portfolio risk of *financial intermediaries* after the shock are novel to this literature.

[7] Our analysis contributes to the literature quantifying the real effects from changes in credit supply to small businesses (see, e.g., Craig, Jackson, and Thomson 2007; Brown and Earle 2017; Greenstone, Mas, and Nguyen 2020). Our study is unique in demonstrating firm-level real effects for *middle-market firms*. More broadly, we complement the literature on real effects from the increased credit supply due to the deregulation of the

control portfolio firms experience a drop in employment growth after the index exclusion event. At the same time, the contraction in employment is more sizable for the firms funded by control BDCs. These somewhat counterintuitive findings could be attributed to several factors. One possible explanation is the deteriorating macroeconomic conditions across counties targeted by treated and control BDCs. Alternatively, these results could be driven by the preshock differences in the quality of treated and control portfolio firms. Another factor to consider is their respective abilities to establish investment relationships with new BDCs following the shock.

Our paper contributes to the debate on bank capital structure and capital regulation. One strand of the literature argues that higher capital levels prevent shareholders from excessive risk-taking, promote monitoring of borrowers and increase the loss-absorbing capacity, hereby disciplining banks from the equity side (see, e.g., Admati et al. 2013; Coval and Thakor 2005; Repullo 2004; Allen, Carletti, and Marquez 2009). Another strand of the literature advocates that banks' reliance on short-term debt like deposits generates liquidity benefits and also acts as a disciplining device through early withdrawals (see, e.g., Diamond and Rajan 2000; Diamond and Rajan 2001; DeAngelo and Stulz 2015). From the perspective of a bank business model, higher capital ratios are detrimental to banks' profitability as they lower benefits stemming from tax shields and government guarantees, among others. Even though higher capital requirements may prevent excessive lending during the periods of credit expansion, higher funding costs may negatively affect overall credit supply volumes (see, e.g., Clerc et al. 2015; Nguyen 2018; Davydiuk 2019). Our paper documents that BDCs are able to do balance-sheet lending with high profit margin, while facing a regulatory equity-to-asset constraint of 50%.

A BDC serves as an example of a shadow bank financed with long-term debt and no access to insured deposits. Moreover, BDCs do not enjoy implicit government guarantees inherent in traditional banking. Unlike other shadow banks, BDCs are, in fact, subject to capital regulation. While it remains inconclusive whether BDCs would choose a similar leverage ratio in the absence of capital requirements, our results demonstrate that shadow banks can engage in balance-sheet lending with a leverage ratio twice as high as those adopting the originate-to-distribute strategy (Jiang et al. 2020). More so, BDCs fund their portfolio firms without engaging in maturity transformation, indicating that it is not a necessary ingredient for balance-sheet lending. Overall, the BDC setting allows us to analyze the effect of funding frictions on capital structure in the absence of deposit insurance, implicit government guarantees, and maturity mismatch.

Apart from understanding what explains high indebtedness of banking institutions, the existing literature discusses efficient approaches to disciplining

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banking sector (see, e.g., Jayaratne and Strahan 1996; Strahan 2003; Huang 2008; Beck, Levine, and Levkov 2010; Amore, Schneider, and Žaldokas 2013; Chava et al. 2013; Cornaggia et al. 2015).

bank managers. On one hand, holding substantial amounts of equity capital creates "skin-in-the-game" concerns for equityholders and deters their opportunistic behavior (Mehran and Thakor 2011). On the other hand, short-term demandable deposits can also act a disciplining device as they can be easily withdrawn (see, e.g., Diamond and Rajan 2001). However, Admati and Hellwig (2013) argue this debt disciplining device is not efficient because of high social costs of bank liquidations, informationally insensitive deposits, and lack of monitoring by uninformed and dispersed retail depositors. Creditors' oversight may further be restricted absent the public disclosure of bank portfolio investments. In this paper, we provide evidence that market discipline exerted by debtholders has a substantial impact on BDC portfolio decisions. Specifically, we show that following the shock to equity funding treated BDCs shift to safer portfolio allocations. An important distinction of our disciplining mechanism is that it does not have to rely on funding withdrawals but is rather working through fairly priced debt. We further demonstrate that the degree of portfolio de-risking depends on a fraction of debt held by informed risk-sensitive creditors. In contrast to banks, creditor oversight has a significant effect on BDCs due to regulatory disclosure of their portfolios and ownership of BDC debt by informed investors (Jiang et al. 2020). Through the lens of a stylized model, we investigate the importance of market discipline and capital regulation in explaining the BDCs' response to the equity funding shock.

This paper is closely related to the recent literature on the expanding role of nonbanks or shadow banks, which has been attributed to tighter regulations in the financial sector (Buchak et al. 2018; Gopal and Schnabl 2022; Davydiuk, Marchuk, and Rosen 2022), superior lending technology (Buchak et al. 2018; Fuster et al. 2019), and the resulting segmentation of the pool of borrowers (Chernenko, Erel, and Prilmeier 2022; Buchak et al. 2018; Begley and Srinivasan 2022).[8] At the same time, the role of nonbanks varies considerably across different markets. The evidence by Buchak et al. (2018) in the mortgage market shows nonbanks take over the origination and servicing of loans. In contrast, in the corporate lending market, Irani et al. (2020) and Berg, Streitz, and Wedow (2022) document that nonbanks serve as the ultimate holders of loans that are initially originated by banks, thereby relaxing banks' financing constraints. However, because of limited regulatory disclosure and opacity in private capital markets, existing studies provide only narrow insights into the funding of nonbanks.[9] To address this gap, we examine the impact of an *equity funding* shock on the decisions of direct lenders, adding to the existing literature on the effects of a shock to debt funding sources (Jiang 2023), capital inflows into high-yield corporate bond funds

[8] Examples of studies that investigate the role of nonbank institutions during the 2007–2008 Financial Crisis include Pozsar et al. (2010), Krishnamurthy (2010), Gorton and Metrick (2012), Acharya, Schnabl, and Suarez (2013), and Bernstein, Lerner, and Mezzanotti (2018).

[9] Jiang et al. (2020) compare capital structure of banks and nonbanks active in the mortgage market.

(Chernenko and Sunderam 2012), and capital withdrawals from money market mutual funds (Chernenko and Sunderam 2014). Our contribution relative to these studies is to focus on how a financial intermediary simultaneously adjusts both its capital structure and portfolio risk in response to a shock. More broadly, our findings contribute to the literature focusing on shocks to the debt funding of traditional banking institutions and studying how these shocks affect credit supply (see, e.g., Peek and Rosengren 2000; Khwaja and Mian 2008; Paravasini 2008; Gilje, Loutskina, and Strahan 2016).

1. BDC Sector

In this section, we explain the institutional details and context for the BDC sector (see Davydiuk, Marchuk, and Rosen [2022] for a more detailed analysis of the BDC sector).

1.1 Institutional details and BDC lending model

A business development company (BDC) is a special category of closed-end investment company. These institutions were created through the *Small Business Investment Incentive Act of 1980* (1980 Act) to stimulate the flow of capital to small- and mid-sized private businesses. As part of their regulatory status, BDCs are required to (a) allocate at least 70% of their capital in eligible assets, (b) provide substantial managerial assistance to their portfolio firms, and (c) maintain a debt-to-equity ratio of 1:1 prior to March 2018 and 2:1 thereafter. Eligible assets include cash, government securities, and investments in eligible portfolio firms, which can be broadly defined as all private U.S. firms and public U.S. firms with equity market capitalization of up to $250 million (see Boehm et al. 2004).

Figure 1 demonstrates pronounced growth, with an average 15% growth per annum, following the 2007–2008 Financial Crisis. As of 2017:Q4, over 90 business development companies exist, 50, of which are publicly held. Together, they have over $90 billion in total assets. The BDC sector expansion coincides with the rise in other forms of nonbank intermediation.[10] Historically, BDCs specialize in providing funding to the middle market, which comprises of firms with annual revenues between $10 million and $1 billion.[11] BDCs predominantly invest in debt securities issued by portfolio firms (about two-thirds of all outstanding deals), but also commonly conduct equity coinvestment (see Appendix Table D.1). Unlike traditional banks, which often follow the originate-to-distribute lending strategy, BDCs directly hold their originated loans until maturity or repayment.

10 See, for example, Buchak et al. (2018), Chernenko, Erel, and Prilmeier (2022), Davydiuk, Marchuk, and Rosen (2022), Fuster et al. (2019), Gopal and Schnabl (2022), and Irani et al. (2020).

11 Alternatively, a middle-market firm is defined as having between 50 and 500 employees.

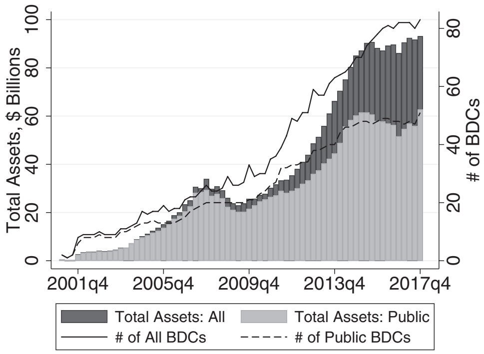

Figure 1
Size of the BDC sector
The figure depicts the aggregate total assets of publicly traded and privately held BDCs, along with their count as reported by SNL Financial. BDCs with missing total assets are excluded from the count. The data on total assets are real quarterly observations from 2001:Q1 to 2017:Q4, expressed in billions of December 2017 dollars. This figure replicates figure 1 from Davydiuk, Marchuk, and Rosen (2022).

To fund their investments in portfolio firms, BDCs raise capital in both private and public markets. Initial rounds of BDC financing are sponsored by private investors, followed by rounds of equity financing through an initial public offering (IPO) and shelf equity offerings. Apart from retail investors, high-yielding BDC stocks attract institutional investors, such as private equity firms, mutual funds, and banks. For their debt financing, BDCs rely on corporate bonds, exchange-traded notes, bank loans, and debentures. A median BDC tends to maintain a book equity-to-assets ratio of 55%–70%, though their maximum leverage ratio allowed by regulation is 50% (see Appendix Figure D.1). Even BDCs in the 25th percentile of the equity-to-assets ratio distribution hold capital buffers of 2–10 percentage points. In contrast to traditional and shadow banking institutions, BDCs engage in little maturity transformation.[12]

1.2 Data sources

In our analysis, we rely on the hand-collected database of the BDC investments as described in Davydiuk, Marchuk, and Rosen (2022). Our baseline sample covers 34 BDCs, providing funding to 4,117 portfolio firms over the period 2012:Q1 through 2016:Q4. It includes information on individual investments and contains the exact addresses for about 80% of portfolio firms. We supplement this investment-level data set with BDC-level financial statement information from S&P SNL Financial and BDC debt capital structure data from

[12] For example, the maturity of a median loan originated by BDCs fluctuates between 4 and 6 years, while the median maturity of BDC-issued bonds and notes is about 6–8 years, bank term and revolving credit loans is 4–6 years (Davydiuk, Marchuk, and Rosen 2022). For a typical BDC the maturity of its assets is on average lower than the maturity of its liabilities (see Appendix Figure D.2).

S&P Capital IQ. To analyze the ownership structure of BDCs, we rely on the WRDS SEC Analytics Suite (13F Holdings Data). Finally, we use the data on stock prices, shares outstanding and trading volume from the Center for Research in Security Prices (CRSP). To obtain real measures, we deflate all of the nominal quantities by the consumer price index from the Bureau of Labor Statistics. The price level is normalized to one in December of 2017.

For BDC-funded firms, we additionally collect the firm-level employment data from Annual Returns/Reports of Employee Benefit Plan filed with the DOL using Form 5500.[13] The DOL gathers the data on the number of employees enrolled in pension plans, such as defined benefit and contribution, and in various health benefit plans. Under the Employee Retirement Income Security Act of 1974, the requirement to file the Form 5500 applies to a broad set of employers, including very small ones. While these filings offer good coverage of pension offerings in general (McCue 2009), the reported numbers are only an approximation for firm-level employment since pension plan participation rates are higher for full-time and higher-paid workers (see, e.g., Perez and Groshen 2014). We merge the employment data with our list of BDC portfolio firms using a string matching algorithm based on the combination of firm name and address (see Appendix 3). We proxy the employment growth with the average of the growth rates in the number of participants for each pension plan, weighted by the number of participants.

1.3 AFFE disclosure requirements and index exclusion event

Despite the rapid expansion of the BDC sector after the 2007–2008 Financial crisis, the growth of public BDCs stagnates after 2014 (see Figure 1). This slowdown can be attributed to the regulatory changes in the disclosure requirements of operating expenses by registered funds. Since 2006, Form N-1A requires that each investment company registered under the *Investment Company Act of 1940* includes a line titled "Acquired Fund Fees and Expenses" in its fee table. These requirements are designed to provide investors with (a) "a better understanding of the actual costs of investing in a fund that invests in other funds" and (b) "the means to compare directly the costs of investing in alternative funds of funds, or the costs of investing in a fund of funds to a more traditional fund" (Securities and Exchange Commission 2006).

The AFFE disclosure requirements make investments into BDC stocks less attractive for institutional investors. As BDC expenses are now consolidated into the acquiring fund's expense ratio, the resulting funds' expenses are overstated. Unlike mutual fund shares, BDCs shares are traded at a price that already reflects their future expenses (adjusted to the present value). Reflecting

[13] We thank Sergey Chernenko for suggesting this data source.

these expenses again under the AFFE rule therefore results in double counting. This issue was recognized by the investment management industry.[14]

Ultimately, the adoption of the AFFE rule resulted in BDCs being removed from major stock indexes due to its distortive impact on the funds' expense ratios. On February 24, 2014, S&P announced its intention to exclude Apollo Investment Corporation and Prospect Capital Corporation from its index, effective February 28. Following this decision, the Frank Russell Company (Russell) announced that it would also remove BDCs from its indexes unless the SEC exempts BDCs from the AFFE rule by May 15, 2014. Absent the SEC reaction, a total of 32 BDCs (including Apollo and Prospect) were dropped from the Russell indexes at the June 2014 index reconstitution (see Appendix Table D.2 and Figure D.3). The reason behind the exclusion in 2014 is that around this time the weight of BDCs in Russell 2500 index approached nearly 1%. If Russell indexes continued to include BDCs, their expense ratios would have increased by 20%–25% over their existing levels of 20–30 basis points. The BDC sector analysts voiced numerous concerns about the impact of the index exclusion on the sector (see Appendix 3). However, BDCs' appeals to the SEC for an AFFE rule exemption and their efforts to regain index membership have not been successful.

The exclusion of BDCs from the stock indexes has led to a dramatic reduction in their institutional ownership and, in particular, mutual fund ownership. To a large extent, this reduction can be attributed to the share sell-offs by mutual funds passively tracking stock indexes around the Russell and S&P index reconstitution events. Panel A of Figure 2 demonstrates that the median share of mutual fund ownership across BDCs removed from the Russell 2500 drops fluctuates between 8% and 15% in the preshock period from 2011:Q1 till 2014:Q2 and between 3% and 7% in the post-shock period from 2014:Q3 till 2017:Q4. We observe a similar drop in the institutional ownership (see panel B of Figure 2). A narrowed investor base subsequently results in lower liquidity for BDC stocks. The average quarterly trading volume of excluded BDCs falls almost twofold: it fluctuates between 29 million and 51 million shares in the preshock period and between 21 million and 38 million shares in the post-shock period (see Appendix Figure D.4).

We argue that the exclusion from the Russell and S&P indexes in 2014 negatively affects BDCs' access to capital markets. To fund their new investments, BDCs often issue equity shares through so-called "shelf offerings," even though they operate as closed-end investment companies. BDCs can access capital markets this way without any restrictions only when

[14] For example, in its prospectus, the Vanguard Index Fund commented: "...[t]he expense ratio of a fund that holds a BDC will thus overstate what the fund actually spends on portfolio management, administrative services, and other shareholder services by an amount equal to these Acquired Fund Fees and Expenses. The Acquired Fund Fees and Expenses are not included in a fund's financial statements, which provide a clearer picture of a fund's actual operating expenses" (see https://www.sec.gov/Archives/edgar/data/36405/000093247114005363/indexfunds485bfinal.htm).

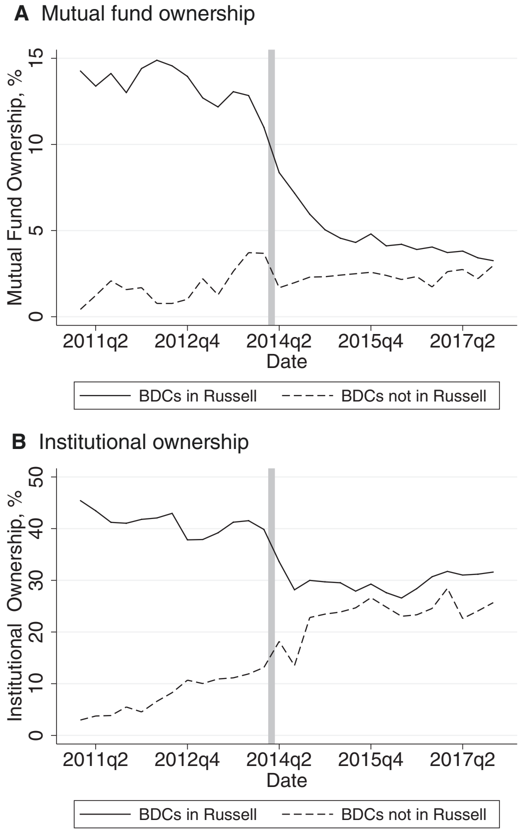

Figure 2
Institutional ownership
The figures depict the cross-sectional median values of the mutual fund ownership in panel A and institutional ownership in panel B across BDCs that were members of the Russell 2500 index as of 2013:Q4 and those that are not over time. The data are quarterly observations from 2011:Q1 to 2017:Q4, expressed in percentages.

their shares are traded at a premium to net asset value (NAV).[15] For below-NAV issuances, BDCs need to seek an approval from their existing shareholders. The Cliffwater's Report on the U.S. Direct Lending indicates that prior to the index exclusion event BDCs' shares were traded at 5%–10% above their NAVs on average.[16] Absent the SEC decision to exempt BDCs from the AFFE rule, in May 2014 the Cliffwater BDC index approaches its NAV level, subsequently pushing BDCs' shares to be traded at a discount for nearly 3 years thereafter. Importantly, these low market valuations limits BDCs' ability to freely raise

15 The net asset value represents the difference between the fair value of assets and total liabilities scaled by the number of outstanding shares. Unlike for mutual funds, a BDC's NAV per share is not the open market price at which potential investors can buy and sell its shares on stock exchanges.

16 This report can be found online (`http://bdcs.com`).

equity and leads to higher future costs of equity financing (see Appendix E.9). Hence, this index exclusion event constitutes a contractionary equity funding shock.

2. Main Findings

In this section, we analyze the efficacy of the market discipline in the direct lending space. To this end, we exploit the exclusion of BDCs from the major stock indexes and the subsequent drop in the flow of equity capital into BDCs. We assess the implications of the AFFE shock on BDC capital structure, investment activity, and portfolio risk exposure. Moreover, we study the real effects on BDC-funded portfolio firms stemming from the changes in the BDC capital supply.

2.1 Empirical strategy

The AFFE shock introduces cross-sectional variation in the flow of capital from mutual fund investors into BDCs. We expect the effect of this shock to be more pronounced for BDCs that have high levels of mutual fund ownership prior to the index exclusion. We therefore define the treated group as BDCs with a preshock mutual fund ownership above the median level and use a difference-in-differences approach to compare outcomes between the treated and control groups before and after the index exclusion.[17]

As a first step, we test whether mutual fund ownership declines more for treated BDCs than for control BDCs after the AFFE shock using the following specification:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t}, \quad (1)$$

where the dependent variable is the mutual fund ownership of a BDC i at time t defined as the ratio of shares held by mutual funds to the total shares outstanding. $Post_t$ is a dummy variable that equals one post the capital supply shock starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i is in the treated group (i.e., a BDC with a preshock mutual fund ownership above the median level). Specifically, we measure the preshock ownership levels by taking the average over the 2-year period prior to 2014, which allows us to account for potential seasonality in the data. To capture the treatment effect, we restrict our sample period to 10 quarters before and after the index exclusion: 2012:Q1 through 2016:Q4. We additionally limit our analysis only to BDCs that conducted an IPO prior to 2012:Q1, which ensures

[17] All the BDCs in the treated group were index members in the pre-2014 period. However, some index members were allocated to the control group due to their relatively low mutual fund ownership prior to the shock (see Appendix Table D.2). For robustness, we study the implications of the AFFE shock when the allocation to the treatment is continuous or discrete based on the average rather than median level of mutual fund ownership or solely based on the index membership (see Appendix E.4).

Table 1
BDC-level descriptive statistics

	N	Mean	SD	Median	10%	25%	75%	90%
Total Assets, $ Billions	33	1.25	1.94	0.54	0.13	0.29	1.05	3.57
(Cash+Securities)/Total Assets, %	33	92.91	17.61	97.10	89.68	95.81	98.19	99.03
Securities/Total Assets, %	33	84.52	20.40	92.99	71.32	83.90	94.31	96.34
Cash/Total Assets, %	33	8.40	9.92	4.73	1.02	1.85	10.35	24.57
Other Assets/Total Assets, %	33	7.09	17.61	2.90	0.97	1.81	4.19	10.32
Fair Value of Investments, $ Billions	34	1.10	1.77	0.39	0.10	0.23	1.15	3.36
Share of Equity Investments, %	34	23.93	31.21	8.05	0.51	3.20	35.82	71.14
Share of Debt Investments, %	34	72.65	30.49	86.64	27.08	64.18	94.03	99.49
Share of Subordinated Debt Investments, %	34	21.82	22.90	12.91	0.00	1.68	40.88	61.33
Share of Senior Debt Investments, %	34	50.83	31.95	49.96	6.55	20.37	84.02	91.46
# of Investment Deals	34	103.50	84.37	81.50	37.00	52.00	130.00	177.00
Share of Equity Deals, %	34	36.68	24.45	30.42	7.69	18.92	56.04	72.73
Share of Debt Deals, %	34	63.32	24.45	69.58	27.27	43.96	81.08	92.31
Share of Subordinated Debt Deals, %	34	16.70	14.22	16.16	0.00	2.63	25.00	35.16
Share of Senior Debt Deals, %	34	46.63	28.52	49.49	4.55	25.00	65.79	87.80
# of Portfolio Firms (PF)	34	63.03	44.89	51.00	21.00	31.00	79.00	131.00
Share of Equity PF, %	34	45.49	33.02	38.27	6.52	16.67	80.00	96.10
Share of Debt PF, %	34	75.17	25.75	84.86	35.48	65.78	94.23	100.00
Share of Subordinated Debt PF, %	34	23.78	21.84	18.40	0.00	4.76	38.24	55.56
Share of Senior Debt PF, %	34	54.13	30.49	51.67	8.86	30.53	85.71	92.16
# of Investment Deals per PF	34	1.65	0.64	1.48	1.14	1.27	1.81	2.34
ME/BE	33	1.01	0.24	1.00	0.71	0.88	1.07	1.25
Equity/Total Assets, %	33	65.35	13.54	60.67	52.18	56.97	70.35	85.31
Debt/Total Assets, %	33	29.72	13.73	34.08	11.83	22.53	39.59	44.71
Institutional Ownership, %	34	35.28	16.05	31.85	10.71	27.49	46.46	55.16
Mutual Fund Ownership, %	34	11.42	7.24	9.61	1.95	5.13	16.10	20.60
Debentures/Total Debt, %	30	18.48	32.30	0.00	0.00	0.00	26.86	73.95

The table reports the descriptive statistics for the BDCs in our baseline regression as of 2013:Q4. A portfolio firm is classified as an equity portfolio firm if it has at least one equity investment outstanding with a BDC. The same definition applies for the debt, subordinated debt, and senior debt portfolio firms. Institutional and mutual ownership levels as well as the share of debentures in total debt are the averages over the 2-year period between 2012:Q1 and 2013:Q4.

that our results are not driven by new lending institutions entering the public equity markets. Our sample of BDCs is restricted to those with available data on mutual fund ownership. Table 1 reports the descriptive statistics for the 34 BDCs in our baseline sample.

Table 2 reports characteristics as of 2013:Q4, that is, prior to the AFFE shock, for the treated and control groups. There are no statistically significant differences across the two groups of BDCs, other than size and net interest margin. We find that treated BDCs have greater total assets on average, which is not surprising as one of the criteria to qualify for index membership is the company's size.[18] We therefore control for observable characteristics, such as size, book leverage, and profitability in the regressions. We additionally include BDC-level and time fixed effects to account for unobservable time-invariant BDC-specific characteristics and common trends in the BDCs' fundamentals. Nonetheless, we cannot rule out that treated and control BDCs may be different with respect to time-varying unobservable characteristics.

[18] In Appendix E.5, we perform a number of additional tests to alleviate the concerns that BDC size could be a confounding factor.

Table 2
Treated versus control BDCs: Descriptive statistics

	Treated			Control			
	N	Mean	SD	N	Mean	SD	Difference
Total Assets, $ Billions	16	2.27	2.64	17	0.42	0.37	1.850***
(Cash+Securities)/Total Assets, %	16	90.14	24.21	17	95.52	7.46	−5.377
Cash/Total Assets, %	16	6.43	8.90	17	10.25	10.73	−3.813
Securities/Total Assets, %	16	83.71	24.26	17	85.28	16.72	−1.565
Other Assets/Total Assets, %	16	9.86	24.21	17	4.48	7.46	5.377
ME/BE	16	0.95	0.14	17	0.96	0.29	−0.007
Equity/Total Assets, %	16	67.99	14.91	17	62.86	12.02	5.120
Debt/Total Assets, %	16	27.99	14.49	17	31.34	13.21	−3.352
Debentures/Total Debt, %	17	12.14	25.44	17	20.47	35.81	−8.330
Total Revenue/Total Assets, %	16	10.96	10.20	17	13.70	22.76	−2.731
EBIT/Total Assets, %	16	8.68	9.95	17	10.20	19.66	−1.525
Interest Income/Total Assets, %	16	9.64	3.51	17	7.54	4.01	2.104
Interest Expense/Total Assets, %	16	1.42	0.76	17	1.50	0.94	−0.080
Net Interest Income/Total Assets, %	16	8.22	3.47	17	6.03	3.50	2.183*
Average Loan Rate, %	17	9.77	1.77	16	10.76	1.87	−0.986
Average Loan Maturity	17	3.89	0.83	17	3.41	1.34	0.486
Incentive Fee, %	12	19.79	0.72	12	20.00	0.00	−0.208
Share of Oil Deals, %	17	3.24	5.32	17	1.77	3.26	1.466
Share of Oil Deals in Fair Value, %	17	2.66	4.79	17	4.53	14.18	−1.861

The table reports the descriptive statistics of BDCs in the control and treated groups as of 2013:Q4. A BDC is in the treated group if it has the preshock mutual fund ownership above the median level.

Table 3 reports the estimates for regression (1). We find that following the AFFE shock treated BDCs experience a 3–5 p.p. larger decline in the mutual fund ownership level than control BDCs. The coefficient estimates are both economically and statistically significant.[19] The corresponding estimate for BDCs' institutional ownership is 4–8 p.p.[20] The magnitude of the drop is economically significant when compared with the preshock levels of institutional and mutual fund ownership: treated BDCs lose nearly one-third of their total mutual fund investor base.

Our difference-in-differences estimates capture the causal effect of the AFFE shock on the BDC outcomes if the following two assumptions hold. First, the exclusion of BDCs from the major indexes was not anticipated. We argue that the S&P and Russell decisions in 2014 were unanticipated by both BDCs and their investors, since the fee disclosure requirements for acquiring funds were amended 8 years earlier (see Section 1.3). Given the relatively small size of the BDC sector in 2006, the SEC could not have anticipated how the AFFE rule would ultimately harm BDCs' access to capital markets and their ability to extend financing to firms. It is therefore highly unlikely that BDCs would

19 For the BDC-level regressions, we report ordinary least squares (OLS) standard errors because of the small size of the panel: 34 BDCs over 20 quarters (i.e., a small-T/small-N case). Our results are robust to autocorrelation adjustments using the Driscoll and Kraay (1998) estimator and to additionally clustering standard errors at the quarter level to control for spatial dependences among BDCs (see Appendix E.7).

20 Including BDC and time fixed effects results in a substantial increase in R-squared. Similarly, we observe high values of R-squared across all BDC-level regressions saturated with fixed effects.

Table 3
Ownership structure

	Mutual Fund Ownership			Institutional Ownership		
Post	-1.98^{***}			-0.29		
	(0.62)			(1.51)		
Treated	11.00^{***}			22.86^{***}		
	(0.59)			(1.47)		
Post × Treated	-4.88^{***}	-4.17^{***}	-3.48^{***}	-8.31^{***}	-6.25^{***}	-3.66^{***}
	(0.84)	(0.42)	(0.45)	(2.09)	(1.16)	(1.21)
$\ln(\text{Assets}_{t-1})$			-0.17			0.98
			(0.48)			(1.35)
Debt/Assets_{t-1}			-0.01			-0.15^{***}
			(0.01)			(0.04)
$\text{Net Int. Inc./Assets}_{t-1}$			-0.01			0.03
			(0.08)			(0.21)
BDC FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes
R^2	.48	.89	.9	.36	.82	.84
N	622	622	577	639	639	594

The table reports the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the mutual fund and institutional ownership of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. Both mutual fund and institutional ownership are expressed in percentages. The data are quarterly observations from 2012:Q1 to 2016:Q4.

both foresee their exclusion from the indexes due to the relatively old regulation and anticipate the exact timing of the S&P and Russell decisions. Importantly, even if BDCs had foresight about their possible exclusion from indexes, it is highly unlikely that they could have manipulated their mutual fund ownership and thus their allocation into the treatment.

The second identification assumption requires that absent the AFFE shock the change in the average outcomes for treated BDCs would not have been different than the change in the average outcomes for the untreated BDCs, that is, the so-called "parallel trend assumption." To formally test whether the average mutual fund and institutional ownership of the treated and control groups evolves in parallel prior to the index exclusion, we estimate the following regression model:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \sum_t \gamma_t (\lambda_t \times Treated_i) + \delta X_{i,t-1} + \epsilon_{i,t}, \quad (2)$$

where λs are post-quarter dummies. For each quarter t in our sample period, we set λ_t to one starting from quarter t and zero otherwise. Importantly, we exclude dummies for Q1 and Q2 of 2014, which implies that we estimate the dynamics of the treatment relative to this reference period. Panels A and B of Figure 3 plot the coefficient estimates of γ along with the 95% confidence intervals. We observe that prior to the AFFE shock the mutual fund and institutional ownership exhibits parallel trends. In the post-shock period, we observe statistically significant negative differences strengthening over time.

Table 4
Equity financing

	ln(MVE)		ln(Price)		Issuances/MVE		ln(BVE)	
Post × Treated	−0.19***	−0.18***	−0.14***	−0.13***	−0.94	−1.38***	−0.12***	−0.16***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.63)	(0.43)	(0.04)	(0.03)
$\ln(\text{Assets}_{t-1})$		0.58***		0.16***		−6.85***		0.70***
		(0.03)		(0.04)		(0.47)		(0.03)
Debt/Assets_{t-1}		−0.00***		−0.00*		0.13***		−0.00
		(0.00)		(0.00)		(0.01)		(0.00)
Net Int. Inc./ Assets_{t-1}		0.02***		−0.00		0.30***		0.01**
		(0.01)		(0.01)		(0.08)		(0.01)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.97	.98	.9	.92	.36	.62	.96	.98
N	654	609	639	594	635	608	634	609

The table reports the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the logarithm of the market value of equity, equity price per share, the ratio of equity issuances to equity market value, and the book value of equity of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. Ratios are expressed in percentages. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

Next, we investigate the reaction of market participants to the shock to validate that the index exclusion event leads to a drop in valuations of treated BDCs. Specifically, we estimate regression (1) with the logarithm of market value of equity being the dependent variable. Results presented in Table 4 demonstrate that treated BDCs exhibit 18%–19% lower growth in their market value of equity following the index exclusion relative to the control group. This change in equity valuations appears to be mostly due to changes in share price. The growth in the share price following the shock is 13%–14% lower for treated BDCs than for control ones. The price drop is in line with mutual funds rebalancing their portfolios and reducing their exposure to BDC equity following the AFFE shock.

The drop in valuations of treated BDCs hampers their ability to raise new equity capital. To measure equity issuances, we follow Boudoukh et al. (2007) and rely on the CRSP market data. We further scale these issuances by the market value of equity to control for potential size effects. Table 4 demonstrates that the equity issuance of treated BDCs declines by 0.9–1.4 p.p. per quarter more than that of the control group following the AFFE shock.

Access to the capital markets is especially important for BDCs since nearly all of them elect to be treated as a regulated investment company (RIC) for tax purposes. This status allows them to pass through net income and capital gains to their shareholders free of corporate tax, but requires them to distribute at least 90% of taxable income to debt- and equityholders. Therefore, BDCs are limited in their ability to grow through capital retention and as such strongly depend on new equity issuance to fund new portfolio investments. Amid the drop in equity issuances, we observe a 12%–16% lower growth in the book

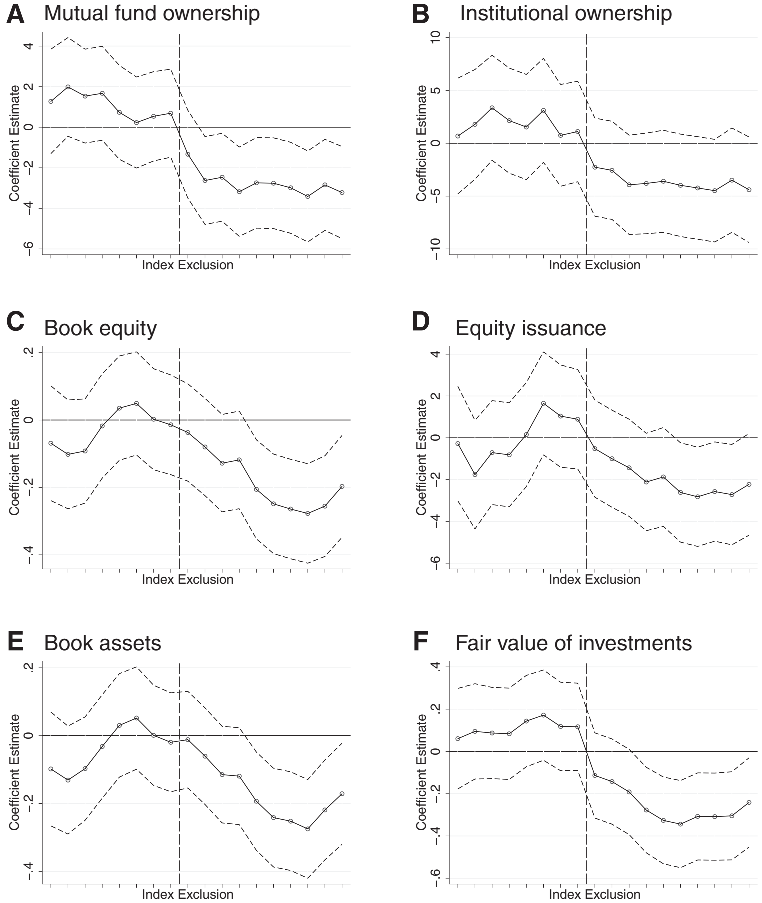

Figure 3
Parallel trends: Treated versus control BDCs
The figures depict the coefficient estimates of γs along with the 95% confidence intervals from the following panel regression: $y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \sum_t \gamma_t (\lambda_t \times Treated_i) + \delta X_{i,t-1} + \epsilon_{i,t}$, where the dependent variable are mutual fund and institutional ownership levels, as well as the annual growth rates of book equity, equity issuance, book assets, and fair value of investments. λs are post-quarter dummies: for each quarter t in the sample period, λ_t is set to one starting from quarter t and zero otherwise. Dummies for Q1 and Q2 of 2014 are excluded. Ownership levels and growth rates are smoothed using the four-quarter moving averages and are expressed in percentages. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

equity of treated BDCs relative to the control group after the AFFE shock (see Table 4). Panel C and D of Figure 3 corroborate our identification assumption that there are no significant differences in the equity growth and equity issuance between the treated and control groups prior to the index exclusion. Hence, the index exclusion constitutes a contractionary equity funding shock.

2.2 Economic framework

To investigate the relative importance of market discipline and capital regulation in explaining the BDCs' response to the AFFE shock, we develop a stylized quantitative model. In this section, we focus on model-implied predictions that we can test empirically. The details of the model are presented in Appendix 3.

In the model, BDCs face the capital requirement of γ imposed by the regulator, with $0 \leq \gamma \leq 1$. They are also subject to market discipline imposed by debtholders. Specifically, we assume that a fraction θ of the BDC's debt financing is fairly priced, with $0 \leq \theta \leq 1$. The BDC internalizes that its choice of capital ratio and portfolio risk affects its cost of debt. We finally assume that raising new equity involves an issuance cost, $\nu > 0$, which allows to capture the AFFE shock as an increase in ν. We calibrate the model parameters to match the empirical moments for BDCs (see Appendix Tables C.1 and C.2). Under this parameter specification, a representative BDC is subject to both market discipline and capital regulation (i.e., $\gamma = 0.50, \theta = 0.76$), referred to as the *MD-CR model*. We additionally consider two counterfactual economic environments, in which the BDC is only subject to (a) market discipline (i.e., $\gamma = 0, \theta = 0.76$), referred to as the *MD model*, or (b) capital regulation (i.e., $\gamma = 0.50, \theta = 0$), referred to as the *CR model*. In the following table, we summarize the model-implied hypotheses regarding the changes in BDCs' outcomes following the AFFE shock:

		MD-CR model	MD model	CR model
Hypothesis 1:	Capital ratio	$\sim$	↓	↑
Hypothesis 2:	Portfolio risk	↓	↓	↓
Hypothesis 3:	Return on assets	↓	↓	↑
Hypothesis 4:	Cost of debt	↓	↓	$\sim$

Both capital regulation and market discipline are sufficient on their own to induce the BDC to optimally maintain a high equity-to-assets ratio. When choosing its capital structure, the BDC takes into account its future cost of equity issuance and its franchise value (i.e., the present value of future payouts to shareholders). All else equal, holding a higher capital ratio allows the BDC to lower expected equity issuance cost (e.g., if capital falls below the capital requirement level and the BDC needs to recapitalize) and to increase the probability of preserving the franchise value. An increase in ν leads to an increase in the marginal benefit of equity capital because raising equity becomes more costly. At the same time, a higher ν negatively affects future payouts and lowers the franchise value thereby reducing the BDC's incentives to minimize the probability of default. In the CR model relative to the MD model, the BDC's considerations about equity issuance costs are more substantial due to the proximity to the recapitalization threshold. The reasons are as follows: (a) the BDC recapitalizes when its net worth approaches the capital requirement level rather than zero, and (b) the BDC operates at a lower capital ratio prior to the shock since the cost of debt is not risk sensitive. Hence, the BDC in the CR model optimally increases their capital ratio and hold a capital buffer in response to the AFFE shock, that is, the equity issuance cost channel dominates the franchise value channel. The direction of the prediction changes in the MD model as the franchise value channel becomes dominant. In the MD-CR model, where both market discipline and capital regulation are active, the two channels counteract each other resulting in no adjustment in capital ratio (see panel A of Appendix Figure C.1).

Hypothesis 1. Following an increase in the equity issuance cost, the BDC increases its capital ratio in CR model, decreases it in MD model, and does not adjust it in MD-CR model.

In the model, the BDC's choice of portfolio risk depends on its future cost of equity issuance and its franchise value. Higher portfolio risk results in a higher equity issuance cost and a lower probability of preserving the continuation value. The AFFE shock can either increase the marginal cost of portfolio risk because raising equity becomes more costly or decrease it because the franchise value falls. Our quantitative analysis reveals that the BDC optimally employs a flight-to-quality strategy following an increase in ν in all three models (see panel B of Appendix Figure C.1). Despite the fact that the equity issuance channel is more pronounced in the MD-CR model than in the MD model, we document a larger drop in the BDC's risk exposure after an increase in ν in the latter model. This is the case since in the MD model the BDC decreases its capital ratio in response to the shock, thereby decreasing its loss-absorbing capacity. To avoid a higher debt cost, the intermediary therefore needs to reduce its risk exposure more in the MD model than in the MD-CR model.

Hypothesis 2. Following an increase in the equity issuance cost, the BDC reduces its portfolio risk in CR, MD, and MD-CR models.

The model also generates predictions for changes in the BDC's profitability and cost of debt funding in response to the AFFE shock (see Appendix Figure C.2). Since in the MD and MD-CR models the cost of debt is fairly priced and therefore increases in portfolio risk, creditors' oversight limits the BDC's risk-taking. As a result, the BDC is incentivized to operate at a level of portfolio risk below the efficient level, namely, the level that maximizes the expected return on loans. By contrast in the CR model, the BDC chooses portfolio risk above the efficient level and keeps it above this level even after the equity issuance cost increase. Given that in our model the expected return on loans is concave with respect to portfolio risk, a reduction in risk in the CR model results in a higher ROA. In the MD and MD-CR models, the flight-to-quality strategy leads to a lower ROA.

Hypothesis 3. Following an increase in the equity issuance cost, the BDC's return on assets increases in the CR model, and decreases in the MD and MD-CR models.

Table 5
Capital structure

	ln(Debt)		Debt-to-Assets	
Post × Treated	−0.18	−0.35**	0.93	−0.10
	(0.15)	(0.14)	(1.30)	(1.29)
ln(Assets$_{t-1}$)		1.64***		10.92***
		(0.13)		(1.27)
Net Int. Inc./Assets$_{t-1}$		−0.01		−0.20
		(0.02)		(0.22)
Controls	No	Yes	No	Yes
BDC FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
R^2	.82	.86	.75	.78
N	634	609	634	609

The table reports the estimated coefficients from panel regressions using an OLS regression:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable are the logarithm of one plus total debt, and the ratio of total debt to total assets of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. Ratios are expressed in percentages. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

The changes in the fairly priced debt rate after the equity shock stem from the changes in both the capital structure and portfolio risk. In the CR model, the debt cost remains constant since it is risk-insensitive. By contrast, in the presence of market discipline the debt cost is decreasing in the capital ratio and increasing in portfolio risk. Therefore, the overall effect of a higher equity issuance cost on the cost of debt funding can be either positive or negative. Our calibrated model generates a drop in the debt cost in the MD and MD-CR models.

Hypothesis 4. Following an increase in the equity issuance cost, the BDC's cost of debt remains unchanged in the CR model, and decreases in the MD and MD-CR models.

In the following section, we empirically explore the impact of the AFFE shock on the BDCs' capital structure, investment activity, and risk exposure.

2.3 BDC capital structure, investment activity, and portfolio risk

2.3.1 Capital structure. We first study the effect of the index exclusion on the BDCs' use of debt financing. Table 5 reports the estimation results of regression (1) with the logarithm of one plus total debt outstanding as a dependent variable.[21] We find that treated group of BDCs experience 18%–35% lower growth in their debt outstanding than BDCs in the control group

21 A few BDCs in our sample do not have any debt outstanding in certain quarters. We therefore use the natural logarithm of one plus total debt outstanding to maintain a consistent sample across regressions.

Table 6
Investment volume

	ln(Book Assets)		ln(Fair Value of Investments)	
Post × Treated	−0.10**	−0.13***	−0.29***	−0.33***
	(0.04)	(0.03)	(0.04)	(0.04)
$\ln(\text{Assets}_{t-1})$		0.71***		0.58***
		(0.03)		(0.05)
Debt/Assets_{t-1}		−0.00		−0.00
		(0.00)		(0.00)
$\text{Net Int. Inc./Assets}_{t-1}$		0.01**		0.00
		(0.01)		(0.01)
BDC FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
R^2	.96	.98	.96	.97
N	634	609	654	609

The table reports the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the logarithm of book assets and fair value of investments of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

following the AFFE shock. Table 5 further shows no differential effect of the index exclusion on the debt-to-asset ratios across the two groups of BDCs, implying no differential change in capital buffers. These findings suggest that the substitution from equity into debt financing is limited in line with the predictions of our MD-CR model (see Hypothesis 1). Therefore, we argue that the lack of substitution between equity and debt financing is attributed to the presence of both market discipline and capital regulation.

2.3.2 Investment activity. Since BDCs are structured as closed-end funds and, therefore, not subject to capital redemptions, they do not have to liquidate their existing asset holdings in response to the AFFE shock. However, the lack of equity capital flow from institutional investors could affect their future schedule of investments. Even though we do not explicitly model the choice of asset holdings, we expect BDCs to contract their future investments in the presence of the equity shock in order to keep their capital ratios unchanged. Estimating regression (1) with the logarithm of total book assets as a dependent variable, we find that the decline in the flow of equity into BDCs impedes their growth. Table 6 documents that treated BDCs experience 10%–13% lower growth in their book assets than control BDCs. Second, we show that this drop in the BDCs' growth is driven by lower investment intensity. Specifically, the fair value of investments exhibit 29%–33% lower growth for treated BDCs following the shock.[22] Panels E and F of Figure 3 corroborate our identification

[22] Throughout the paper, we report the raw coefficient estimates. However, since the dependent variable is the logarithm, the exact estimates should be computed the exponential transformation. For example, a −30% estimate corresponds to -26% (i.e., $e^{-0.30} - 1$).

assumption that the investment activities of treated and control BDCs evolve in parallel prior to the index exclusion. We additionally document that the drop in investment activity is not a purely dollar volume effect but is also in terms of the number of relationships that BDCs establish with portfolio firms (see Appendix E.1).

To disentangle the capital supply and demand effects of the AFFE shock, we follow the identification approach of Khwaja and Mian (2008) and analyze the changes in the fair value of investments following the index exclusion by including firm-time fixed effects. Specifically, we estimate the following investment-level regression:

$$y_{k,j,i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{k,j,i,t}, \tag{3}$$

where the dependent variable is the logarithm of one plus fair value of investments of type k originated by BDC i to firm j at time t. Including firm-time fixed effects allows us to test whether the same portfolio firm receiving funding from multiple direct lenders experience a larger decline in financing from treated BDCs than from control BDCs. Since we are comparing investments provided by BDCs to the same firm, the changes in firm-specific capital demand are absorbed by the firm-time fixed effects.

Table 7 reports the estimation results. We document that portfolio firms receive 32% less funding from treated BDCs than from the control group (see column 1 in panel A of Table 7). To account for portfolio firms that are no longer funded by BDCs following the AFFE shock, we forward fill the fair value of investments with zeros after an investment relationship is terminated. As reported in column 2 of panel A in Table 7, the effect of the AFFE shock on the capital supply is larger in the magnitude after accounting for withdrawn investments. Moreover, we investigate to what extent the effect is driven by intensive versus extensive margin by restricting the above specification only to the BDC-portfolio-firm pairs that exist both before and after the shock (see column 3 of panel A in Table 7). The coefficient estimate is slightly smaller in the magnitude to the coefficient estimate in column 1, suggesting that the negative effect of the AFFE shock on the capital supply is mostly due to the intensive margin.

To further strengthen our analysis, we estimate specification (3) by including firm-instrument-type-time fixed effects. Doing so allows the changes in firm demand to differ across investment types. The difference-in-differences coefficient estimate is comparable in the magnitude to the coefficient estimate in the regression with firm-time fixed effects (see column 4 in panel A of Table 7). We continue to find a negative effect of the AFFE shock on the fair value of investments when considering separately debt investments and its two categories, namely, subordinated and senior debt deals (see panel B of Table 7). However, the coefficient estimate for subordinated debt is statistically insignificant as there are relatively fewer firms receiving subordinated debt from treated and control BDCs simultaneously.

Table 7
Investment volume controlling for firms' demand

A. Fair value of investments

	All				
	(1)	(2)	(3)	(4)	(5)
Post × Treated	−0.32***	−0.39***	−0.27***	−0.34***	−0.16***
	(0.10)	(0.07)	(0.09)	(0.06)	(0.04)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Firm-Time FE	Yes	Yes	Yes	No	No
Firm-Instrument-Time FE	No	No	No	Yes	No
County-Instrument-Time FE	No	No	No	No	Yes
Industry-Instrument-Time FE	No	No	No	No	Yes
R^2	.68	.64	.69	.65	.48
N	10557	22628	8954	23927	42453

B. Fair value of debt investments by type

	Debt			Subordinated		Senior	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post × Treated	−0.40***	−0.37***	−0.11**	−0.21	−0.61***	−0.41***	−0.04
	(0.07)	(0.07)	(0.05)	(0.14)	(0.13)	(0.08)	(0.06)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Time FE	Yes	No	No	Yes	No	Yes	No
Firm-Instrument-Time FE	No	Yes	No	No	No	No	No
County-Time FE	No	No	No	No	Yes	No	Yes
County-Instrument-Time FE	No	No	Yes	No	No	No	No
Industry-Time FE	No	No	No	No	Yes	No	Yes
Industry-Instrument-Time FE	No	No	Yes	No	No	No	No
R^2	.64	.65	.35	.77	.49	.64	.33
N	21330	20202	29449	3991	7245	16211	22204

The panels report the estimated coefficients from investment-level panel regressions using OLS:

$$y_{k,j,i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{k,j,i,t},$$

where the dependent variable is the logarithm of the fair value of investments of type k originated by a BDC i to a portfolio firm j at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. In column 1 of panel A, we estimate the baseline specification with firm-time fixed effects. In the remaining columns, we forward fill the fair value of investments with zeros after an investment relationship is terminated and replace the dependent variable with the logarithm of one plus the fair value of investments. In column 3 of panel A, we additionally require that a portfolio firm has an investment relationship with the same treated and control BDC before and after the shock. In panel B, we estimate the baseline specification for debt investments and its two categories, namely, subordinated debt and senior debt. The data are real quarterly observations from 2012:Q1 to 2016:Q4. Standard errors are clustered at the portfolio-firm level.

Since including firm-time fixed effects reduces our sample of portfolio firms, we additionally follow the approach by Popov and Van Horen (2014), Acharya, Eisert, Eufinger, and Hirsch (2018), and Degryse, Jonghe, Jakovljević, Mulier, and Schepens (2019) and rely on the industry-time and county-time fixed effects. The estimates of the difference-in-differences effect on the fair value of all investments continue to be negative and statistically significant, though smaller in magnitude (see column 5 in panel A of Table 7). With a larger sample of portfolio firms, we

Table 8
Investment decomposition: Fair value of investments

A. Fair value of investments by type

	ln(Equity Inv.)		ln(Debt Inv.)		ln(Sub. Debt Inv.)		ln(Senior Debt Inv.)	
Post × Treated	−0.07	−0.05	−0.14**	−0.13**	−1.17***	−1.12***	0.16**	0.19**
	(0.10)	(0.10)	(0.06)	(0.06)	(0.15)	(0.15)	(0.08)	(0.09)
$\ln(\text{Assets}_{t-1})$		1.10***		0.39***		0.79***		0.30***
		(0.11)		(0.07)		(0.16)		(0.09)
Debt/Assets_{t-1}		0.00		0.00		0.00		−0.01*
		(0.00)		(0.00)		(0.00)		(0.00)
$\text{Net Int. Inc./Assets}_{t-1}$		0.02		0.01		0.01		0.02
		(0.02)		(0.01)		(0.03)		(0.01)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.87	.9	.97	.97	.87	.89	.95	.95
N	654	609	654	609	654	609	654	609

B. Portfolio shares

	% of Equity Inv		% of Debt Inv.		% of Sub. Debt Inv.		% of Senior Debt Inv.	
Post × Treated	−2.73***	−3.97***	1.05	1.92	−7.96***	−7.07***	9.01***	8.99***
	(1.04)	(1.13)	(1.08)	(1.18)	(1.32)	(1.39)	(1.44)	(1.44)
$\ln(\text{Assets}_{t-1})$		5.69***		−6.22***		1.18		−7.40***
		(1.24)		(1.30)		(1.54)		(1.59)
Debt/Assets_{t-1}		−0.03		0.06		0.16***		−0.10**
		(0.04)		(0.04)		(0.05)		(0.05)
Net Int. Inc./ Assets_{t-1}		−0.17		0.10		0.41*		−0.31
		(0.20)		(0.21)		(0.25)		(0.25)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.96	.96	.95	.95	.86	.87	.92	.94
N	654	609	654	609	654	609	654	609

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the logarithm of one plus fair value of equity and debt investments in panel A and the share of equity and debt investments in terms of the fair values in panel B of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. The equity and debt shares are expressed in percentages. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

now find a statistically significant negative effect of the AFFE shock on the subordinated debt funding received from treated relative to control BDCs.

2.3.3 Portfolio risk. We assess the changes in BDCs' choice of portfolio risk by analyzing their portfolio allocations across different investment instruments. To this end, we estimate regression (1) with the dependent variables being the logarithm of fair value of equity and debt instruments, including its two types, namely, senior and subordinated debt (see panel A of Table 8). We find that the decline in the fair value growth of investments for treated BDCs is mainly driven by the decline in allocations to subordinated debt instruments. By contrast, the investments in senior debt by treated BDCs experience a 16%–19% higher growth than those of control BDCs. These results suggest that BDCs employ a flight-to-quality strategy and adjust riskier portfolio allocations first in response to the AFFE shock.[23]

We also investigate the changes in the relative portfolio shares of different instrument types (see panel B of Table 8). In line with the previous figures, we find a 7–8 p.p. larger decline in the share of the subordinated debt investments and a 9 p.p. larger increase in the share of the senior debt investments for the treated BDCs than for the control ones. Moreover, we document a 3–4 p.p. larger decline in the portfolio share of equity investments for treated BDCs following the shock.[24] We continue to find that BDCs tilt their portfolio allocations away from riskier investments, in terms of not only dollar volume but also the number of outstanding deals (see Appendix E.1). In sum, this flight-to-quality strategy is in line with our model predictions. Hypothesis 2 states that either economic mechanism by itself—market discipline or capital regulation—can induce BDCs to reduce risk exposure in response to higher equity issuance costs.

The changes in the investment portfolio of BDCs following the index exclusion have direct implications on their profitability. In this context, we analyze the net interest margin earned by BDCs, which is defined as a ratio of net interest income to total assets. Panel A of Table 9 reports that treated BDCs face a 1.2- to 1.5-p.p. larger drop in their net interest margin. This decline is predominantly driven by the reduction in the interest income consistent with BDCs' shift toward safer portfolios. Moreover, we compare the returns on assets, equity, and cost of debt across the treated and control BDCs. Amid a drop in the interest income, we find a more pronounced decline in ROA and ROE for treated BDCs than the control group (see panel B of Table 9). This finding is supported by the predictions of the MD and MD-CR models (see Hypothesis 3). In contrast, the CR model which does not have market discipline predicts an increase in BDCs' profitability for an empirically plausible range of the equity issuance cost. Panel B of Table 9 further documents that treated BDCs face a 1.5–1.7 p.p. lower cost of debt than the control group, which indicates that BDC debt is risk-sensitive. Hypothesis 4 states that such a drop in the debt cost is feasible only in the presence of creditors' oversight, that is, in the MD and MD-CR models.

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[23] These findings might seem to be inconsistent with our estimates in panel B of Table 7, in which we control for the changes in firm capital demand by including firm-time fixed effects. However, note that while the firm-level regressions focus on relative funding provided by treated versus control BDCs to a given portfolio firm, the current BDC-level regression compares the capital allocated to all portfolio firms by treated versus control BDCs.

[24] One could argue that our coefficient estimates in panels A and B of Table 8 are inconsistent. For example, we document no differential effect of the capital supply shock on the dollar volume of equity investments. Provided that we also find a strong negative effect on the dollar volume of all investments, one should expect to find a positive rather than a negative effect on the portfolio share of equity investments. This discrepancy can be explained by the fact the regression for portfolio shares is more subject to the effect of outliers than the regression for log quantities. A few BDCs in our sample specialize in either making equity or debt investments. Specifically, the number of equity (debt) investment deals for RAND and GSVC (SUNS and WHF) exceeds 97%. If we exclude these lenders from the sample, we find a negative and statistically significant effect of the AFFE shock on the dollar volume of equity investments (see Appendix E.3).

Table 9
Profitability and Cost of Debt

A. Net interest margin

	Net Interest Income		Interest Income		Interest Expense	
Post × Treated	−1.49***	−1.24***	−1.57***	−1.37***	−0.09	−0.14**
	(0.25)	(0.24)	(0.24)	(0.24)	(0.07)	(0.07)
ln(Assets$_{t-1}$)		−2.18***		−2.04***		0.14*
		(0.26)		(0.26)		(0.07)
Debt/Assets$_{t-1}$		0.01		0.02***		0.02***
		(0.01)		(0.01)		(0.00)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.81	.84	.86	.87	.77	.8
N	634	614	634	614	633	613

B. Returns on assets, equity, and cost of debt

	ROA		ROE		Cost of Debt	
Post × Treated	−3.90***	−3.83***	−4.69***	−4.55***	−1.68***	−1.52***
	(0.71)	(0.72)	(0.99)	(1.01)	(0.32)	(0.31)
ln(Assets$_{t-1}$)		−1.97**		−2.66**		−2.18***
		(0.77)		(1.09)		(0.42)
Debt/Assets$_{t-1}$		0.03		0.03		−0.01
		(0.02)		(0.03)		(0.01)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.61	.61	.57	.57	.49	.53
N	616	610	621	614	537	532

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the net interest margin and its components in panel A and the returns on assets, equity, and cost of debt in panel B of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. Financial ratios are expressed in percentages. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

Our empirical findings jointly with our theoretical framework imply that market forces play the dominant role in shaping the BDCs' response to the index exclusion event. Absent market discipline, treated BDCs would have optimally increased their capital ratios, experienced a drop in profitability, and faced no change in debt cost after the AFFE shock. At the same time, our model reveals that capital regulation is necessary to capture the lack of substitution of equity and debt financing. Without capital requirements in place, treated BDCs would have optimally decreased their capital buffers after reducing their portfolio risk.

2.4 Role of market discipline

In this section, we provide further evidence that creditors' oversight plays an important role in driving the BDCs' response to the AFFE shock. For this purpose, we exploit the fact that BDCs can receive debt funding in the form of debentures sponsored by SBA.[25] A debenture is an unsecured debt instrument with maturity of 10 years or more and semiannual interest payments. The SBA charges a premium of about 2% on debentures in excess of an interest rate on a 10-year Treasury bond. All debenture debt is pooled by the SBA and sold to public investors in the form of SBA-guaranteed trust certificates with a fixed interest rate. Overall, we argue that debenture debt is less risk-sensitive relative to, for example, corporate bonds due to fixed rate interest rates, long maturities, and, most importantly, the fact that ultimate investors hold a pooled set of debentures under the SBA guarantees. Therefore, we can proxy the strength of market discipline imposed by creditors based on the debt composition. Specifically, we consider a BDC to face a high degree of market discipline if the share of fairly priced debt in its debt funding is high or equivalently the share of government-sponsored debentures is low.[26]

Our theoretical framework introduced in Section 2.2 also generates predictions on how the strength of market discipline affects the BDC's response to an increase in the equity issuance cost. In the model, the degree of creditors oversight is captured by a parameter θ representing the share of the fairly priced debt in the BDC's debt funding. We therefore consider the following two alternative model specifications compared to our benchmark MD-CR model: the MD-CR model with (a) a low degree of market discipline (i.e., $\gamma = 0.50$, $\theta = 0.33$), and (b) a high degree of market discipline (i.e., $\gamma = 0.50$, $\theta = 1.00$). Our quantitative analysis shows that the BDC optimally increases its capital ratio in response to the equity shock when the degree of creditors' oversight is low and decreases it when the degree of creditors' oversight is high (see Appendix Figure C.3). With respect to risk adjustment, we find that in both models the BDC employs the flight-to-quality strategy after an increase in the equity issuance cost. However, the magnitude of a drop in the portfolio risk is larger in the model with stronger market discipline. Since the BDC decreases its capital ratio in response to the shock in the model with a high degree of creditors' oversight, it needs to reduce its risk exposure more in order to preserve its loss-absorbing capacity and avoid paying higher debt costs.

To test these model predictions, we estimate the following triple-difference specification at the BDC level:

$$\begin{aligned} y_{i,t} = {} & \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Low\ Debentures\ Share_i + \beta_4 Post_t \times Treated_i \\ & + \beta_5 Treated_i \times Low\ Debentures\ Share_i + \beta_6 Post_t \times Low\ Debentures\ Share_i \\ & + \beta_7 Post_t \times Treated_i \times Low\ Debentures\ Share_i + \delta X_{i,t-1} + \epsilon_{i,t}, \end{aligned} \tag{4}$$

[25] To be funded with debentures, a BDC needs to obtain a small business investment company (SBIC) status. The SBIC regulation identifies types of investments that can be financed with debenture debt, which aligns well with the restrictions of the 1940 Investment Act imposed on BDCs.

[26] The choice of a BDC to rely on government-sponsored debentures might correlate with BDC-level characteristics. In untabulated results, we find that BDCs with a low or high share of debenture debt prior to the index exclusion are similar in terms of observable fundamentals reported in Table 2. Additionally, we believe that BDCs are unlikely to choose their share of debenture debt anticipating the index exclusion event.

where *Low debenture share*$_i$ is an indicator that equals one if a BDC i has preshock share of debentures in the debt funding below the average level.[27] Our coefficient of interest is β_7, capturing the differential response of treated BDCs with a low and high share of debenture debt to the AFFE shock.

Our model implies a negative triple difference coefficient β_7 for the capital ratio since BDCs subject to a high degree of market discipline would optimally decrease their capital ratio, while BDCs subject to a high degree of market discipline would increase it after the shock. However, in the data we find no differential change in the capital structure for treated BDCs with a low and high share of debenture debt. This finding suggests that there could be other frictions in leverage adjustment which are outside of the model. According to the model, we further expect BDCs facing stronger creditors' oversight to reduce the risk exposure of their portfolios more. The results in Table 10 support our theoretical predictions. While the triple difference coefficient for the portfolio share of equity investments is not statistically significant, we document differential adjustments in the portfolio shares of subordinated and senior debt deals. Specifically, treated BDCs facing a high degree of market discipline reduce the share of the subordinated debt investments by 8–11 p.p. and increase the share of the senior debt investments by 6–11 p.p. more than treated BDCs subject to a low degree of market discipline after the shock. These findings imply that stronger creditors' oversight results in a larger reduction in the portfolio risk. If market discipline played no role in shaping the BDCs' response to the AFFE shock, we would not have observed any differential portfolio adjustments by BDCs with a low and high share of debenture debt. We therefore argue that creditors' oversight can discipline portfolio risk decisions.

2.5 Real effects

Davydiuk, Marchuk, and Rosen (2022) document that the surge in the BDC financing following the 2007–2008 Financial Crisis stimulates growth of middle-market firms. After the index exclusion, we observe a reduced flow of equity capital into BDCs leading to lower investment intensity. We expect that the positive effects of BDC financing on the middle-market sector could be contained amid the equity funding shock.

2.5.1 Employment growth. To investigate who bears the costs of BDCs' funding disruption, we introduce treatment allocation at the portfolio firm level, *Treated Firm*, and analyze the firm-level employment dynamics using a difference-in-differences approach. A BDC-funded firm is classified as treated (control) if it has an outstanding investment with a treated (control) BDC

[27] If a BDC has no debt funding prior to the shock, it faces no creditors' oversight and, as such, it is classified as an intermediary with a high share of debenture debt.

Table 10
Role of market discipline

	Debt-to-Assets		% of Equity Inv		% of Debt Inv.		% of Sub. Debt Inv.		% of Senior Debt Inv.	
Post × Treated	0.75	−0.52	−3.30*	−6.50***	0.72	3.86*	−0.82	−1.25	1.54	5.12**
	(2.27)	(2.04)	(1.85)	(1.93)	(1.91)	(1.98)	(2.34)	(2.40)	(2.55)	(2.51)
Post × Low Debenture Share	3.19	3.72**	3.45**	4.71***	−5.74***	−6.98***	1.32	−1.85	−7.05***	−5.13**
	(1.96)	(1.85)	(1.68)	(1.75)	(1.73)	(1.79)	(2.13)	(2.18)	(2.32)	(2.28)
Post × Treated × Low Debenture Share	−1.23	−1.58	0.31	2.19	0.91	−1.20	−10.59***	−7.57**	11.49***	6.37**
	(2.77)	(2.55)	(2.30)	(2.41)	(2.36)	(2.47)	(2.90)	(3.00)	(3.16)	(3.14)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.77	.82	.96	.96	.95	.95	.86	.87	.92	.93
N	596	573	616	573	616	573	616	573	616	573

The table reports the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Low\ Debentures\ Share_i + \beta_4 Post_t \times Treated_i$$

$$+ \beta_5 Treated_i \times Low\ Debentures\ Share_i + \beta_6 Post_t \times Low\ Debentures\ Share_i$$

$$+ \beta_7 Post_t \times Treated_i \times Low\ Debentures\ Share_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the ratio of total debt to total assets and the portfolio share of equity and debt investments in terms of the fair values of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. $Low\ Debenture\ Share_i$ is an indicator that equals one if a BDC i has preshock share of debentures in the debt funding below the average level. The ratio of total debt to total assets and portfolio shares are expressed in percentages. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

Table 11
Firm-level employment

	(1)	(2)	(3)	(4)	(5)	(6)
Post	−0.064***	−0.054***				
	(0.012)	(0.015)				
Treated Firm	−0.027**	−0.039***				
	(0.011)	(0.013)				
Post × Treated Firm	0.028*	0.033*	0.046***	0.047***	0.042*	0.037*
	(0.014)	(0.019)	(0.015)	(0.015)	(0.022)	(0.022)
Year FE	No	No	Yes	No	No	No
Firm FE	No	No	Yes	Yes	Yes	Yes
$\widehat{\text{Firm-Year FE}}$	No	Yes	No	No	No	No
Industry-Year FE	No	No	No	Yes	No	Yes
County-Year FE	No	No	No	No	Yes	Yes
R2	.0088	.0101	.291	.308	.428	.449
N	6193	3878	6133	6096	4550	4518

The table reports the estimated coefficients from the difference-in-difference estimation:

$$\Delta Emp_{j,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \epsilon_{j,t},$$

where the dependent variable in each regression is the annual growth rate of employment winsorized at 1% of a portfolio firm j at time t. $Post_t$ is a dummy variable that equals one from 2015 onward and zero before. $Treated\ Firm_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with a treated BDC prior to the shock. Portfolio firms with outstanding investments with both treated and control BDCs prior to the shock are excluded. $\widehat{Firm\text{-}Year\ FE}_j$ is the imputed firm-year fixed effects from regression (3) with the dependent variable being the natural logarithm of fair value of investments. The data are annual and span the period 2011-2017. Standard errors are clustered at the portfolio-firm level.

within the 2 years preceding the shock.[28] Formally, we estimate the following regression:

$$\Delta Emp_{j,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \epsilon_{j,t}, \tag{5}$$

where the dependent variable is the annual growth rate of employment winsorized at 1% of a portfolio firm j at time t. Since we expect employment to react with a delay, we define the post variable as a dummy variable which equals zero before 2015 and one afterward.[29] The sample period starts in 2011 and ends in 2017. We do not include the period following the regulatory changes in March 2018 on BDCs' leverage restrictions to preclude the effect of confounding factors. Importantly, to control for the time-varying firms' capital demand we either estimate specification (5) with industry-year and county-year fixed effects or include the imputed firm-year fixed effects as an additional control variable (see, e.g., Alfaro, García-Santana, and Moral-Benito 2021).

Table 11 reports that firms relying on funding from the treated BDCs in the preshock period experience a 2.8–4.7 p.p. larger employment growth than firms

28 Portfolio firms with outstanding investments with both treated and control BDCs within the 2 years preceding the shock are excluded. For robustness, we consider alternative allocations of portfolio firms into the treated and control groups (see Appendix E.9).

29 Since BDCs were excluded from the indexes in 2014:Q3, we run a robustness check where the post-shock period starts in 2014. All results continue to hold and are not reported for brevity.

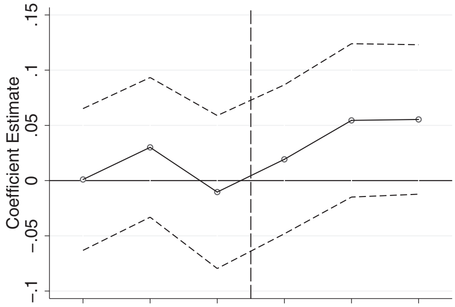


Figure 4
Parallel trends: Firm-level employment growth
The figure depicts the coefficient estimates of γs along with the 95% confidence intervals from the following panel regression:

$$y_{j,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \sum_t \gamma_t \left(\lambda_t \times Treated\ Firm_j\right) + \epsilon_{j,t},$$

where the dependent variable in each regression is the annual growth rate of employment winsorized at 1% of portfolio firm j at time t. λs are post-year dummies: for each year t in the sample period, λ_t is set to one starting from year t and zero otherwise. Dummy for 2014 is excluded. $Treated\ Firm_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with a treated BDC prior to the shock. Portfolio firms with outstanding investments with both treated and control BDCs prior to the shock are excluded. The data are annual and span the period 2011-2017.

in the control group.[30] To validate our identification strategy, we show that the parallel trend assumption holds (see Figure 4). At first glance, this positive effect on firm-level employment appears to go against the notion that the importance of the credit access for firms' growth and economic development. However, the regression estimates indicate that the employment growth rates of control firms are 5.4–6.4 p.p. lower after the shock relative to before, while the comparable estimates for treated firms indicate only 1.5–3.7 p.p. lower growth. Given that the decline in employment growth for control firms is twice as large as for treated firms, the difference-in-differences coefficient is positive and statistically significant. We document similar results when we run the analysis separately for small and large firms (see Appendix E.8).

2.5.2 Possible channels. A number of possible channels could have contributed to the differential decline in the employment growth of the BDC-funded firms. First, the positive difference-in-differences coefficient could be driven by the differential change in macroeconomic conditions across geographical areas targeted by treated and control BDCs. However, we observe similar employment growth trends in counties with presence of treated

[30] The results are both qualitatively and quantitatively similar if we use alternative measures of employment growth (see Appendix E.8). Additionally, given that our firm employment data are based on the number of employees enrolled in pension plans and pension plan participation rates are higher for full-time and higher-paid workers, we therefore only have a proxy measure of employment growth. Our conclusions continue to hold as long as there is no differential response in the number of nonenrolled employees for treated and control portfolio firm or the response in the number of nonenrolled and enrolled employees is qualitatively similar.

and control portfolio firms (see Appendix Figure D.5). Moreover, including county-time and industry-time fixed effects in regressions allows us to control for the common economic trends at the county and industry levels. We therefore argue that deteriorating economic conditions can contribute to the common downward trend in employment growth of treated and control firms but unlikely to explain the differential magnitude of the drop.

Second, our results on firm-employment could be also explained by a certification channel akin to Holmstrom and Tirole (1997). In the model, the certification works through the existence of informed investors who can monitor firms' activity and prevent them from shirking. In turn, uniformed investors require monitoring by informed investors when funding firms. In line with their model, we interpret BDCs with an outstanding investment in a firm as informed investors with respect to this firm since they provide managerial assistance. Suppose that after the shock a treated BDC continues investing in firm A and stops investing in firm B. Even if these firms were identical in terms of their quality, investment in firm A is more attractive for outside (i.e., less informed) investors than investment in firm B. This is the case because the treated BDC continues to monitor (i.e., provide managerial assistance to) firm A, making it less likely to shirk. Consequently, control BDCs might prefer to stop funding their existing firms and coinvest in firm A, as long as they can free-ride on the monitoring effort of treated BDCs. Hence, firms of control BDCs might be crowded out by certified firms of treated BDCs, thereby experiencing a larger drop in the employment growth due to the contraction in financing.

The interpretation of the certification channel becomes more nuanced when there is a distribution of firm quality. Suppose that treated and control BDCs invest in two identical quality distributions of firms prior to the shock. After the shock, treated BDCs would more likely stop investing in firms from the bottom of the quality distribution. Hence, the fact that a treated BDC continues to invest in firm A after the shock would reveal that firm A is of better quality than firm B. Again, firm A is an attractive investment opportunity for outside investors beyond their savings on monitoring costs. The average quality of certified firms by treated BDCs is higher that the average quality of firms funded by control BDCs. Next, suppose that there exist preshock quality differences between firms of control and treated BDCs. For example, larger BDCs, that is, those that were members of stock indexes, could have been able to select superior firms than smaller control BDCs due to their combination of managerial skills, screening technology, and market power. In the extreme scenario, the worst firm of a treated BDC is better than the best firm of a control BDC. Under this assumption, both firms A and B are attractive investments for outside investors, that is, receiving funding from a treated BDC is a signal of quality in itself. Control BDCs thus might prefer to stop funding their existing firms and invest in firms of treated BDCs as they are of better quality. As a result, the differential drop in the employment growth can be attributed to the crowding out effect. If additionally treated firms can weather better the decline in BDC funding than

Table 12
Establishing relationships with new BDCs

	(1)	(2)	(3)
Post	−0.48***	−0.47***	−0.48***
	(0.03)	(0.03)	(0.03)
Treated Firm	−0.10***	−0.14***	−0.10***
	(0.03)	(0.03)	(0.04)
Post × Treated Firm	0.15***	0.13***	0.21***
	(0.04)	(0.04)	(0.05)
$\widehat{\text{Firm-Time FE}}$	Yes	Yes	Yes
BDC-Level Controls	Yes	Yes	Yes
R^2	.17	.21	.17
N	2931	2036	1906

The table reports the estimated coefficients from investment-level panel regressions using OLS:

$$y_{j,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \delta \overline{X}_{j,t-1} + \epsilon_{j,t},$$

where the dependent variable is the indicator that equals one if a portfolio firm j receives a debt investment from at least one new BDC. The sample is restricted only to newly originated debt deals. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated\ Firm_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with a treated BDC prior to the shock. Portfolio firms with outstanding investments from both treated and control BDCs prior to the shock are excluded. Specification (2) focuses on treated firms that continue investment relationship with their treated BDCs after 2016:Q1, while specification (3) focuses on treated firms that exit investment relationship with their treated BDCs. $\widehat{Firm\text{-}Time\ FE}_j$ is the imputed firm-time fixed effects from regression (3) with the dependent variable being the natural logarithm of fair value of investments. The BDC-level controls are averages at the firm level. The data are quarterly observations from 2012:Q1 to 2016:Q4. Standard errors are clustered at the portfolio-firm level.

control firms due the differences in their quality, the crowding out effect will be reinforced.

2.5.3 Establishing relationships with new BDCs. To evaluate the ability of treated and control portfolio firms to secure new BDC financing, we estimate firm-level regression (5) with the dependent variable being an indicator that equals one if a portfolio firm receives a debt investment from at least one new BDC. For this analysis, we restrict the sample only to newly originated debt deals. The first column of Table 12 presents the estimation results. We find that treated firms are 15% more likely to establish a lending relationship with a new BDC than firms in the control group following the AFFE shock.[31] Our results therefore reveal that treated portfolio firms are more likely to replenish their financing and diversify across BDCs following the shock than control firms.

Furthermore, we explore the ability of treated portfolio firms to establish investment links with new BDCs if they continue to receive financing from their existing BDCs (i.e., firms A from our earlier example) and if they exit their investment relationship (i.e., firms B) after the shock. The second and third columns of Table 12, correspondingly, present the estimation results. For

31 Recall that we collect firm-level employment data by merging our investment-level BDC data set with the DOL data. We match 47% of BDC portfolios firms in our analysis sample. To rule out potential selection bias, we therefore repeat our analysis for a subset of firms with the DOL employment data. All the findings continue to hold (see Appendix Table E.12).

both groups of treated portfolio firms, we document a positive and statistically significant difference-in-differences coefficient. These findings indicate the presence of a certification effect reinforced by the differences in the average quality of treated and control portfolio firms since both firms A and B are more likely to get funding from new BDCs. Note that we do not exclude the possibility that some firms B are actively exiting their investment relations to get better financing terms.

2.5.4 Pricing terms on financing from new BDCs. Next, we study at what terms treated and control portfolio firms secure financing from new BDCs following the index exclusion. In particular, we estimate the following regression at the instrument level,

$$y_{k,j,i,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \epsilon_{k,j,i,t}, \tag{6}$$

where the dependent variable is the rate of a loan of type k issued by a BDC i to a portfolio firm j at time t. To account for potential differences in the firms' capital demand, we include the imputed firm-instrument-type-time fixed effects as an additional control variable.

Table 13 presents the estimation results. We find that treated firms obtain debt funding at rates 0.71 p.p. lower than control firms following the AFFE shock. By estimating regression (6) separately for the two types of debt investments, we additionally document that treated portfolio firms receive 1.57 p.p. higher rates on subordinated debt deals and 0.91 p.p. lower rates on senior debt deals. These results are in line with the flight-to-quality strategy of treated BDCs that shift their portfolio composition from subordinated debt and toward senior debt. Therefore, treated portfolio firms which rely on subordinated debt prior to the shock have limited access to this type of funding from their existing BDCs. Because of the lower supply of subordinated debt, treated portfolio firms receive higher rates than the control group. At the same time, treated portfolio firms relying on senior debt prior to the shock are more likely to continue investment relationships with their existing BDCs. Provided that these firms still receive managerial assistance from their treated BDCs (i.e., certified), they can secure lower rates on senior debt from new BDCs that can save on monitoring costs. Overall, these results on loan pricing act as a supporting evidence of the certification channel.

3. Conclusion

To investigate the effectiveness of market discipline in the direct lending space, we use a difference-in-differences setting and exploit the 2014 exclusion of BDCs from major stock indexes as an exogenous shock to their equity financing. We find that following their exit from indexes treated BDCs face a reduced demand from institutional investors, thereby leading to a drop in their valuations and limiting their ability to raise new equity capital. In response to

Table 13
Pricing terms on financing from new BDCs

	All Debt			Subordinated			Senior		
	T vs C	T	C	T vs C	T	C	T vs C	T	C
Post	0.00	−0.70***	0.00	−2.36***	−0.80**	−2.36***	0.24	−0.68***	0.24
	(0.41)	(0.22)	(0.41)	(0.60)	(0.32)	(0.60)	(0.44)	(0.25)	(0.44)
Treated Firm	−1.39			6.17**			−4.96***		
	(1.81)			(2.44)			(1.81)		
Post × Treated Firm	−0.71			1.57**			−0.91*		
	(0.46)			(0.68)			(0.51)		
Firm-Instrument-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BDC-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.22	.23	.14	.4	.23	.47	.23	.24	.15
N	1443	907	536	248	165	83	1195	742	453

The table reports the estimated coefficients from investment-level panel regressions using OLS:

$$y_{k,j,i,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \epsilon_{k,j,i,t},$$

where the dependent variable is the rate of a loan of type k originated by a BDC i to a portfolio firm j at time t. The sample includes only debt deals that portfolio firms receive from new BDCs. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated\ Firm_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with a treated BDC prior to the shock. Portfolio firms with outstanding investments with both treated and control BDCs prior to the shock are excluded. $Firm\text{-}Instrument\text{-}Type\text{-}Time\ FE_j$ is the imputed firm-instrument-type-time fixed effects from regression (3) with the dependent variable being the natural logarithm of fair value of debt investments. The BDC-level controls are averages at the firm level. The data are quarterly observations from 2012:Q1 to 2016:Q4. Standard errors are clustered at the portfolio-firm level.

the AFFE shock, treated BDCs maintain their capital structure unchanged and reduce the risk exposure of their portfolios. Such response can be rationalized in a model in which BDCs are subject both to market discipline in the form of fairly priced debt and capital regulation. Furthermore, we document a greater reduction in portfolio risk for treated BDCs facing stronger creditors' oversight. Our findings demonstrate that market forces can be an efficient disciplining device for financial intermediaries.

The BDC index exclusion event had ramifications for the BDC sector as a whole. The SEC's reluctance to exempt BDCs from the AFFE rule might have hampered incentives of private BDCs to conduct an IPO. Since 2014 the share of privately held BDCs has risen to nearly one-third of the market. On one hand, this shift in the market structure might limit the strength of the market discipline as only publicly traded direct lenders are required to disclose their portfolio allocations. On the other hand, limited access of BDCs to public capital markets can represent an obstacle for the funding flow into the middle-market sector. The overall effect of these new developments on resiliency of the BDC sector is beyond the scope of this paper.

Following the lobbying efforts of the largest BDCs, in March 2018 the U.S. Congress passed the Small Business Credit Act, which allows BDCs to increase their leverage twofold with the intent to stimulate lending to middle-market firms. Despite the potential benefits from an expansion in BDCs' deployable capital, the existing shareholders may object to substantial increases in leverage. Amid the portfolio concentration in high-yield investments, even small markdowns of outstanding deals may result in downgrades of BDCs' debt, thereby leading to higher costs of capital. Another attempt to address the AFFE impact on direct lenders is to allow acquiring funds to disclose BDCs' fees in footnotes rather than in main fee tables conditional on ownership level below 10%. Both of these regulatory innovations can potentially alleviate the effects of the AFFE requirements and stimulate growth in the middle-market sector. We leave these questions for future research.

Appendix A. Matching BDC Portfolio Firms with DOL Data

In this Appendix, we describe the algorithm that we use to match our list of BDC portfolio firms against the list of firms in the DOL Form 5500 data. We first create unique lists of firms from each data set based on the combination of name, city, state, and ZIP code. Even though we perform the matching using names, we additionally rely on the firm's employer identification number (EIN) from the DOL data to ensure that we do not match the same DOL firm with multiple BDC portfolio firms.

After creating the unique firm lists, we begin an iterative process of modifying the firm string values and checking for exact matches. The first-round modifications simply involve converting all characters to uppercase and removing punctuation. For each exact firm name string match, we compare the location information provided in each data source and classify the overlap into one of the following categories: (a) state, city, and five-digit ZIP code; (b) state and city; (c) state and five-digit ZIP code; (d) five-digit ZIP code; (e) state and three-digit ZIP code; (f) three-digit ZIP code; (g) state; and (h) none. This list is categorized according to our ranking of location overlap quality. We save all of the matches from this step before proceeding to the next round of firm name string modifications.

Each subsequent round of firm name string modification increasingly changes the string values in ways that make them more consistent. The goal is to uncover the cases in which the firm name strings differ slightly despite representing the same entity. Potential reasons for such discrepancies include source-specific naming conventions and typographical errors. Specifically, in the second round, we replace common abbreviations with the corresponding long form (e.g., we replace “CORP” with “CORPORATION,” “LLC” with “LIMITED LIABILITY COMPANY”). We also convert common words from plural to singular (e.g., we replace “INDUSTRIES” with “INDUSTRY”). In the third round, we standardize the expressions for “CORPORATION” and “LIMITED” (e.g., we replace “INCORPORATION” with “CORPORATION”). In the fourth round, we remove any information presented in parentheses, such as “(USA)” or “(FKA [...]).” In the fifth round, we remove several common words for entity designations, such as “CORPORATION," “COMPANY," “HOLDING," and “LIMITED." Note that this last step allows for potential name matches in which one of the names omits the entity designation.

This process can result in multiple potential matches for the same BDC portfolio firm. We take the best match among the potential options first according to the match round and then according to the location overlap quality. This selection procedure is done from both the BDC firm and DOL firm perspective to ensure that any given firm from either data set only appears once in the linked table of firm names.

As a final step, we augment the above matching procedure in two ways. First, we run a fuzzy matching procedure and manually review the results to identify additional potential matches. Second, we manually review the entire list of matches to eliminate incorrect links. This step is necessary given the inherent unstandardized nature of firm name strings.

Overall, we match 52% of the BDC portfolio firms that appear within our analysis sample to the DOL data. The majority (76%) were made within the first round of string name modifications and nearly half (47%) have the perfect location information overlap (city, state, and five-digit ZIP code). Almost one quarter of matches (23%) only have location overlap at the state level. We consider such matches acceptable because business names are registered at the state level. Finally, 12% of matches are based on name only, but these correspond to cases in which we do not have any location information for the firm from the BDCs’ SEC filings.

Appendix B. Industry Reaction to Index Exclusion of BDCs

In support of our argument that index exclusion was not anticipated by the BDC sector, we find no discussion of AFFE-related issues in industry and analyst reports with the outlook for 2014 (see, e.g., Wells Fargo Securities, Equity Research Department 2013). By contrast, the removal of BDCs from major stock indexes became “the main topic ‘du jour’ in the BDC space” in the second quarter of 2014 (Wells Fargo Securities, Equity Research Department 2014).

Analysts voiced concerns over how an unavoidable drop in institutional ownership would affect retail investors holding BDC shares. On the one hand, they argued that diminished shareholder oversight of BDC managers from institutional investors could lead to looser governance practices. On the other hand, analysts feared that BDCs with access to government-sponsored debt financing in the form of SBA debentures may engage in excessive risk-taking. The outflow of institutional investors could lead to a drop in BDC share prices, thereby pushing dividend yields up and subsequently resulting in a higher cost of equity funding for BDCs. To keep dividends unchanged, BDCs might take risks on the asset side of their balance sheet allowing them to earn a higher required rate of return. BDCs relying on risk-insensitive government-sponsored debt would be able to engage in risk-taking without facing an increase in their cost of debt financing.

Another concern discussed in BDC sector reports is that the index reconstitution could generate a substantial sell-off of BDC shares pushing down BDC prices and generating volatility spikes. Given that the exclusion from the stock indexes had no impact on BDC fundamentals, a decrease in market valuation of BDCs means that their shares would be traded below their net asset values. As a result, BDCs would be limited in their ability to issue new equity to fund their future investments. Furthermore, such tendencies in the sector may discourage new BDCs from going public, hereby decreasing liquidity in the market. For retail investors, investments in private BDCs are more risky due to high up-front fees and substantially less opportunities to sell their shares in the future. For BDC investors, in general, the prevalence of privately held BDCs would lead to less transparency in the BDC sector and limited benefits from market discipline.

Following the index exclusion, BDCs appealed to the SEC to exempt them from the AFFE disclosure. Besides a reduction in benefits that BDCs provide to retail investors, an argument in favor for the exemption is built on the resemblances of BDCs to real estate investments companies (REITs) with respect to their fee and expense structures. Nevertheless, REITs remain treated differently from BDCs due to an exemption in the 1940 Act for companies operating in the real estate industry. The SEC did not issue any exemptions for BDCs. Recognizing the adverse effects of the index exclusion, BDCs joined the Coalition for Small Business Growth (CSBG) in 2016, and in 2018 the coalition was succeeded by the Coalition for Business Development (CBD). These coalitions spent about $1 million in lobbying expenses over the 2016–2020 period.[32] For instance, the CSBG secured passage of the Small Business Credit Availability Act, which allowed BDCs to increase their debt holdings twofold. Even though the SEC announced a proposed modification to the disclosure rule in August 2020 permitting to omit the AFFE items if a fund holds less than 10% of their total assets in BDCs, this proposal was not a part of the new rule adopted in October 2020. Effectively, in 2014 BDCs were permanently excluded from the major indices.

Appendix C. Economic Framework

C.1 Model Setup

The model is discrete-time, infinite-horizon. There are three classes of risk-neutral agents: penniless entrepreneurs, deep-pocketed investors, and BDCs. Entrepreneurs finance their projects by taking loans from BDCs. BDCs fund loans to entrepreneurs by raising equity and debt capital from investors.

Entrepreneurs. There is a continuum of ex ante identical entrepreneurs of measure one born at each date t. They can undertake one-period investment projects, each of which require a unit investment. A project produces a payoff of $1+(\phi_1-\phi_2\sigma_t)\sigma_t+\sigma_t\epsilon_{t+1}$ at date $t+1$, where ϵ_{t+1} are idiosyncratic shocks drawn from a standard normal distribution identically distributed across time and projects, that is, $\epsilon_{t+1}\sim iid\mathcal{N}(0,1)$. A financial intermediary issuing a loan to an entrepreneur chooses the project's amount of risk $\sigma_t\in\left[\underline{\sigma},\overline{\sigma}\right]$. Recall that according to their regulatory status, BDCs are required to provide managerial assistance to their portfolio firms and as such can influence entrepreneurs' investment decisions.

Investors. At each date, a large number of investors are willing to supply financial intermediaries with debt and equity capital. The required expected return on BDC equity is $r_e\geq 0$, while the required expected return on BDC debt is $r_f\geq 0$. We assume that $r_f<r_e$ allowing us to capture a comparative disadvantage of equity financing in a reduced form (e.g., tax advantage of debt financing).

Business development companies. BDCs specialize in providing loans to entrepreneurs by channeling funds from investors. Consider a representative BDC that at each date t lends a unit-size loan to the measure-one continuum of entrepreneurs and chooses the amount of risk σ_t, at which it wants entrepreneurs to operate at date $t+1$. We assume that the intermediary incurs a

[32] See https://www.opensecrets.org/federal-lobbying/clients/summary?cycle=2018&id=F218679 and https://www.opensecrets.org/federal-lobbying/clients/summary?cycle=2019&id=F317447.

constant operating cost μ per unit of extended loans. This assumption allows us to capture the cost of managerial assistance that BDCs provide to their portfolio firms. To finance the difference between the lending amount and the net worth k_{t+1}, available to the BDC at the end of period t (going into period $t+1$), the BDC borrows an amount $1-k_{t+1}$ from investors in debt capital markets.

The BDC faces a capital requirement constraint imposed by the government that obliges it to keep an equity-to-loans ratio, k_{t+1}, of at least γ, with $0 \le \gamma \le 1$. This specification subsumes a laissez-faire regime with no capital regulation in place ($\gamma=0$). In line with the evidence, we assume that the BDC can raise two types of debt financing: fairly priced debt (e.g., bonds) and risk-insensitive debt (e.g., government-sponsored debentures). Risk-insensitive debt is insured by the regulator who repays debtholders in case the BDC defaults. As such, the promised rate of return on insured debt is equal to the required expected rate of return on debt, that is, r_f. Fairly priced debt is risky. Thus, debtholders require a higher promised rate of return $r_{t+1}(k_{t+1}, \sigma_t) \ge 0$ than the required expected rate of return on debt. We assume that debtholders recover only a fraction $0 \le c < 1$ of the initial assets of the failed BDC, that is, the bankruptcy involves deadweight costs. For simplicity, we assume $c=0$. Importantly, the BDC internalizes that its choices of leverage k_{t+1} and portfolio risk σ_t affect its cost of debt financing. Additionally, we assume that the BDC takes its composition of debt financing as given: a fraction θ of debt financing is fairly priced and a fraction $1-\theta$ of debt financing is risk-insensitive, where $0 \le \theta \le 1$. This formulation includes a specification in which the intermediary faces no market discipline imposed by debtholders and all debt is insured by the government (i.e., $\theta=0$).

Provided that BDCs specialize in providing funding to middle-market firms, which are typically credit-rationed in the lending market, we assume that the BDC acts as a monopolist and as such extract all the pledgeable return from entrepreneurs. At date t, the BDC obtains revenue $1+r_{l,t} = 1+(\phi_1-\phi_2\sigma_{t-1})\sigma_{t-1}+\epsilon_t$ and incurs cost μ per unit of loans extended at time $t-1$. Thus, its revenues are worth $1+r_{l,t}-\mu$. Its debt costs are $\left(1+r_{d,t}(k_t,\sigma_{t-1})\right)(1-k_t)$, where $r_{d,t}(k_t,\sigma_{t-1}) \equiv \theta r_t(k_t,\sigma_{t-1})+(1-\theta)r_f$ is the weighted average cost of debt capital. This implies that the BDC's profits realized at date t per unit of loans are equal to

$$\pi_t(k_t,\sigma_{t-1},\epsilon_t) \equiv (\phi_1-\phi_2\sigma_{t-1})\sigma_{t-1}+\sigma_{t-1}\epsilon_t-\mu-r_{d,t}(k_t,\sigma_{t-1})(1-k_t).$$

Note that the BDC's choice of σ_{t-1} determines both the exposure to risk (i.e., $Var_{t-1}\left[r_{l,t}\right]=\sigma_{t-1}^2$) and the expected productivity (i.e., $E_{t-1}\left[r_{l,t}\right]=(\phi_1-\phi_2\sigma_{t-1})\sigma_{t-1}$). The parameters ϕ_1 and ϕ_2 govern the shape of the risk-productivity frontier. We assume that the BDC's risk choice is bounded by $\underline{\sigma}=\frac{\phi_1-\sqrt{\phi_1^2-4\phi_2 r_f}}{2\phi_2}$ and $\overline{\sigma}=\frac{\phi_1+\sqrt{\phi_1^2-4\phi_2 r_f}}{2\phi_2}$ as well as $r_f < \frac{\phi_1^2}{4\phi_2}$, which ensures that projects are positive NPV if they are fully financed with risk-insensitive debt. For ease of notation, in what follows, we suppress the dependence of debt interest rates on leverage and risk choices.

We assume that when the financial intermediary does not have sufficient funds to service its debt liabilities, it defaults. In particular, the BDC defaults whenever the shock ϵ_t is below a cutoff level ϵ_t^* defined by the following expression:

$$k_t+\pi_t\left(k_t,\sigma_{t-1},\epsilon_t^*\right)=0 \Leftrightarrow \epsilon_t^* = \frac{\mu+r_{d,t}-\left(1+r_{d,t}\right)k_t-(\phi_1-\phi_2\sigma_{t-1})\sigma_{t-1}}{\sigma_{t-1}}.$$

Note that we implicitly assume that the financial intermediary cannot raise new equity to cover its payments to debtholders.

The net worth k_{t+1} available to the BDC at the end of period t (conditional on no default at date t) evolves according to

$$\begin{aligned} k_{t+1} &= k_t+\pi_t(k_t,\sigma_{t-1},\epsilon_t)-d_t, \\ &= \left(1+r_{d,t}\right)k_t+(\phi_1-\phi_2\sigma_{t-1})\sigma_{t-1}+\sigma_{t-1}\epsilon_t-\mu-r_{d,t}-d_t, \end{aligned}$$

where d_t is the net payouts to the BDC's shareholders per unit of loans. A positive net transfer, $d_t > 0$, means that the equityholders receive dividends, while a negative one, $d_t < 0$, means that there is an equity issuance. Although BDCs can raise equity capital unrestrictedly when setting up its loan portfolio at date $t=0$, recapitalization for financial intermediaries with ongoing relationships is subject to an equity issuance cost $\psi(d_t)=-\nu e^{-d_t} d_t$, where $\nu \geq 0$. Note that this continuous functional form for the equity issuance cost approximates the discrete issuance cost given by $-\nu 1_{d_t<0} d_t$. Recall that following the exclusion of BDCs from stock indices, their shares were traded at a discount to net asset value. As such, BDCs needed to seek an approval from existing shareholders in order to raise new equity through shelf offerings. We therefore argue that low market valuations following the index exclusion event limited BDCs' ability to access equity capital markets. Hence, we interpret the AFFE shock as an increase in ν.

The promised rate of return on the fairly priced debt r_t is characterized by the following expression,

$$\left(1+r_f\right)=(1+r_t)\left(1-\Phi\left(\epsilon_t^*\right)\right),$$

where $\Phi(\cdot)$ is a cumulative density function of the standard normal distribution. Investors who provided the fairly priced debt receive their promised rate of return r_t only in case the BDC survives (i.e., when $\epsilon_t \geq \epsilon_t^*$) and otherwise receive zero. Since the investors are risk-neutral, they require a promised rate of return r_t such that in the expectation they receive the required expected return on debt r_f. Using the implicit function theorem, we can establish the following properties of the fairly priced debt rate:

$$r_{k,t} \equiv \frac{dr_t}{dk_t} = -\frac{(1+r_t)\phi\left(\epsilon_t^*\right)\frac{1+r_{d,t}}{\sigma_{t-1}}}{\left(1-\Phi\left(\epsilon_t^*\right)\right)-(1+r_t)\phi\left(\epsilon_t^*\right)\frac{\theta(1-k_t)}{\sigma_{t-1}}},$$

$$r_{\sigma,t} \equiv \frac{dr_t}{d\sigma_{t-1}} = \frac{(1+r_t)\phi\left(\epsilon_t^*\right)\left(\frac{\phi_2\sigma_{t-1}^2 - r_{l,t}^*}{\sigma_{t-1}^2}\right)}{\left(1-\Phi\left(\epsilon_t^*\right)\right)-(1+r_t)\phi\left(\epsilon_t^*\right)\frac{\theta(1-k_t)}{\sigma_{t-1}}},$$

where $\phi(\cdot)$ is a cumulative density function of the standard normal distribution and $r_{l,t}^* \equiv \mu + r_{d,t} - \left(1+r_{d,t}\right)k_t$. Therefore, assuming that $\left(1-\Phi\left(\epsilon_t^*\right)\right)-(1+r_t)\phi\left(\epsilon_t^*\right)\frac{\theta(1-k_t)}{\sigma_{t-1}} > 0$, we have that the fairly priced debt rate is (a) decreasing in the capital ratio, and (b) increasing in the portfolio risk when $\phi_2\sigma_{t-1}^2 > r_{l,t}^*$ (i.e., when the capital ratio is high or portfolio risk is high) and decreasing in the portfolio risk otherwise.

Before characterizing the optimal allocations, we must also understand how the BDC default threshold depends on its choice of the capital ratio and portfolio risk. Other things equal, a higher equity-to-loans ratio k_t leads to a lower default threshold ϵ_t^* and hence a lower default probability of the BDC:

$$\epsilon_{k,t}^* \equiv \frac{\partial \epsilon_t^*}{\partial k_t} = -\frac{1+r_{d,t}-\theta r_{k,t}(1-k_t)}{\sigma_{t-1}} < 0.$$

In the presence of market discipline (i.e., $\theta > 0$), the direct effect is reinforced by the *debt rate effect*: a higher capital ratio allows the BDC to secure fairly priced debt financing at a lower rate, further lowering the default threshold and thus the default probability.

All else equal, a higher portfolio risk σ_{t-1} can lead either to a higher or a lower default threshold:

$$\epsilon_{\sigma,t}^* \equiv \frac{\partial \epsilon_t^*}{\partial \sigma_{t-1}} = \frac{\phi_2\sigma_{t-1}^2 - r_{l,t}^*}{\sigma_{t-1}^2} + \frac{\theta r_{\sigma,t}(1-k_t)}{\sigma_{t-1}} \lesseqgtr 0.$$

For high levels of capital ratio or portfolio risk, that is, when $k_t > \frac{\mu+r_{d,t}-\phi_2\sigma_{t-1}^2}{1+r_{d,t}}$ or $\sigma_{t-1}^2 > \frac{\mu+r_{d,t}-\left(1+r_{d,t}\right)k_t}{\phi_2}$, a higher portfolio risk leads to a higher default threshold and thus to a higher default probability. Once again, in the presence of market discipline, the direct effect is reinforced by the *debt rate effect*: a higher portfolio risk results in a higher cost of fairly priced debt financing, further increasing the default threshold and thus the default probability. For low levels of capital ratio or portfolio risk, a higher portfolio risk leads to a lower default threshold and thus a lower probability of default. When the capital ratio is low, the shareholders have little skin-in-the-game and as such a higher portfolio risk could allow the intermediary to lower the probability of default (so-called "gambling for resurrection"). For low levels of portfolio risk, a higher σ_{t-1} leads to a higher expected loan productivity $E_{t-1}\left[r_{l,t+1}\right]=(\phi_1-\phi_2\sigma_t)\sigma_t$, which lowers the default threshold and thus the default probability.

The BDC is managed in the interest of its equityholders, who are protected by limited liability. Its optimization problem is written recursively. The state variables of the BDC are its capital ratio k_t, portfolio risk σ_{t-1}, and the realization of the shock ϵ_t. Because of the equity issuance costs, the necessary cash flow to payout d_t is $d_t-\psi(d_t)$. The BDC discounts the future equity payouts with the discount factor $\frac{1}{1+r_e}$. It chooses this period's equity payout d_t and the next period's capital ratio k_{t+1} and portfolio risk σ_t to solve,

$$v(k_t,\sigma_{t-1},\epsilon_t)=\max_{d_t,k_{t+1},\sigma_t}\left\{d_t+\nu e^{-d_t}d_t+\frac{1}{1+r_e}\int_{\epsilon^*_{t+1}}v(k_{t+1},\sigma_t,\epsilon_{t+1})d\Phi(\epsilon_{t+1})\right\}$$

$$d_t=\left(1+r_{d,t}\right)k_t+(\phi_1-\phi_2\sigma_{t-1})\sigma_{t-1}+\sigma_{t-1}\epsilon_t-\mu-r_{d,t}-k_{t+1},$$

$$1+r_f=(1+r_t)\left(1-\Phi\left(\epsilon^*_t\right)\right),$$

$$\epsilon^*_t=\frac{\left(\mu+r_{d,t}-\left(1+r_{d,t}\right)k_t\right)-(\phi_1-\phi_2\sigma_{t-1})\sigma_{t-1}}{\sigma_{t-1}},$$

$$\gamma\le k_{t+1}\le 1 \quad \underline{\sigma}\le\sigma_t\le\overline{\sigma}.$$

C.2 Quantitative assessment

In what follows, we assess the BDC's optimal allocations and its response to the AFFE shock (i.e., an increase in the equity issuance cost captured by the parameter ν) after numerically solving the model under a realistic calibration.

Table C.1 describes our baseline calibration of the model. The model is calibrated at annual frequency. We first discuss our choice of parameters that can be directly inferred from the empirical moments for BDCs. We focus on a set of treated BDCs, that is, those affected by the index exclusion event, and the sample period between 2012:Q1 and 2014:Q2, that is, prior to the AFFE shock. The parameter γ is set to 0.50, which is in line with the capital requirements imposed on BDCs by the regulation. Unlike traditional banks, BDCs face only a simple leverage constraint, which makes the model equity-to-loans ratio a close counterpart to the data, with the exception that in practice BDCs also invest in cash, government securities, and equity of their portfolio firms. Even though in the model r_l governs only the return on loans extended to entrepreneurs, it can be broadly interpreted as the return on the BDC assets. Since in the model the portfolio risk σ is chosen by BDCs, a lower portfolio risk choice could be viewed as a portfolio shift toward cash-like securities and senior debt deals, while a higher one could be interpreted as a shift toward subordinated debt deals and equity investments. Using the SNL Financial data, we find that the average ratio of *Noninterest Expenses/Assets* for treated BDCs is equal to 3.77%. We therefore set the parameter μ governing the operating cost per unit of loans to 0.04.

For their debt financing, BDCs borrow both through public debt instruments (i.e., fairly priced debt) and through government-sponsored debentures (i.e., risk-insensitive debt). According to Capital IQ, for an average treated BDC debentures constitute 23.91% of its total debt. In the model, the parameter θ is the share of fairly priced debt. We thus set θ to 0.76 in our baseline calibration. However, we also study the sensitivity of the BDC optimal allocation to different levels of θ as it governs the degree of market discipline imposed on BDCs by their creditors. In particular, we consider calibrations in which θ is equal to 0.33 and 1.00 since the average share of debenture debt for BDCs with a low and high degree of market discipline is equal to 67.20% and 0.29%,

Table C.1
Configuration of model parameters

Parameter	Model Function	Target Moment
$\gamma = 0.50$	capital constraint	capital requirement for BDCs
$\mu = 0.04$	operating cost	average noninterest expense/assets
$\theta = 0.76$	share of fairly-priced debt	average share of non-debenture debt
$r_f = 0.04$	required expected return on debt	average yield on debenture debt
$r_e = 0.08$	required expected return on equity	average ROE
$\phi_1 = 0.65$ $\phi_2 = 0.80$	risk-productivity frontier	average ROA, cost of debt, and equity-to-assets ratio
$\nu = 0.05$	equity issuance cost	

The table reports the parameters values in our baseline specification, the model function governed by a specific parameter, and the corresponding data moment disciplining the value of that parameter.

respectively. According to Capital IQ, an average treated BDC incurs an interest rate of 3.78% on the debenture debt financing. Hence, we set the required expected rate of return on debt, r_f, to 0.04. Next, we set the parameter r_e governing the required expected return on equity equal to 0.08. This value for r_e implies that the spread between the required expected return on equity and debt is equal to 4%, which is the midvalue for the spread estimate in the literature. Carlstrom and Fuerst (1997) and Gomes, Yaron, and Zhang (2003) set a spread between the rates of return required by entrepreneurs and those required by their lenders to 5.5%; Iacoviello (2005) set the spread to 3.16%; and Van den Heuvel (2008) set the spread to 4%.

The remaining three parameters ϕ_1, ϕ_2, and ν cannot be directly mapped onto the observed empirical moments for BDCs. In the model, the parameters ϕ_1 and ϕ_2 govern the conditional expected return on loans (i.e., $E_{t-1}\left[r_{l,t}\right] = (\phi_1 - \phi_2\sigma_{t-1})\sigma_{t-1}$): holding the portfolio risk choice fixed, the loan rate is increasing in ϕ_1 and decreasing in ϕ_2. At the same time, these parameters also govern the equilibrium fairly priced debt rate. Holding the capital ratio and portfolio risk fixed, the probability of the BDC default is decreasing in ϕ_1 and increasing in ϕ_2, which implies that the fairly priced debt rate is also decreasing in ϕ_1 and increasing in ϕ_2. The parameters ϕ_1 and ϕ_2 also have an indirect effect on the loan rate through the BDC's optimal choice of portfolio risk and on the fairly priced debt through the BDC's optimal choice of capital ratio and portfolio risk. For example, a higher ϕ_1 leads to a higher continuation value (i.e., the present value of future payouts to shareholders), which in turn leads to a higher optimal capital ratio and a lower optimal portfolio risk. This shift in the optimal allocations consequently lowers the probability of the BDC default and, thus, the fairly priced debt rate. Also, a decline in the optimal portfolio risk results in a lower loan rate if the BDC operates at $\sigma < \sigma^e \equiv \frac{\phi_1}{2\phi_2}$ and a higher one otherwise. A parameter ν governing the cost of equity issuance affects the loan and debt rate only indirectly through the optimal BDC's choice of leverage and portfolio risk. Since we do not observe in the data a direct counterpart of σ, we select ϕ_1, ϕ_2, and ν to jointly match the average return on assets, cost of debt, and equity-to-assets ratio. In the data, the average return on assets for treated BDCs is equal to 8.40%. The model counterpart is the average loan rate net of the operating cost. The average cost of debt for treated BDCs is equal to 5.68%, which given the values of θ and r_f implies that the average fairly priced debt rate is equal to 6.21%.

In Table C.2, we report the moments both in the data and in the model. Specifically, we solve the model using the value function iteration approach and then simulate it 1,000 times for 40 years. Half of the observations are discarded to mitigate the influence of the starting values for the state variables. Using the simulated data, we calculate the averages of model series reported in the table across the simulations. In our baseline specification, a representative BDC is subject both to market discipline imposed by creditors and capital requirements imposed by the regulator (i.e., $\theta = 0.76$, $\gamma = 0.50$, $r_f = 0.04$)—the *MD-CR model*. To gain a better understanding of the economic mechanisms driving the BDCs' response to the AFFE shock, we also consider a number of counterfactual parameter specifications. In particular, we report the model statistics for an environment in which the BDC (a) operates only in the presence of market discipline

Table C.2
First moments in the data and model

				Model				
			θ:	0.76	0.76	1.00	0.33	0.00
			γ:	0.50	0.00	0.50	0.50	0.50
		Data	r_f:	0.04	0.04	0.04	0.04	0.054
Equity-to-Assets Ratio	k	69.79		71.22	71.20	74.10	63.08	51.11
At or Below Capital Constraint	$k \leq \gamma$	1.88		1.24	1.24	0.43	5.19	95.96
Portfolio Risk	σ			36.49	36.48	36.06	37.21	47.67
Fairly-Priced Debt Rate	r	6.21		5.81	5.81	5.37	7.53	0.00
Cost of Debt	r_d	5.68		5.38	5.38	5.37	5.17	5.40
ROA	$r_l - \mu$	8.40		9.07	9.07	9.04	9.11	8.81
Probability of BDC Default	$\Phi(\epsilon^*)$			1.71	1.71	1.30	3.26	11.73

The table reports the first moments computed as averages of the data and model series. The summary statistics in the data are computed in the quarterly sample of treated BDCs for the period 2012:Q1 and 2014:Q2. The empirical rates of returns are annualized. The summary statistics in the model are computed based on the simulated data.

(i.e., $\theta = 0.76$, $\gamma = 0$, $r_f = 0.04$), the *MD model*, and (b) is subject only to capital requirements (i.e., $\theta = 0$, $\gamma = 0.50$, $r_f = 0.054$), the *CR model*. Note that in the CR model we change the risk-insensitive debt rate to 5.4%, to make the cost of debt financing comparable to the MD and MD-CR models. Additionally, we analyze the MD-CR model with (a) a low degree of creditors' oversight (i.e., $\theta = 0.33$, $\gamma = 0.50$, $r_f = 0.04$), the *LMD-CR model*, and (b) a high degree of creditors' oversight (i.e., $\theta = 1.00$, $\gamma = 0.50$, $r_f = 0.04$), the *HMD-CR model*.

In the MD-CR model, we find that the BDC finds it optimal to maintain substantial capital buffers of about 20% in line with the evidence (see Table C.2). Since the capital requirement is rarely binding, the BDC's optimal allocations in the MD model is nearly identical to optimal allocations in the MD-CR model. As the share of fairly priced debt financing decreases, the optimal capital ratio goes down. In the CR model, the capital constraint is nearly always binding. These results can be more formally established from the BDC's first-order conditions with respect to k_{t+1}:

$$\begin{aligned}\frac{\partial v}{\partial k_{t+1}} = & -1 - \nu e^{-d_t}(1-d_t) + \lambda_t \\ & + \frac{1 + r_{d,t+1} - \theta r_{k,t+1}(1-k_{t+1})}{1+r_e}\left(1 - \Phi\left(\epsilon^*_{t+1}\right)\right) \\ & + \frac{1 + r_{d,t+1} - \theta r_{k,t+1}(1-k_{t+1})}{1+r_e}\int_{\epsilon^*_{t+1}} \nu e^{-d_{t+1}}(1-d_{t+1})\, d\Phi(\epsilon_{t+1}) \\ & + \frac{1 + r_{d,t+1} - \theta r_{k,t+1}(1-k_{t+1})}{1+r_e}\frac{v\left(k_{t+1}, \sigma_t, \epsilon^*_{t+1}\right)}{\sigma_t}\phi\left(\epsilon^*_{t+1}\right),\end{aligned} \tag{C1}$$

where λ_t is the Lagrange multiplier associated with the capital requirement constraint. The marginal cost of one unit of k_{t+1} is one plus the marginal equity issuance cost at date t. The marginal benefit of one unit of k_{t+1} is the discounted value of one conditional on no default at date $t+1$. Moreover, an additional unit of k_{t+1} allows the BDC to (a) relax the capital requirement constraint at date t, referred to as the *capital constraint channel*, (b) lower the total payments to creditors at date $t+1$, referred to as the *debt cost channel*, (c) reduce the equity issuance cost at date $t+1$, referred to as the *equity issuance cost channel*, and (d) to decrease the default threshold ϵ^*_{t+1} and, thus, increase the probability of receiving the continuation value, referred to as the *franchise value channel*.[33] In the presence of market discipline (i.e., $\theta > 0$), there exists an additional benefit

33 Across all parameter specifications, the optimal equity payout d_t^{opt} is well below one and, thus, $\int_{\epsilon^*_{t+1}} \nu e^{-d_{t+1}}\left(1-d_{t+1}\right) d\Phi\left(\epsilon_{t+1}\right) > 0$.

of an additional unit of k_{t+1}: since the fairly priced debt rate is decreasing in the capital ratio, a higher capital ratio allows the BDC to lower its payments to creditors, thereby further strengthening the debt cost, equity issuance cost, and franchise value channels. Hence, all else equal, a higher θ leads to a higher equity-to-loans ratio.

While the BDC optimally maintains capital buffers in the presence of market discipline, the capital requirement constraint is nearly always binding in the CR model (see Table C.2). This implies that the BDC's franchise value and equity issuance cost are not high enough to overweight the higher ongoing cost of equity financing relative to debt financing and induce the intermediary to hold capital buffers. In other words, a higher equity issuance cost (i.e., a higher ν) and/or a larger franchise value at the default threshold (i.e., a higher ϕ_1 or lower ϕ_2) would be necessary to generate a capital buffer of 20% in the CR model.

Now let us analyze the optimal choice of portfolio risk by the BDC. First, if the financial intermediary were fully equity financed, it would choose σ_t to maximize the conditional expected return on loans that would be equal to the efficient level of portfolio risk: $\sigma^e \equiv \frac{\phi_1}{2\phi_2} = 0.41$. Second, since the limited liability provides shareholders with a call option, the intermediary might find it optimal to risk-shift and choose $\sigma_t^{opt} > \sigma^e$ if the franchise value is sufficiently low (see, e.g., Merton 1977). However, in the presence of market discipline, the risk-shifting incentives of the BDC could be hampered since a higher portfolio risk choice could lead to a higher fairly priced debt rate. Table C.2 confirms that the intermediary finds it optimal to engage in risk-taking in the CR model. As the degree of market discipline imposed by creditors strengthens (i.e., θ increases), the optimal portfolio risk goes down and falls further below the efficient level σ^e. These results can be more formally established through the BDC's first-order conditions with respect to σ_t:

$$\begin{aligned}\frac{\partial v}{\partial \sigma_t} &= \frac{1}{1+r_e}(\phi_1 - 2\phi_2\sigma_t)\left(1-\Phi\left(\epsilon^*_{t+1}\right)\right)\\ &+ \frac{1}{1+r_e}\left(E\left[\epsilon_{t+1}|\epsilon_{t+1} > \epsilon^*_{t+1}\right] - \theta r_{\sigma,t+1}(1-k_{t+1})\right)\left(1-\Phi\left(\epsilon^*_{t+1}\right)\right)\\ &- \frac{1}{1+r_e}\int_{\epsilon^*_{t+1}} \nu e^{-d_{t+1}}(1-d_{t+1})\left(-\phi_1 + 2\phi_2\sigma_t - \epsilon_{t+1} + \theta r_{\sigma,t+1}(1-k_{t+1})\right) d\Phi(\epsilon_{t+1})\\ &- \frac{1}{1+r_e}\left(\frac{\phi_2\sigma_t^2 - r^*_{l,t+1}}{\sigma_t} + \theta r_{\sigma,t+1}(1-k_{t+1})\right)\frac{v\left(k_{t+1},\sigma_t,\epsilon^*_{t+1}\right)}{\sigma_t}\phi\left(\epsilon^*_{t+1}\right). \qquad \text{(C2)}\end{aligned}$$

First, note that the inequality $\phi_2\sigma_t^2 > r^*_{l,t+1}$ is always satisfied in our numerical solution given the targeted empirical moments and, in particular, substantial capital buffers maintained by BDCs in practice. This in turn implies that $r_{\sigma,t+1} > 0$. There are a number of channels in place that make the BDC's optimal choice of portfolio risk deviate from the efficient one. On one side, an additional unit of σ_t allows the intermediary to increase the value of the shareholders' call option as captured by the term $E\left[\epsilon_{t+1}|\epsilon_{t+1} > \epsilon^*_{t+1}\right] = \frac{\phi\left(\epsilon^*_{t+1}\right)}{1-\Phi\left(\epsilon^*_{t+1}\right)} > 0$, which is the *risk-shifting motive*. On the other side, portfolio risk is costly since an additional unit of σ_t results in (a) a higher equity issuance cost at date $t+1$, which is the *equity issuance cost channel*,[34] and (b) a higher default threshold ϵ^*_{t+1} and, thus, a lower probability of receiving the continuation value. This is the *franchise value channel*. Finally, the market discipline also plays an important role in shaping the intermediary's risk choice. Since a higher portfolio risk results in a higher fairly priced debt rate, an additional

34 Note that an additional unit of σ_t does not necessarily results in a higher equity issuance cost at date $t+1$. This is only the case for high levels of capital ratio and/or portfolio risk. However, provided that the BDC maintains a sufficiently high capital ratio and operates at high portfolio risk exposure under our baseline parameter specification, we indeed have that an additional unit of σ_t increases the equity issuance cost at date $t+1$.

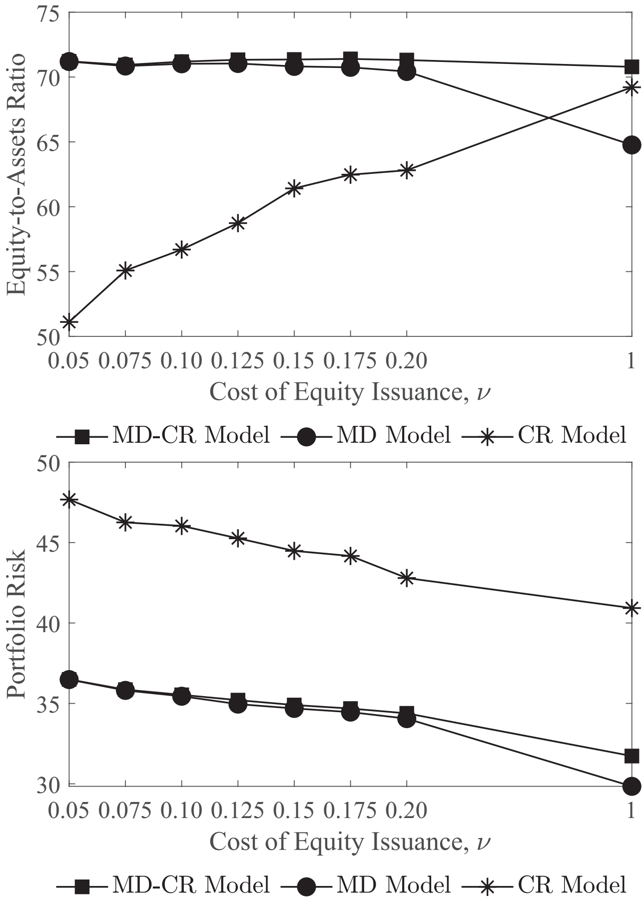


Figure C.1
Sensitivity of the BDC's optimal allocations to equity issuance cost
The figures depict the sensitivity of the BDC's optimal capital ratio and portfolio risk with respect to the equity issuance cost in panels A and B, respectively. Each point in the figures is the average of optimal allocations across the simulations for different values of the parameter $\nu \in \{0.05, 0.075, 0.10, 0.125, 0.15, 0.175, 0.20, 1\}$. The model simulation is based on the parameter values specified in Table C.1, except for θ, γ, r_f, and ν. In the MD-CR model, we set $\theta = 0.76$, $\gamma = 0.50$, and $r_f = 0.04$. In the MD model, we set $\theta = 0.76$, $\gamma = 0$, and $r_f = 0.04$. In the CR model, we set $\theta = 0$, $\gamma = 0.50$, and $r_f = 0.054$.

unit of σ_t increases the BDC's liabilities to creditors, thereby lowering the risk-shifting motive, increasing the equity issuance cost, and reducing the survival probability. Therefore, all else equal, a higher θ leads to a lower portfolio risk.

Next, we investigate the effect of a higher equity issuance cost following the index exclusion event on the BDC's optimal allocations. Figure C.1 shows the sensitivity of the optimal capital ratio and portfolio risk with respect to the parameter ν.

As shown in panel A of Figure C.1, the BDC's optimal choice of capital ratio can either decrease or increase in response to a higher equity issuance cost. To gain an intuition behind these findings, we focus on an interior solution for the capital ratio.[35] The sign of $\frac{dk_{t+1}^{opt}}{d\nu}$ then can be obtained by total differentiation of the first-order condition with respect to k_{t+1}, that is, the expression (C1):

$$\frac{dk_{t+1}^{opt}}{d\nu} = -\left(\frac{\partial^2 v}{\partial k_{t+1}^2}\right)^{-1}\left(\frac{\partial^2 v}{\partial k_{t+1}\partial \sigma_t}\frac{d\sigma_t^{opt}}{d\nu} + \frac{\partial^2 v}{\partial k_{t+1}\partial \nu}\right),$$

where $\frac{\partial^2 v}{\partial^2 k_{t+1}} < 0$ by the second-order condition. Holding the portfolio risk unchanged, the sign of $\frac{dk_{t+1}^{opt}}{d\nu}$ would coincide with the sign of $\frac{\partial^2 v}{\partial k_{t+1}\partial \nu}$:

$$\begin{aligned}\frac{\partial^2 v}{\partial k_{t+1}\partial \nu} = & -e^{-d_t}(1-d_t) \\ & + \frac{1+r_{d,t+1}-\theta r_{k,t+1}(1-k_{t+1})}{1+r_e}\int_{\epsilon_{t+1}^*} e^{-d_{t+1}}(1-d_{t+1})d\Phi(\epsilon_{t+1}) \\ & - \frac{1}{1+r_e}\frac{1+r_{d,t+1}-\theta r_{k,t+1}(1-k_{t+1})}{\sigma_t}e^{k_{t+2}}k_{t+2}\phi\left(\epsilon_{t+1}^*\right).\end{aligned}$$

As the parameter ν increases, the marginal cost of one unit of k_{t+1} increases due to the higher marginal equity issuance cost at date t. At the same time, the marginal benefit of one unit of k_{t+1} also increases due to the lower marginal equity issuance cost at date $t+1$. This implies that the financial intermediary might choose to build up additional capital buffers in order to increase its loss-absorbing capacity and avoid high equity issuance costs in the future. There exists an additional channel in place: as the equity issuance cost increases, the BDC's franchise value at the default threshold decreases, that is, $\frac{\partial v\left(k_{t+1},\sigma_t,\epsilon_{t+1}^*\right)}{\partial \nu} = -e^{k_{t+2}}k_{t+2} < 0$. This suggests that the financial intermediary might choose to decrease its capital ratio in response to a higher ν since it cares less about its survival probability. Which channel dominates depends on the model specification as well as the BDC's optimal allocations when $\nu = 0.05$.

Our numerical analysis demonstrates that in the CR model the equity issuance cost channel dominates the franchise value channel. Therefore, the BDC optimally increases its capital ratio following an increase in the equity issuance cost (see panel A of Figure C.1). The opposite is true in the MD model. These findings could be in part explained by the fact that the equity issuance cost channel is stronger in the presence of capital requirements than with no capital regulation, all else equal: the intermediary incurs an issuance cost when its net worth approaches the capital requirement level rather than zero. Moreover, prior to the equity shock, the BDC operates at a lower capital ratio and a higher portfolio risk in the CR model than in the MD model, which further strengthens the equity issuance cost channel and weakens the franchise value channel. In the MD-CR model, the equity issuance cost channel balances out the franchise value channel since the equity issuance cost channel is stronger than in the MD model. As a result, we observe effectively no change in the optimal capital ratio following an increase in the equity issuance cost as shown in panel A of Figure C.1. This finding is in line with our evidence that following the AFFE shock there was no differential change in the debt-to-assets ratio for the treated and control BDCs (see Table 5).

Panel B of Figure C.1 demonstrates that across all parameter specification the BDC employs a flight-to-quality strategy in response to a higher equity issuance cost, that is, optimally chooses to reduce its portfolio risk. In what follows, we focus on an interior solution for σ_t. The sign of $\frac{d\sigma_t^{opt}}{d\nu}$

35 Since the value function is neither concave nor convex in k_{t+1} and σ_t, its maximization may have interior or corner solutions. There also could be multiple optimal values for capital ratio and portfolio risk.

then can be obtained by total differentiation of the first-order condition with respect to σ_t, that is, the expression (C2):

$$\frac{d\sigma_t^{opt}}{d\nu} = -\left(\frac{\partial^2 \upsilon}{\partial \sigma_t^2}\right)^{-1} \left(\frac{\partial^2 \upsilon}{\partial \sigma_t \partial k_{t+1}} \frac{dk_{t+1}^{opt}}{d\nu} + \frac{\partial^2 \upsilon}{\partial \sigma_t \partial \nu}\right),$$

where $\frac{\partial^2 \upsilon}{\partial \sigma_t^2} < 0$ by the second-order condition. Holding the capital ratio choice fixed, the sign of $\frac{d\sigma_t^{opt}}{d\nu}$ would coincide with the sign of $\frac{\partial^2 \upsilon}{\partial \sigma_t \partial \nu}$:

$$\frac{\partial^2 \upsilon}{\partial \sigma_t \partial \nu} = -\frac{1}{1+r_e} \int_{\epsilon_{t+1}^*} e^{-d_{t+1}} (1-d_{t+1}) \big(-\phi_1 + 2\phi_2 \sigma_t - \epsilon_{t+1} + \theta r_{\sigma,t+1} (1-k_{t+1})\big) d\Phi(\epsilon_{t+1})$$

$$+ \frac{1}{1+r_e} \left(\frac{\phi_2 \sigma_t^2 - r_{l,t+1}^*}{\sigma_t} + \theta r_{\sigma,t+1} (1-k_{t+1})\right) \frac{e^{-k_{t+2}} k_{t+2}}{\sigma_t} \phi\left(\epsilon_{t+1}^*\right).$$

The trade-offs faced by the BDC when adjusting the portfolio risk in response to a higher equity issuance cost are rather similar to the ones it faces when adjusting the optimal capital ratio. On one hand, as the parameter ν increases the marginal cost of an extra unit of σ_t increases due to a higher equity issuance cost at date $t+1$. This channel implies that the financial intermediary might choose to decrease its risk exposure following the equity shock. On the other hand, a higher equity issuance cost results in the lower marginal benefit of an extra unit of σ_t because of a lower franchise value at the default threshold. This channel, by contrast, can lead to a higher portfolio risk following an increase in the equity issuance cost.

Across all parameter specifications, the equity issuance cost channel dominates the franchise value channel (see panel B of Figure C.1). Recall that the strength of each channel depends on the model specification as well as the BDC's optimal allocations prior to the shock. The relative drop in the portfolio risk following an increase in ν is larger in the CR model than in the MD model. This is the case since that the equity issuance channel is stronger with than without capital regulation in place. Moreover, in the CR model the BDC operates at a lower capital ratio and a higher portfolio risk than in the MD model, which makes the equity issuance cost channel even stronger and the franchise value channel weaker. At the same time, the above stated reasons cannot explain the differential drop in the optimal risk exposure in the MD and MD-CR models. We have to take into account the changes in the capital structure in response to the shock. Since in the MD model the BDC optimally decreases its capital ratio, its loss-absorbing capacity goes down. Therefore, the intermediary needs to reduce its risk exposure more in the MD model than in the MD-CR model to avoid higher debt costs. Even though we do not observe a direct data counterpart of σ_t, the BDC's flight-to-quality strategy following the equity issuance shock is line with our evidence. Specifically, we document that following the index exclusion event treated BDCs shifted from equity investments and subordinated debt deals and toward cash-like securities and subordinated debt deals (see Table 8 and Appendix Table E.2).

Our empirical findings further reveal that following the index exclusion event treated BDCs face a 4 p.p. larger drop in their ROA than the control group (see panel B of Table 9). To a great extent, this finding could be attributed to the reduction in asset risk by treated BDCs. As shown in panel A of Figure C.2, we find a *qualitatively* similar effect of a higher ν on the BDC's profitability in the MD and MD-CR models. Recall that the BDC operates at $\sigma < \sigma^e$ and, thus, a lower portfolio risk leads to a lower conditional expected return on loans. In the MD-CR model, when ν increases from 0.05 to 0.20, the ROA decreases from 9.03% to 8.82%. If ν increases to 1.00, the ROA drops to 8.56%. The magnitude of the effect is larger than in the MD model than in the MD-CR model due to a larger drop in the portfolio risk following the shock. When ν increases to 0.20 (1.00), the ROA drop to 8.75% (8.10%). By contrast, in the CR model the BDC operates at $\sigma > \sigma^e$. This implies that a lower portfolio risk leads to a higher conditional expected return on loans as long as BDC

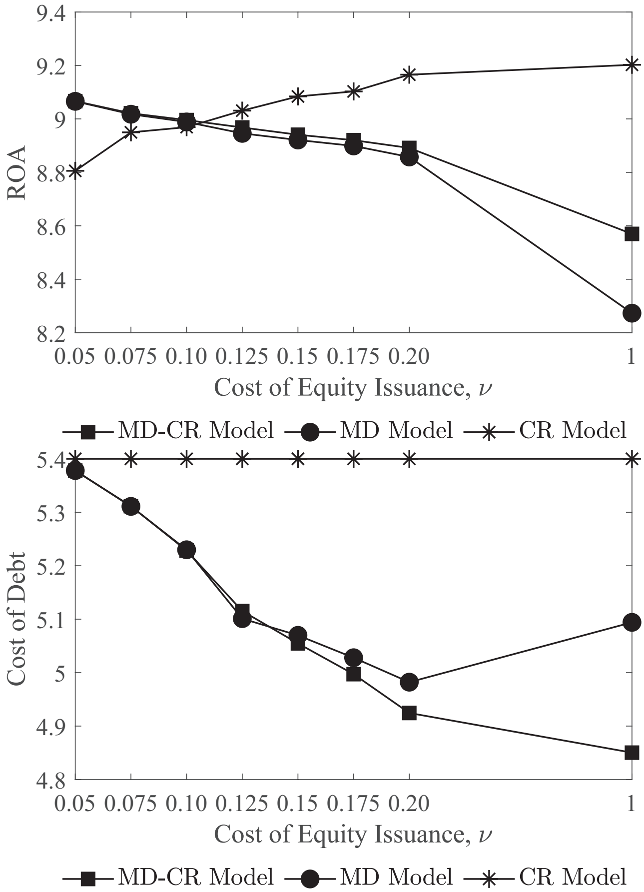


Figure C.2
Sensitivity of the BDC's ROA and ROD to equity issuance cost
The figures depict the sensitivity of the BDC's rates of returns on assets and debt with respect to the equity issuance cost in panels A and B, respectively. Each point in the figures is the average of optimal allocations across the simulations for different values of the parameter $\nu \in \{0.05, 0.075, 0.10, 0.125, 0.15, 0.175, 0.20, 1\}$. The model simulation is based on the parameter values specified in Table C.1, except for θ, γ, r_f, and ν. In the MD-CR model, we set $\theta = 0.76$, $\gamma = 0.50$, and $r_f = 0.04$. In the MD model, we set $\theta = 0.76$, $\gamma = 0$, and $r_f = 0.04$. In the CR model, we set $\theta = 0$, $\gamma = 0.50$, and $r_f = 0.054$.

continues to operate at portfolio risk above the efficient level after the shock. For example, when ν increases from 0.05 to 0.20, the ROA increases from 8.79% to 9.04%, which is counterfactual to the evidence. When a drop in the portfolio risk is sufficiently large, the ROA can also decrease.

In the data, we also observe a 1.5 p.p. larger drop in the ROD for treated BDCs relative to the control group after the AFFE shock (see panel B of Table 9). In the MD-CR model, the cost of debt financing decreases from 5.38% to 4.92% (4.85%) when the equity issuance cost increases from 0.05 to 0.20 (1.00). This drop in the debt cost is driven by a reduction in the BDC's portfolio risk and no change in the capital structure. In the MD model, there are two competing effects in place: while a lower portfolio risk after the shock leads to a lower debt cost, a lower capital ratio leads to a higher debt cost. Panel B of Figure C.2 demonstrates that the former effect dominates the latter one. In the CR model the cost of debt financing is equal to the risk-insensitive debt rate and as such remains unchanged with an increase in the equity issuance cost.

Finally, we investigate the BDC's response to an increase in the equity issuance cost depending on the strength of market discipline imposed by its creditors. Specifically, we compare the optimal allocations in two counterfactual economic environments: the MD-CR model with either (a) a high degree of creditor oversight (HMD-CR model) or (b) a low degree of creditor oversight (LMD-CR model). In the model with a high degree of creditor oversight, the BDC is entirely financed with the fairly priced debt, and in the model with a low degree of creditor oversight, the BDC is predominantly financed with risk-insensitive debt. Figure C.3 demonstrates that the BDC with the low (high) degree of market discipline would optimally choose to increase (decrease) its capital ratio in response to the equity shock. Recall that the key channels inducing the intermediary to maintain capital buffers are (a) the capital constraint, (b) the debt cost, (c) the equity issuance cost, and (d) the franchise value. An increase in ν strengthens the equity issuance channel making equity capital more beneficial and weakens the franchise value channel making equity capital less beneficial. Which channel dominates depends on the BDC's optimal allocations prior to the shock. Specifically, the intermediary holds larger capital buffers and operates at a lower risk exposure in the HMD-CR model than in the LMD-CR model, which makes the equity issuance channel weaker and the franchise value channel stronger. As a result, in the HMD-CR model the franchise channel dominates the equity issuance channel resulting in a higher capital ratio after the shock, while the opposite is true in the LMD-CR model.

As shown in panel B of Figure C.3, the BDC would find it optimal to employ the flight-to-quality strategy in response to the equity shock both in the HMD-CR and LMD-CR models. The magnitude of a drop in the portfolio risk though is larger in the model with a high than a low degree of creditors' oversight. Recall that, when choosing its optimal risk exposure, the BDC trades-off the loan productivity and risk-shifting motive with the equity issuance cost and franchise value. An increase in ν strengthens the equity issuance cost channel, making portfolio risk more costly, and weakens the franchise value channel, making the portfolio risk less costly. The differences in the optimal allocations prior to the shock cannot explain the BDC's differential response to the shock across the two model specifications. Since the intermediary maintains a higher capital ratio and operates at a lower portfolio risk in the HMD-CR model than LMD-CR model, which makes the equity issuance channel weaker and the franchise value channel stronger. Consequently, if anything, we should find a larger drop in the portfolio risk in the latter model than in the former one. However, because in the HMD-CR model the BDC decreases its capital ratio in response to the shock, it needs to reduce its portfolio risk more than in the LMD-CR model to preserve its loss-absorbing capacity and avoid paying a higher debt cost.

The empirical counterpart of this counterfactual analysis is our triple difference regression, in which we compare the outcomes of treated BDCs with a low and a high share of debenture debt (see Table 10). Since the BDC with a low (high) degree of market discipline optimally chooses to increase (decrease) its capital buffers in response to a higher equity issuance cost, the model predicts a negative triple difference coefficient for the equity-to-assets ratio. However, our regression estimates indicate no statistically significant differential change in the capital structure of treated BDCs with a low and a high share of debenture debt. This suggests other frictions in leverage adjustment that are outside of the model. With respect to the portfolio risk, the model demonstrates that the BDC with a higher degree of creditors' oversight reduces its risk exposure more in response to the shock, thereby implying a negative triple difference coefficient for the portfolio risk. In line with this model prediction, we find that treated BDCs with a low share of debenture debt (i.e., a high degree of market discipline) reduced their portfolio shares of subordinated debt deals and increased their portfolio shares of senior debt deals more than treated BDCs with a high share of debenture debt.

In summary, the flight-to-quality behavior following the capital supply shock can be generated in both the model with only market discipline and the model with capital regulation in place.

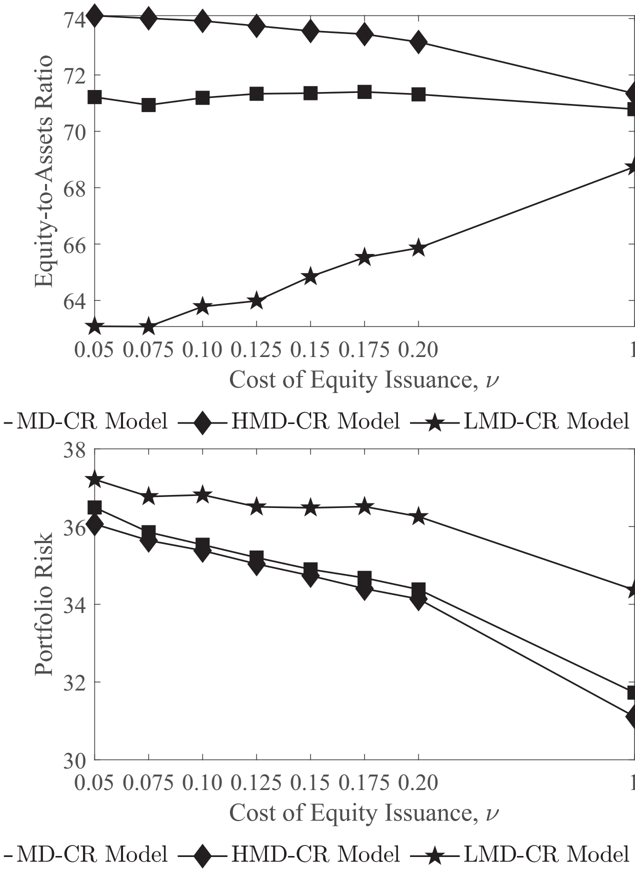


Figure C.3
Sensitivity of the BDC's optimal allocations to equity issuance cost for different degrees of market discipline
The figures depict the sensitivity of the BDC's optimal capital ratio and portfolio risk with respect to the equity issuance cost in panels A and B, respectively. Each point in the figures is the average of optimal allocation across the simulations for different values of the parameter $\nu \in \{0.05, 0.075, 0.10, 0.125, 0.15, 0.175, 0.20, 1\}$. The model simulation is based on the parameter values specified in Table C.1, except for θ and ν. We set θ to 1.00 and 0.33 in the HMD-CR and LMD-CR models, respectively.

However, the model's predictions for the capital structure, profitability, and debt cost are different with and without creditors' oversight. In the CR model, the BDC would optimally increase its capital ratio following the index exclusion event. More so, the drop in the risk exposure would result in higher loan revenues for a plausible range of the equity issuance cost and no change in the cost of debt funding. These model predictions are counterfactual to the evidence. At the same time, the market discipline alone cannot explain limited substitution between equity and debt financing after the index exclusion event. In the MD model, the BDC would optimally decrease its capital buffers in response to the equity shock. Therefore, both mechanisms—market discipline and capital regulation—are necessary to capture the BDC's response to the shock observed in the data. Our triple difference specification comparing intermediaries with a low versus a high share of debenture debt provides further evidence that market discipline plays an important role in shaping the BDCs'

Appendix D. Additional Tables and Figures

Table D.1
Investment portfolio of BDCs

A. Investment instruments

	Count	Mean	SD	Median	10%	25%	75%	90%
Portfolio Firms, Count	34	63.03	44.89	51.00	21.00	31.00	79.00	131.00
Outstanding Deals, Count	34	108.59	88.25	81.50	37.00	52.00	130.00	216.00
Outstanding Debt Deals, %	34	61.11	24.15	65.69	27.27	43.96	79.94	92.31
Outstanding Equity Deals, %	34	35.45	23.90	28.90	5.88	18.92	51.85	68.09
Outstanding Structured Products, %	34	3.30	6.73	0.00	0.00	0.00	2.38	11.27

B. Pricing terms of debt securities

	Count	Mean	SD	Median	10%	25%	75%	90%
Outstanding Loan Size, $ Millions	2157	12.00	20.58	6.29	0.52	2.32	13.67	26.70
New Loan Size, $ Millions	387	14.41	27.48	8.41	0.91	3.40	15.63	30.84
New Loan Maturity, Years	379	4.64	1.79	4.92	2.00	3.67	5.83	6.83
New Loan Rate, %	380	9.47	2.92	9.25	6.00	7.25	11.50	13.50
Rate: Cash Only, %	116	10.33	2.73	10.00	8.00	8.50	12.00	13.50
Rate: PIK Only, %	10	11.42	4.47	12.12	4.10	12.00	15.00	15.00
Rate: Cash and/or PIK, %	38	13.09	2.12	13.00	10.50	12.00	14.50	15.50
Rate: Base + Spread, %	202	8.21	2.25	7.75	6.00	6.25	10.00	11.00

The panels report summary statistics for investment portfolios of BDCs included in the baseline regression sample. The figures in panel A represent the cross-sectional statistics on investment instruments across BDCs. The figures in panel B represent the cross-sectional statistics on pricing terms across BDC debt deals. The data on loan size are expressed in millions of December 2017 dollars. Allocations in collateralized loan obligations, collateralized debt obligations, venture capital funds, mutual funds, and other funds are excluded. The summary statistics are reported as of 2013:Q4.

decisions. If creditors did not discipline the intermediary's choice of leverage and risk, we would have found no differential response to the AFFE shock across BDCs with a low versus a high share of debenture debt funding.

Table D.2
List of BDCs

BDC Ticker	BDC Name	Mutual Fund Ownership, %	Institutional Ownership, %	Treated	Index Member
SLRC	Solar Capital Ltd.	26.53	58.53	1	1
AINV	Apollo Investment Corp.	26.41	53.45	1	1
PNNT	PennantPark Investment Corp.	22.34	50.79	1	1
MVC	MVC Capital Inc.	20.60	57.79	1	1
MCC	Medley Capital Corp.	20.47	53.56	1	1
ARCC	Ares Capital Corp.	20.23	55.16	1	1
MCGC	MCG Capital Corp.	17.90	45.20	1	1
ACAS	American Capital Ltd.	17.47	63.71	1	1
CSWC	Capital Southwest Corp.	16.10	44.00	1	1
TCRD	THL Credit Inc.	15.30	53.96	1	1
SUNS	Solar Senior Capital Ltd.	15.19	46.46	1	1
MFIN	Medallion Financial Corp.	14.78	43.70	1	1
NMFC	New Mountain Finance Corp.	14.23	45.87	1	1
GBDC	Golub Capital BDC Inc.	13.62	40.26	1	1
PSEC	Prospect Capital Corp.	12.62	33.00	1	1
GLAD	Gladstone Capital Corp.	10.56	28.60	1	1
TICC	Oxford Square Capital Corp.	9.76	30.71	1	1
TCAP	Triangle Capital Corp.	9.46	27.96	0	1
HRZN	Horizon Technology Finance Corp.	9.32	27.63	0	1
GAIN	Gladstone Investment Corp.	8.96	39.79	0	1
TCPC	Blackrock TCP Capital Corp.	8.86	41.66	0	1
GSVC	SuRo Capital Corp.	8.42	28.83	0	1
MAIN	Main Street Capital Corp.	8.35	27.03	0	1
FDUS	Fidus Investment Corp.	8.00	25.35	0	1
PFLT	PennantPark Floating Rate Capital Ltd.	6.53	27.57	0	1
FULL	Full Circle Capital Corp.	5.13	7.39	0	0
SCM	Stellus Capital Investment Corp.	5.01	30.33	0	1
WHF	Whitehorse Finance Inc.	4.80	10.71	0	1
OFS	OFS Capital Corp.	4.14	20.48	0	0
TINY	180 Degree Capital Corp.	3.39	3.56	0	0
MRCC	Monroe Capital Corp.	1.95	11.61	0	0
EQS	Equus Total Return Inc.	1.01	9.28	0	0
SAR	Saratoga Investment Corp.	0.79	27.49	0	0
RAND	Rand Capital Corp.	0.09	27.98	0	0
AMTCQ	Ameritrans Capital Corp.		2.49		0
BKCC	Blackrock Capital Investment Corp.				0
WCAP	Winfield Capital Corp.				0
NEWT	Newtek Business Services Corp.				0
SVVC	Firsthand Technology Value Fund Inc.				1
KCAP	Portman Ridge Finance Corp.				0

The table lists publicly traded BDCs that conducted an IPO prior to 2012. Mutual fund and institutional ownership are the BDC-level averages over the 2-year period prior to 2014. *Treated* is an indicator that equals one if a BDC has preshock mutual fund ownership above the median level. *Index member* is an indicator that equals one if a BDC was a member of Russell 2500 index. Only AINV and PSEC were members of S&P 500 index. CPTA, GARS, HTGC, and FSC were members of Russell 2500 index but went public after 2012.

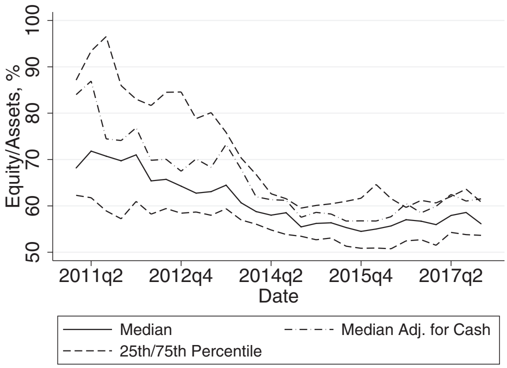


Figure D.1
Leverage of BDCs
The figure depicts the cross-sectional median, as well as the 25th and 75th percentiles of the ratios of total book equity to total book assets across BDCs over time. The green dash-dot line represents the cross-sectional median of the ratios of total book equity to total book assets net of cash holdings across BDCs over time. The data are quarterly observations from 2011:Q1 to 2017:Q4, expressed in percentages.

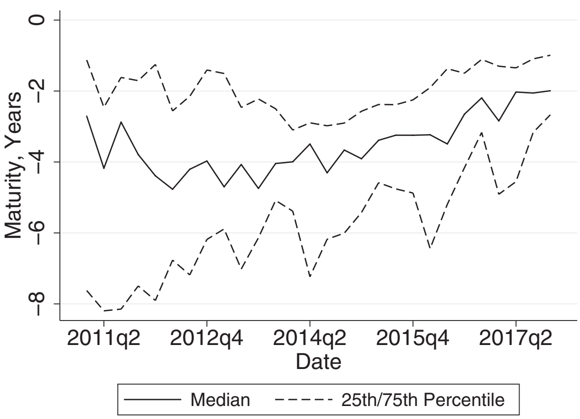


Figure D.2
BDC maturity mismatch
The figure depicts the cross-sectional median, as well as the 25th and 75th percentiles of maturity mismatch between BDCs' assets and liabilities over time. We measure the BDC-level maturity mismatch as difference between the average loan maturity across new debt deal originations and the average maturity of BDC liabilities. The data on the maturity of BDC liabilities are smoothed using the four-quarter moving averages. Maturities are expressed in years. The sample covers the period from 2010:Q1 to 2017:Q4.

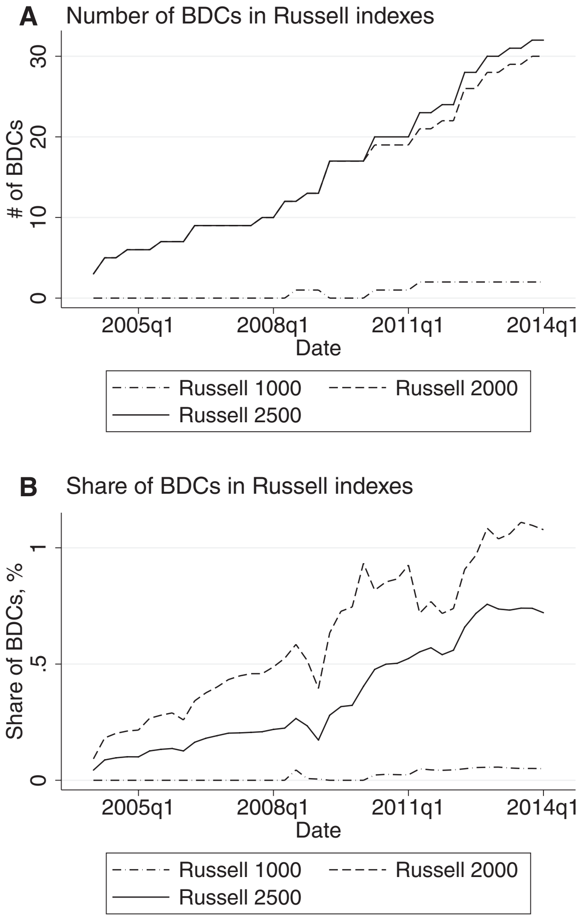


Figure D.3
BDCs in Russell indexes
Panel A depicts the number of BDCs included in the Russell indexes. Panel B depicts the share of BDC in the Russell indexes in terms of market capitalization.

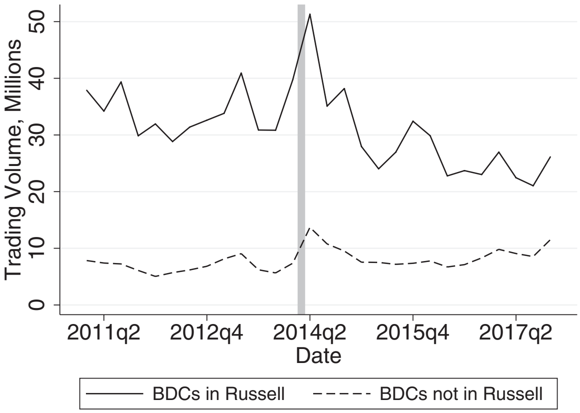


Figure D.4
Trading volume
The figure depicts the cross-sectional average values of the quarterly trading volume across BDCs that are members of the Russell 2500 index as of 2013:Q4 and those that are not over time. The data are quarterly observations from 2011:Q1 to 2017:Q4, expressed in millions of shares.

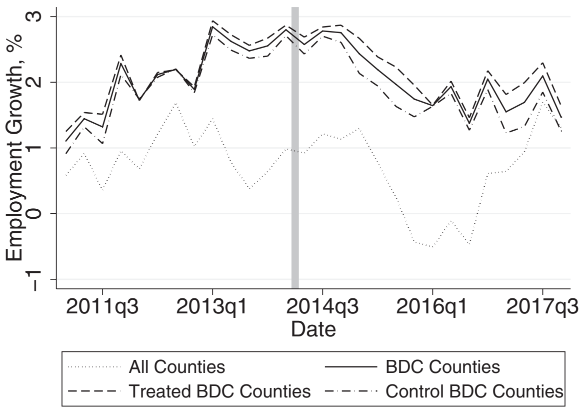


Figure D.5
Middle-market employment growth
The figure depicts the cross-sectional average of the employment growth of middle-market firms (i.e., firms with between 50 and 500 employees) over time. The black dotted line represents the cross-sectional average of the employment growth across all counties in the United States. The solid green line represents the cross-section average of the employment growth across counties with presence of BDC-funded firms. The dashed blue and dash-dot red lines are the cross-section averages of the employment growth across counties with presence of treated and control firms, respectively. The county-level employment data come from the Bureau of Labor Statistic. Employment growth rates are annual and expressed in percentages. The data are quarterly observations from 2011:Q1 to 2017:Q4.

Appendix E. Robustness Analyses

In this Appendix, we provide supportive evidence as well as conduct a number of robustness checks to corroborate and further validate our main findings. We explore alternative criteria for allocating BDCs into the treatment group, consider potential confounding factors, such as a BDC size and an oil price shock in 2014, and alternative allocations of portfolio firms into the treatment group. Our findings continue to hold both quantitatively and qualitatively.

E.1 BDC Investment Activity: Intensive versus Extensive Margin

Recall that the decline in the flow of equity into BDCs after the index exclusion event impedes their growth. To understand whether this decline in investment growth is a purely dollar volume effect, we additionally study the number of relationships that BDCs establish with portfolio firms. Appendix Table E.1 documents that the number of portfolio firms of treated BDCs exhibit 17% lower growth than the number of portfolio firms of control BDCs following the index exclusion. The magnitude of the effect is larger when we restrict the sample only to portfolio firms funded through equity investments or subordinate debt investments. At the same time, we find that the number of senior debt portfolio firms of treated BDCs exhibits 9%–11% higher growth than the number of senior debt portfolio firms of control BDCs. Interestingly, there is also no differential change in the number of new portfolio firms following the index exclusion across treated and control BDCs. Both treated and control BDCs establish fewer relationships with new portfolio firms after the shock; however, the drop is of a similar magnitude for the two groups of BDCs. However, we find that treated BDCs reduce the number of new portfolio firms funded through subordinated debt more than control BDCs. Overall, these findings are in line with a flight-to-quality strategy employed by treated BDCs after the index exclusion event.

E.2 BDC Portfolio Risk

We assess the changes in BDCs' risk exposure by analyzing their portfolio allocations across different investment instruments in terms of the fair value of investments. For robustness, we also analyze the changes in the BDCs' portfolio composition in terms of the number of outstanding deals. In panel A of Appendix Table E.2, we show that, across all investment instruments, treated BDCs hold 22% fewer deals than control BDCs following the AFFE shock. We continue to find that the effect is the most pronounced for equity and subordinated debt deals. In particular, we find that treated BDCs experience 32%–40% lower growth in the number of outstanding equity deals following the index exclusion than control BDCs. The comparable estimate for subordinated debt deals is 92%–93%. At the same time, we observe that treated BDCs experience 13%–15% larger growth in the number of outstanding senior debt deals than control BDCs after the AFFE shock. Panel B of Appendix Table E.2 further confirms that treated BDCs tilt their portfolio allocations away from equity investments and subordinated debt deals and toward senior debt deals. These findings are in line with the evidence reported in Table 8.

In Appendix Table E.3, we investigate the effect of the AFFE shock on the number of deals per portfolio firm. We find that treated BDCs hold 4%–5% fewer deals per portfolio firm than BDCs in the control group. The corresponding estimate for debt deals is 4%–6%. These results are in line with our previous finding of no differential change in the number of new portfolio firms following the capital supply shock across treated and control BDCs. For firms with debt deals of different seniority from one BDC, the decline in number of debt deals per firm can also indicate that affected BDCs close subordinated debt deals first. These findings further support a flight-to-quality strategy by treated BDCs.

E.3 BDCs Specializing in Equity or Debt Investments

A few BDCs in our analysis sample specialize in either making equity or debt investments. Specifically, for RAND and GSVC the number of equity investment deals exceeds 97%, while for SUNS and WHF the number of debt investment deals exceeds 97%. For these BDCs, the fair

Table E.1
Number of portfolio firms

A. All portfolio firms

	ln(# of PF)		ln(# of Equity PF)		ln(# of Debt PF)		ln(# of Sub. Debt PF)		ln(# of Senior Debt PF)	
Post × Treated	−0.17***	−0.17***	−0.40***	−0.34***	−0.15***	−0.15***	−0.84***	−0.82***	0.09	0.11*
	(0.03)	(0.04)	(0.06)	(0.05)	(0.04)	(0.05)	(0.08)	(0.08)	(0.06)	(0.07)
ln(Assets$_{t-1}$)		0.24***		0.54***		0.15***		0.41***		0.11
		(0.04)		(0.06)		(0.05)		(0.09)		(0.07)
Debt/Assets$_{t-1}$		−0.00		−0.00		−0.00		0.01**		−0.00**
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Net Int. Inc./Assets$_{t-1}$		−0.01		0.02**		−0.01		0.00		−0.00
		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.92	.93	.88	.91	.93	.93	.85	.86	.92	.92
N	654	609	654	609	654	609	654	609	654	609

B. New portfolio firms

	ln(# of New PF)		ln(# of New Equity PF)		ln(# of New Debt PF)		ln(# of New Sub. Debt PF)		ln(# of New Senior Debt PF)	
Post × Treated	−0.04	−0.02	−0.01	−0.01	−0.07	−0.05	−0.30***	−0.36***	0.08	0.11
	(0.11)	(0.11)	(0.09)	(0.10)	(0.10)	(0.10)	(0.08)	(0.08)	(0.10)	(0.11)
ln(Assets$_{t-1}$)		−0.38***		0.03		−0.28**		−0.12		−0.31***
		(0.12)		(0.11)		(0.12)		(0.09)		(0.12)
Debt/Assets$_{t-1}$		−0.01		−0.00		−0.01*		0.00		−0.01**
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Net Int. Inc./Assets$_{t-1}$		−0.04*		0.00		−0.04**		−0.02		−0.04**
		(0.02)		(0.02)		(0.02)		(0.01)		(0.02)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.58	.62	.48	.5	.61	.63	.5	.51	.65	.67
N	654	609	654	609	654	609	654	609	654	609

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the logarithm of one plus number of all portfolio firms in panel A and new portfolio firms in panel B of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. A portfolio firm is classified as an equity portfolio firm if it has at least one equity investment outstanding with a BDC. The same definition applies for the debt, subordinated debt, and senior debt portfolio firms. A portfolio firm is classified as new if it has received financing from a BDC i for the first time. The data are quarterly observations from 2012:Q1 to 2016:Q4.

Table E.2
Investment Decomposition: Number of Investment Deals

A. Number of outstanding deals by type

	ln(# of Deals)		ln(# of Equity Deals)		ln(# of Debt Deals)		ln(# of Sub Debt Deals)		ln(# of Senior Debt Deals)	
Post × Treated	−0.22***	−0.22***	−0.40***	−0.32***	−0.19***	−0.21***	−0.92***	−0.93***	0.13**	0.15**
	(0.04)	(0.04)	(0.06)	(0.06)	(0.04)	(0.05)	(0.09)	(0.09)	(0.06)	(0.07)
ln(Assets$_{t-1}$)		0.37***		0.63***		0.23***		0.46***		0.21***
		(0.04)		(0.06)		(0.05)		(0.10)		(0.07)
Debt/Assets$_{t-1}$		0.00		0.00		−0.00		0.01***		−0.01**
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Net Int. Inc./Assets$_{t-1}$		−0.01		0.02*		−0.01		−0.00		−0.00
		(0.01)		(0.01)		(0.01)		(0.02)		(0.01)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.9	.92	.87	.91	.94	.94	.84	.86	.93	.93
N	654	609	654	609	654	609	654	609	654	609

B. Portfolio shares

	% of Equity Deals		% of Debt Deals		% of Sub Debt Deals		% of Senior Debt Deals	
Post × Treated	−4.72***	−4.28***	4.72***	4.28***	−6.36***	−6.79***	11.08***	11.07***
	(1.16)	(1.14)	(1.16)	(1.14)	(0.99)	(1.03)	(1.44)	(1.37)
ln(Assets$_{t-1}$)		9.26***		−9.26***		−0.13		−9.13***
		(1.26)		(1.26)		(1.13)		(1.52)
Debt/Assets$_{t-1}$		0.04		−0.04		0.13***		−0.17***
		(0.04)		(0.04)		(0.03)		(0.05)
Net Int. Inc./Assets$_{t-1}$		0.50**		−0.50**		0.15		−0.65***
		(0.20)		(0.20)		(0.18)		(0.24)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.91	.93	.91	.93	.8	.82	.91	.93
N	654	609	654	609	654	609	654	609

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the natural logarithm of number of outstanding deals in panel A and the share of equity and debt investments in terms of the number of investment deals in panel B of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. The data are quarterly observations from 2012:Q1 to 2016:Q4.

Table E.3
Number of Investment Deals per Portfolio Firm

	ln(# of Deals per PF)		ln(# of Debt Deals per PF)	
Post × Treated	−0.05***	−0.04**	−0.04***	−0.06***
	(0.02)	(0.02)	(0.02)	(0.02)
ln(Assets$_{t-1}$)		0.13***		0.08***
		(0.02)		(0.02)
Debt/Assets$_{t-1}$		0.00**		0.00
		(0.00)		(0.00)
Net Int. Inc./Assets$_{t-1}$		0.00		−0.00
		(0.00)		(0.00)
BDC FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
R^2	.87	.9	.82	.84
N	654	609	654	609

The table reports the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the natural logarithm of outstanding deals per portfolio firm by a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. The data are quarterly observations from 2012:Q1 to 2016:Q4.

value of equity and debt investments is very sensitive to minor changes in the portfolio composition. Moreover, their ability to adjust portfolio risk by shifting across instrument types could be limited due to their specialization in a specific type of investment. For robustness, we estimate the effect of the AFFE shock on the BDCs' portfolio composition excluding these four BDCs from our sample. Our results continue to hold (see Appendix Table E.4).

E.4 BDC Allocation to Treatment

In our baseline specifications, we study the implications of the AFFE shock when the allocation of BDCs into the treatment is discrete based on the median preshock level of mutual fund ownership. We additionally report the effects of the index exclusion on the BDC outcomes using the continuous measure of mutual fund ownership. To capture the average effect of $Post$, we demean the continuous treatment variable in our regressions. We further standardize it for ease of interpretation. Appendix Table E.5 documents that a one standard deviation increase in mutual fund ownership prior to the shock results in a 1.58 p.p. larger drop in the mutual fund ownership following the shock relative to before. This shift in equity ownership ultimately leads to 7% and 15% lower growth in the BDCs' book equity and fair value of investments, correspondingly.

In our main analysis, we rely on the median ownership levels, which allows us to account for potential asymmetry in the ownership distribution. Alternatively, one could split BDCs into treated and control groups based on the average preshock level of mutual fund ownership. Panel A of Appendix Table E.6 reports these results. We continue to find that the treated BDCs experience a significantly lower growth in book equity—13% as compared to 16% in the baseline regression—than do BDCs in the control group, with subsequent lower growth in the fair value of investments at 31% as compared to 33% in the baseline regression.

Furthermore, we focus on the mutual fund ownership to allocate BDCs into the treatment as this type of institutional investors specialize in tracking market indexes and, as a result, are susceptible to index reconstitution events. For robustness, we additionally analyze the impact of the index exclusion on the BDC outcomes when BDCs are allocated into the treatment group based on their overall institutional ownership. Panel B of Appendix Table E.6 demonstrates that our difference-in-differences estimates, although weaker, remain both statistically and economically significant. These lower magnitudes could be driven by substantial heterogeneity in the institutional investor

Table E.4
Investment Decomposition: Fair Value of Investments (Excluding Outliers)

A. Fair value of investments by type

	ln(Equity Inv.)		ln(Debt Inv.)		ln(Sub. Debt Inv.)		ln(Senior Debt Inv.)	
Post × Treated	−0.13	−0.17**	−0.06	−0.04	−1.11***	−1.14***	0.20**	0.26***
	(0.10)	(0.09)	(0.06)	(0.07)	(0.16)	(0.17)	(0.09)	(0.10)
ln(Assets$_{t-1}$)		1.34***		0.35***		0.77***		0.36***
		(0.09)		(0.07)		(0.18)		(0.10)
Debt/Assets$_{t-1}$		−0.00		0.00		0.00		−0.00
		(0.00)		(0.00)		(0.01)		(0.00)
Net Int. Inc./ Assets$_{t-1}$		0.02		0.02		−0.01		0.03*
		(0.02)		(0.01)		(0.03)		(0.02)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.89	.93	.96	.96	.86	.87	.94	.94
N	578	539	578	539	578	539	578	539

B. Portfolio shares

	% of Equity Inv		% of Debt Inv.		% of Sub. Debt Inv.		% of Senior Debt Inv.	
Post × Treated	−3.98***	−5.66***	1.82	3.08**	−8.48***	−8.37***	10.31***	11.45***
	(1.13)	(1.22)	(1.17)	(1.27)	(1.44)	(1.56)	(1.52)	(1.58)
ln(Assets$_{t-1}$)		7.14***		−7.80***		0.61		−8.41***
		(1.31)		(1.37)		(1.68)		(1.70)
Debt/Assets$_{t-1}$		−0.08**		0.12***		0.18***		−0.06
		(0.04)		(0.04)		(0.05)		(0.05)
Net Int. Inc./ Assets$_{t-1}$		−0.25		0.14		0.22		−0.08
		(0.23)		(0.24)		(0.30)		(0.30)
BDC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.95	.95	.94	.94	.86	.87	.92	.93
N	578	539	578	539	578	539	578	539

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the logarithm of one plus fair value of equity and debt investments in panel A and the share of equity and debt investments in terms of the fair values in panel B of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. We exclude the BDCs specializing in either equity or debt investments from the sample (i.e., RAND, GSVC, SUNS, and WHF). The equity and debt shares are expressed in percentages. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

base, who might differ in their investment strategies and goals as to why they gain exposure to the BDC equity.

Finally, we report the results when the treated group is comprised of all BDCs that have been excluded from the stock indexes. The difference-in-differences estimates are presented in panel C of Appendix Table E.6. Such assignment of BDCs into the treatment results in unbalanced group of treated and control BDCs as compared to our benchmark specification. Specifically, the control group now does not include BDCs excluded from the indexes with low preshock mutual fund ownership. Our results continue to hold both quantitatively and qualitatively.

E.5 BDC Size

One potential concern could be that our results are in part driven by the BDC fundamentals related to mutual fund ownership rather than by the capital supply shock. For example, the BDC size could be a confounding factor since our treated BDC are on average larger than the control group (see Table 2). It is however important to admit that passive mutual funds are holding BDC stocks by tracking the stock indices, which implies that the mutual fund ownership levels are less sensitive

Table E.5
BDC Outcomes: Continuous Treatment Effect

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−1.58***	−1.48**	−0.07***	−0.06***	−0.15***
	(0.23)	(0.61)	(0.01)	(0.01)	(0.02)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.89	.84	.98	.98	.97
N	577	594	609	609	609

The table reports the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the mutual fund ownership in specification (1), the institutional ownership in specification (2), the natural logarithm of book equity in specification (3) the natural logarithm of book assets in specification (4), the natural logarithm of fair value of investments in specification (5) of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is the standardized level of a BDC i's preshock mutual fund ownership. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

to BDC fundamentals. The key reason the mutual fund ownership is correlated with BDC size is because larger BDCs are more likely to be included in stock indices. Moreover, even though treated BDCs are larger than the control ones, there is a significant overlap in the size distribution of the two groups (see panel B in Appendix Figure E.1). To further alleviate these concerns, we perform a number of robustness checks.

First, we redo our analysis excluding the four smallest and four largest BDCs from our sample. Panel A of Appendix Table E.7 shows that our results remain both qualitatively and quantitatively very similar to our baseline estimation. Second, we estimate reestimate our regressions including an additional control variable, that is, *Preshock BDC size* interacted with the *Post* dummy (see panel C of Appendix Table E.7). If anything, the magnitude of our difference-in-differences coefficient $Post \times Treated$ becomes larger. This finding serves as evidence that BDC size is not a confounding factor. Moreover, even unobservables correlated with this control should not be a concern as argued byAltonji, Elder, and Taber (2005). Finally, in a triple difference specification, we document qualitatively similar effects on our outcomes of interest for small and large BDCs (see panel D of Appendix Table E.7). Overall, these robustness tests indicate that our findings are not confounded by the BDC size.

E.6 Exposure to Oil Price Shock

One potential concern could be that the exclusion of BDCs from Russell and S&P 500 indexes coincides with other contemporaneous shocks to direct lenders and/or firms borrowing from them. An example of such a shock is the 2014 drop in crude oil prices, from about \$100 to \$50 per barrel. If treated BDCs lend more heavily to firms in the oil and gas industry than do control BDCs, our findings could partially or fully stem from the oil price shock.

In line with this hypothesis, we should observe a larger drop in profitability of treated BDCs relative to the control group following the index exclusion (see Table 9). To explore the preshock exposure of BDCs to the oil price shock, we compare the share of deals originated to firms in "Petroleum and Natural Gas" industry across treated and control BDCs, in terms of both the number and fair values (see Table 2).[36] If anything, the dollar exposure to the oil and gas industry of the treated group is 2% smaller than that of the control group. Next, we conduct two additional

36 "Petroleum and Natural Gas" industry is the Fama-French industry group with code 30 within 49-industry classification.

Table E.6
BDC Outcomes: Alternative Allocation to Treatment

A. Preshock average mutual fund ownership

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−2.83***	−2.10*	−0.13***	−0.10***	−0.31***
	(0.45)	(1.20)	(0.03)	(0.03)	(0.04)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.89	.84	.98	.98	.97
N	577	594	609	609	609

B. Preshock median institutional ownership

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−2.60***	−3.00**	−0.09***	−0.07**	−0.24***
	(0.45)	(1.18)	(0.03)	(0.03)	(0.04)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.89	.84	.98	.98	.97
N	577	596	614	614	614

C. Excluded from stock indexes

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−4.55***	−4.61***	−0.18***	−0.13***	−0.29***
	(0.67)	(1.63)	(0.04)	(0.04)	(0.05)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.89	.85	.98	.98	.97
N	577	596	609	609	609

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the mutual fund ownership in specification (1), the institutional ownership in specification (2), the natural logarithm of book equity in specification (3) the natural logarithm of book assets in specification (4), the natural logarithm of fair value of investments in specification (5) of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if (a) a BDC i has preshock mutual fund ownership above the average level in panel A; (b) a BDC i has preshock institutional ownership above the median level in panel B; and (c) a BDC i has been excluded from the stock indexes in panel C. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

robustness checks: (a) we redo our analysis excluding BDCs with high exposure to the oil and gas industry, and (b) conduct a placebo test allocating BDCs into the treatment based on their exposure to the oil price shock. In a given quarter, a BDC's exposure to the oil price shock is calculated as the ratio of the fair value of investments allocated to firms in "Petroleum and Natural Gas" industry relative to the fair value of all outstanding investments. Appendix Table E.8 presents the estimation results.

Specifically, we exclude BDCs with pre-2014 exposure to the oil price shock larger than 25% in panel A and larger than 10% in panel B.[37] We continue to find that treated BDCs experience a 3.1–3.4 p.p. larger decline in the mutual fund ownership level than control BDCs following the capital supply shock. These figures are comparable to our benchmark estimate of 3.5 p.p. (see Table 3).

37 In panel A, we exclude Equus Total Return Inc. (44%) from our analysis. In panel B, we additionally exclude Capital Southwest Corp. (14%) and Harris & Harris Group (13%).

Table E.7
BDC Outcomes: BDC Size

A. Exclude smallest & largest BDCs

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−4.08***	−3.54**	−0.14***	−0.12***	−0.35***
	(0.52)	(1.41)	(0.04)	(0.04)	(0.05)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.87	.78	.93	.93	.89
N	451	452	452	452	452

B. BDC size as confounding factor

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−4.64***	−6.38***	−0.19***	−0.17***	−0.40***
	(0.53)	(1.48)	(0.05)	(0.05)	(0.06)
Post × Pre-Shock BDC Size	1.07***	2.29***	0.04*	0.04	0.06**
	(0.28)	(0.74)	(0.02)	(0.02)	(0.03)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.9	.85	.97	.97	.97
N	577	594	609	609	609

C. Triple difference specification

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−4.18***	−6.24***	−0.20***	−0.17***	−0.39***
	(0.54)	(1.49)	(0.05)	(0.05)	(0.06)
Post × Pre-Shock	−0.46	1.49	0.06*	0.08**	0.00
BDC Size	(0.49)	(1.13)	(0.04)	(0.04)	(0.04)
Post × Treated × Pre-Shock	2.18***	1.37	−0.04	−0.07	0.11*
BDC Size	(0.58)	(1.47)	(0.05)	(0.05)	(0.06)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.9	.85	.97	.97	.97
N	577	594	609	609	609

The panels report the estimated coefficients from panel regressions using OLS, where the dependent variable is the mutual fund ownership in specification (1), the institutional ownership in specification (2), the natural logarithm of book equity in specification (3) the natural logarithm of book assets in specification (4), the natural logarithm of fair value of investments in specification (5) of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. $Preshock\ BDC\ size_i$ is the standardized level of a BDC i's pre-shock size, measured with the natural logarithm of book assets. In panel A, we exclude four smallest BDCs (i.e., RAND, EQS, FULL, TINY) and four largest BDCs (i.e., AINV, PSEC, ACAS, ARCC) based the preshock average of book assets. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

The effects of the index exclusion on BDCs' activity also remain unchanged. BDCs' inability to raise equity capital results in reduced capital allocation to portfolio firms.

Our results of a placebo test that allocates BDCs into the treatment based on their exposure to the oil price shock are presented in panel C of Appendix Table E.8. We estimate regression (1) by switching $Treated_i$ with a dummy variable that equals one if a BDC i is has the preshock exposure to the gas and oil industry above the median level. The estimates of the difference-in-differences effect are either statistically insignificant or statistically significant and positive. These estimation results indicate that our findings are not confounded by the drop of oil prices in 2014.

E.7 Standard Errors

For the BDC-level regressions, we choose the OLS standard errors because of the small size of our panel data set: 32 BDCs over 20 quarters, that is, we have a small-T/small-N case. With a

Table E.8
BDC Outcomes: Exposure to Oil Price Shock

A. Exclude BDCs with an exposure larger than 25%

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−3.38***	−3.47***	−0.13***	−0.11***	−0.29***
	(0.46)	(1.23)	(0.03)	(0.03)	(0.04)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.9	.84	.98	.98	.97
N	564	581	589	589	589

B. Exclude BDCs with an exposure larger than 10%

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−3.07***	−4.97***	−0.11***	−0.09***	−0.26***
	(0.47)	(1.23)	(0.03)	(0.03)	(0.04)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.9	.83	.98	.98	.98
N	536	549	549	549	549

C. Placebo test

	(1)	(2)	(3)	(4)	(5)
Post × High Oil Shock Exposure	−0.65	2.46**	0.05	0.03	0.08*
	(0.47)	(1.22)	(0.03)	(0.03)	(0.04)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.89	.84	.98	.98	.97
N	577	596	672	672	665

The panels report the estimated coefficients from panel regressions using OLS, where the dependent variable is the mutual fund ownership in specification (1), the institutional ownership in specification (2), the natural logarithm of book equity in specification (3) the natural logarithm of book assets in specification (4), the natural logarithm of fair value of investments in specification (5) of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. BDCs with pre-2014 exposure to the oil price shock larger than 25% in panel A and 10% in panel B are excluded. The exposure to the oil price shock is defined as the ratio of the fair value of investments in Petroleum and Natural Gas industry to the fair value of all investments. $High\ Oil\ Shock\ Exposure_i$ is an indicator that equals one if a BDC i has pre-2014 exposure to the oil price shock above the median level. The data are real quarterly observations from 2012:Q1 to 2016:Q4.

present-day standard clustering dimension—a BDC as a unit at which the treatment is assigned (Bertrand, Duflo, and Mullainathan 2004)—we are left with 32 clusters to derive the asymptotic properties of the estimator. First, this number is below a rule of thumb of 50 clusters according to Angrist and Pischke (2008). Estimators with poor asymptotic properties can result in over- and under-rejection of the null hypothesis (MacKinnon, Nielsen, and Webb 2023). Second, the time dimension of our panel may not be long enough to reliably estimate the within-cluster variance-covariance matrix. Finally, some (but not all) of the within-cluster variation may be absorbed after including fixed effects.

For robustness, we use the Driscoll and Kraay (1998) estimator to account for potential autocorrelation of the BDC-level outcomes up to 4 of quarters (see Table E.9). We choose to correct for 4 quarters of autocorrelation despite the fact that in our specification the optimal number of lags suggested by the estimation procedure is below one. Furthermore, if one expects the outcomes to be correlated across BDCs, we need to compute the two-way clustered standard errors (Cameron, Gelbach, and Miller 2011; Thompson 2011). In this case, the asymptotic properties

Table E.9
BDC Outcomes: Standard Errors

A. HAC-adjusted standard errors

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−4.17***	−6.25***	−0.12*	−0.10	−0.29***
	(0.67)	(1.70)	(0.07)	(0.07)	(0.07)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.89	.82	.96	.96	.96
N	622	639	634	634	654

B. Double-clustered standard errors

	(1)	(2)	(3)	(4)	(5)
Post × Treated	−4.17***	−6.25***	−0.12**	−0.10**	−0.29***
	(0.66)	(1.19)	(0.05)	(0.05)	(0.03)
Controls	Yes	Yes	Yes	Yes	Yes
BDC FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
R^2	.89	.82	.96	.96	.96
N	622	639	634	634	654

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the mutual fund ownership in specification (1), the institutional ownership in specification (2), the natural logarithm of book equity in specification (3) the natural logarithm of book assets in specification (4), the natural logarithm of fair value of investments in specification (5) of a BDC i at time t. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. In panel A, we control for autocorrelation of the BDC-level outcomes up to 4 of quarters using the Driscoll and Kraay (1998) estimator. In panel B, we double cluster standard errors on the BDC and quarter levels using the Driscoll and Kraay (1998) estimator with the maximum autocorrelation of 4 quarters The data are real quarterly observations from 2012:Q1 to 2016:Q4.

Table E.10
Firm-Level Employment: Alternative Measures of Employment Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Post × Treated Firm	0.043**	0.046***	0.038***	0.039*	0.040**	0.040***
	(0.017)	(0.015)	(0.012)	(0.020)	(0.020)	(0.014)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
R2	.289	.291	.314	.208	.209	.26
N	6133	6133	6133	6247	6247	6247

The table reports the estimated coefficients from the difference-in-difference estimation:

$$\Delta Emp_{j,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \epsilon_{j,t},$$

where the dependent variable in each regression is the annual growth rate of employment of a portfolio firm j at time t. In columns 1–3, we compute the average growth rate across different plans. In columns 4–6, we compute the growth rate of total employment across plans. Growth rates are winsorized at 1% in columns 2 and 5, and at 5% in columns 3 and 6. $Post_t$ is a dummy variable that equals one from 2015 onward and zero before. $Treated\ Firm_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with a treated BDC prior to the shock. Portfolio firms with outstanding investments with both treated and control BDCs prior to the shock are excluded. The data are annual and span the period 2011-2017. Standard errors are clustered at the portfolio-firm level.

Table E.11
Firm-Level Employment: Small vs. Large Firms

	Small				Large			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	−0.055***				−0.052**			
	(0.018)				(0.024)			
Treated Firm	−0.037**				−0.041**			
	(0.017)				(0.020)			
Post × Treated Firm	0.037	0.045*	0.068*	0.079*	0.030	0.051***	0.054*	0.038
	(0.026)	(0.024)	(0.038)	(0.040)	(0.028)	(0.019)	(0.031)	(0.031)
Firm FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
$\widehat{\text{Firm-Year FE}}$	Yes	No	No	No	Yes	No	No	No
Industry-Year FE	No	Yes	No	Yes	No	Yes	No	Yes
County-Year FE	No	No	Yes	Yes	No	No	Yes	Yes
R2	.0084	.319	.483	.51	.013	.321	.505	.547
N	1954	2775	1909	1887	1924	3310	2272	2255

The table reports the estimated coefficients from the difference-in-difference estimation:

$$\Delta Emp_{j,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \epsilon_{j,t},$$

where the dependent variable in each regression is the annual growth rate of employment winsorized at 1% of a portfolio firm j at time t. $Post_t$ is a dummy variable that equals one from 2015 onward and zero before. $Treated\ Firm_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with a treated BDC prior to the shock. Portfolio firms with outstanding investments with both treated and control BDCs prior to the shock are excluded. A portfolio firm is classified as large (small) if its number of employees is above (below) median level as of 2014. $\widehat{Firm\text{-}Year\ FE}_j$ is the imputed firm-year fixed effects from regression (3) with the dependent variable being the natural logarithm of fair value of investments. The data are annual and span the period 2011-2017. Standard errors are clustered at the portfolio-firm level.

are defined by the clustering direction with the smallest number of clusters (i.e., 20 time clusters for our panel). We again rely on the Driscoll and Kraay (1998) estimator but additionally cluster standard errors at the quarter level. In this way, we control for spatial dependences among BDCs (see panel B of Table E.9). While we can implement the described empirical procedure, MacKinnon, Nielsen, and Webb (2023) argue that the asymptotic theory for the two-way clustering is still under the development.

E.8 Real Effects

In our baseline specification, we proxy firm-level employment growth with the average of the growth rates in the number of participants for each pension plan, weighted by the number of participants. Additionally, we winsorize this measure at 1%. For robustness, we reestimate the difference-in-differences specification for the employment growth using an alternative proxy, that is, the growth rate in the total number of participants across the pension plans (see Appendix Table E.10). Moreover, we report the results for two measures of employment growth when they are not winsorized and winsorized at 5%. Our findings remain both qualitatively and quantitative similar.

The regression estimates in Table 11 indicate that in the preshock period the employment growth of firms in the control group is 2.7%–3.9% higher than of firms in the treated group, suggesting that control firms are on average smaller than treated ones in terms of the number of employees. Therefore, one might be concerned that the observed differential effect of the AFFE shock on the employment growth across the two groups of portfolio firms is stemming from the differences in firm size. For example, a decrease in the number of employees by 1 would result in a larger drop in the employment growth for small firms than large ones. We thus perform a subsample analysis and estimate regression (5) separately for small and large firms (see Appendix Table E.11). We document a positive effect for both small and large firms. The coefficient estimates are statistically significant for most specifications. Specifically, we find that small (large)

Table E.12
Establishing Relationships with new BDCs: Firms with Employment Data

	(1)	(2)	(3)
Post	−0.49***	−0.49***	−0.48***
	(0.04)	(0.04)	(0.04)
Treated Firm	−0.09**	−0.14***	−0.08
	(0.04)	(0.04)	(0.05)
Post × Treated Firm	0.21***	0.18***	0.34***
	(0.05)	(0.05)	(0.07)
$\widehat{\text{Firm-Time FE}}$	Yes	Yes	Yes
BDC-Level Controls	Yes	Yes	Yes
R^2	.16	.21	.17
N	1625	1168	1005

The table reports the estimated coefficients from investment-level panel regressions using OLS:

$$y_{j,t} = \beta_1 Post_t + \beta_2 Treated\ Firm_j + \beta_3 Post_t \times Treated\ Firm_j + \delta \overline{X}_{j,t-1} + \epsilon_{j,t},$$

where the dependent variable is the indicator that equals one if a portfolio firm j receives a debt investment from at least one new BDC. The sample is restricted only to newly originated debt deals. $Post_t$ is a dummy variable that equals one starting from 2014:Q3 and zero otherwise. $Treated\ Firm_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with a treated BDC prior to the shock. Portfolio firms with outstanding investments from both treated and control BDCs prior to the shock are excluded. Specification focuses on treated firms that continue investment relationship with their treated BDCs after 2016:Q1, while specification (3) focuses on treated firms that exit investment relationship with their treated BDCs. $\widehat{Firm\text{-}Time\ FE}_j$ is the imputed firm-time fixed effects from regression (3) with the dependent variable being the natural logarithm of fair value of investments. We limit the sample of portfolio firms to those with employment data from the DOL. The BDC-level controls are averages at the firm level. The data are quarterly observations from 2012:Q1 to 2016:Q4. Standard errors are clustered at the portfolio-firm level.

firms relying on funding from the treated BDCs in the preshock period experience a 3.7%–7.9% (3.0%–5.4%) larger employment growth than small (large) firms in the control group. These findings imply that the changes in firm-level employment are not mechanically driven by the differences in firm size, but are rather induced by the AFFE shock. We collect firm-level employment data by merging our investment-level BDC data set with the DOL data. We match 47% of BDC portfolios firms in our analysis sample. To rule out potential selection bias, we therefore repeat our analysis for the firm propensity to establish investment relationship with new BDCs focusing on a subset of firms with the DOL employment data. All the findings continue to hold (see Appendix Table E.12).

E.9 Firm Allocation to Treatment

For robustness, we consider two alternative treatment allocations for portfolio firms. While the benchmark specification excludes firms receiving funding from both treated and control BDCs in the preshock period, we additionally consider the extended set of treated firms. Specifically, we classify a firm as treated if it had an investment relationship with at least one treated BDC in the preshock period. Furthermore, we use a continuous treatment measure, which allows us to capture the extent of firm's exposure to treated BDCs. In particular, we calculate the share of funding received from treated BDCs by a given firm for each quarter and then take the time-series average of these quantities over the preshock period. We analyze the impact of the AFFE shock on firm-level employment growth with these two alternative firm treatment allocations. The estimation results for the extended set of treated firms and the continuous treatment measure are reported in panels A and B of Appendix Table E.13. The effect of the AFFE shock on firm-level employment is quantitatively similar to our baseline specification. Appendix Figure E.2 further demonstrates that there are no statistical differences among the treated and control firms prior to the index exclusion.

Table E.13
Firm-Level Employment: Alternative Firm Allocation to Treatment

A. Firm treated extended

	(1)	(2)	(3)	(4)	(5)	(6)
Post	−0.064***	−0.054***				
	(0.011)	(0.014)				
Treated	−0.024**	−0.037***				
	(0.010)	(0.012)				
Post × Treated	0.030**	0.034*	0.047***	0.045***	0.039*	0.033
	(0.014)	(0.018)	(0.014)	(0.015)	(0.020)	(0.021)
Year FE	No	No	Yes	No	No	No
Firm FE	No	No	Yes	Yes	Yes	Yes
$\widehat{\text{Firm-Year FE}}$	No	Yes	No	No	No	No
Industry-Year FE	No	No	No	Yes	No	Yes
County-Year FE	No	No	No	No	Yes	Yes
R2	.00801	.00901	.29	.304	.422	.437
N	7059	4502	6992	6959	5338	5306

B. Continuous exposure

	(1)	(2)	(3)	(4)	(5)	(6)
Post	−0.060***	−0.049***				
	(0.011)	(0.014)				
Treated	−0.020*	−0.036***				
	(0.010)	(0.012)				
Post × Treated	0.025*	0.029	0.042***	0.041***	0.039*	0.034
	(0.014)	(0.018)	(0.014)	(0.015)	(0.020)	(0.021)
Year FE	No	No	Yes	No	No	No
Firm FE	No	No	Yes	Yes	Yes	Yes
$\widehat{\text{Firm-Year FE}}$	No	Yes	No	No	No	No
Industry-Year FE	No	No	No	Yes	No	Yes
County-Year FE	No	No	No	No	Yes	Yes
R2	.0077	.0089	.29	.304	.422	.437
N	7059	4502	6992	6959	5338	5306

The panels report the estimated coefficients from the difference-in-difference estimation:

$$\Delta Emp_{j,t} = \beta_1 Post_t + \beta_2 Treated_j + \beta_3 Post_t \times Treated_j + \epsilon_{j,t},$$

where the dependent variable in each regression is the annual growth rate of employment winsorized at 1% of a portfolio firm j at time t. $Post_t$ is a dummy variable that equals one from 2015 onward and zero before. In panel A, $Treated_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with *at least one* treated BDC prior to the shock. Portfolio firms with outstanding investments with both treated and control BDCs prior to the shock are classified as treated. In panel B, $Treated_j$ represents the share of funding received by a portfolio firm j from treated BDCs in the preshock period. $\widehat{Firm\text{-}Year\ FE}_j$ is the imputed firm-year fixed effects from regression (3) with the dependent variable being the natural logarithm fair value of investments. The data are annual and span the period 2011-2017.Standard errors are clustered at the portfolio-firm level.

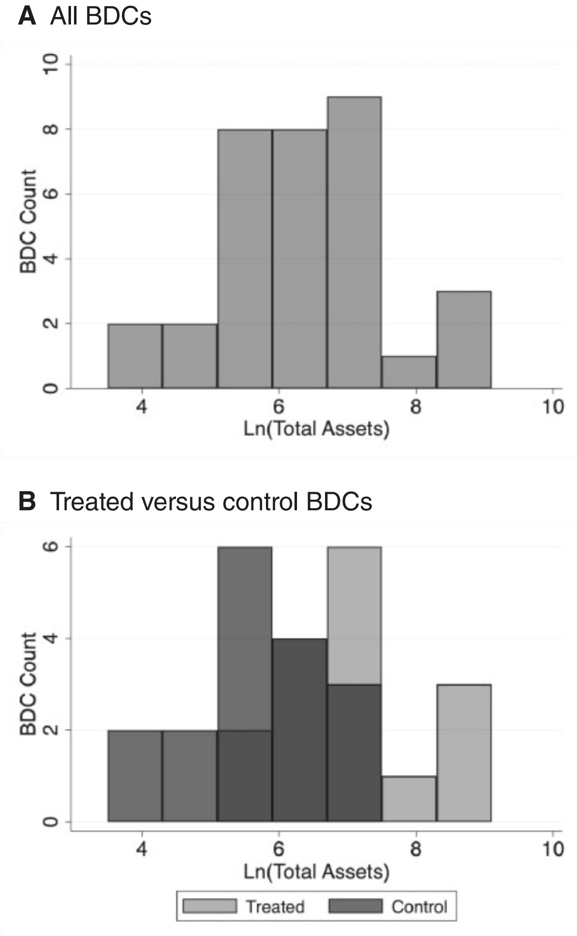
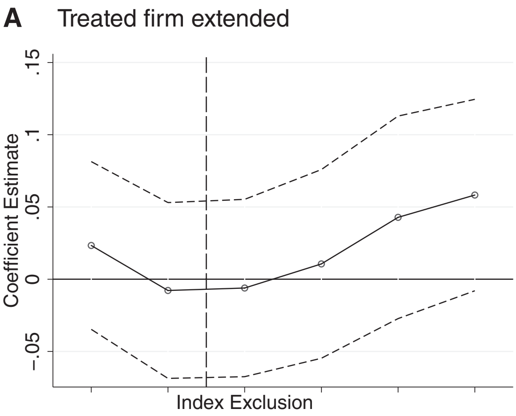


Figure E.1
Distribution of BDC size
The figures depict the distribution of BDC size across all direct lenders in panel A and across control and treated groups in panel B as of 2013:Q4. A BDC i is in the treated group if it has the preshock mutual fund ownership above the median level.



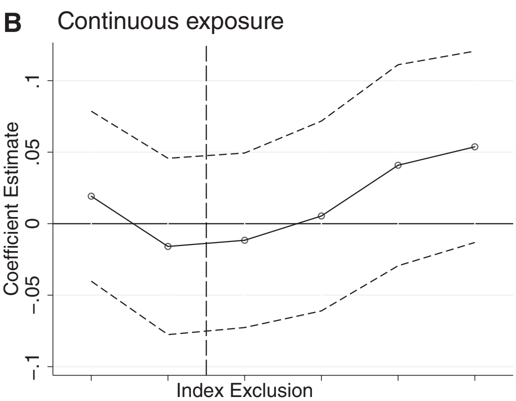


Figure E.2
Parallel trends: Firm-level employment growth
The figures depict the coefficient estimates of γs along with the 95% confidence intervals from the following panel regression:

$$y_{j,t} = \beta_1 Post_t + \beta_2 Treated_j + \sum_t \gamma_t \left(\lambda_t \times Treated_j\right) + \epsilon_{j,t},$$

where the dependent variable in each regression is the annual growth rate of employment winsorized at 1% of portfolio firm j at time t. λs are post-year dummies: for each year t in the sample period, λ_t is set to one starting from year t and zero otherwise. Dummy for 2014 is excluded. In panel A, $Treated_j$ is an indicator that equals one if a portfolio firm j has an outstanding investment with *at least one* treated BDC prior to the shock. Portfolio firms with outstanding investments with both treated and control BDCs prior to the shock are classified as treated. In panel B, $Treated_j$ represents the share of funding received by a portfolio firm j from treated BDCs in the preshock period. The data are annual and span the period 2011-2017.

Appendix F. Costs of BDC Capital

In this Appendix, we analyze the changes in BDCs' direct costs of raising capital following the index exclusion. While the stock index reconstitution inadvertently affected the institutional ownership of BDCs, it is less evident whether BDCs faced higher costs of raising capital going forward. For this analysis, we collect gross spreads, yields and fees for BDC equity and debt issuances from the Securities Data Companies' (SDC) Platinum. For equity, we focus on the costs of shelf offerings conducted by BDCs. Following Lee, Lochhead, Ritter, and Zhao (1996),

Table F.1
Cost of BDC Capital

A. Equity issuance

	Gross Spread Net Fees		Gross Spread	
	(1)	(2)	(3)	(4)
Post × Treated	0.386	0.195	1.182*	0.974
	(0.641)	(0.645)	(0.705)	(0.698)
$Ln(Assets_{t-1})$		−0.380*		−0.490**
		(0.196)		(0.212)
$Debt/Assets_{t-1}$		0.005		−0.003
		(0.019)		(0.020)
Net Int. Inc./$Assets_{t-1}$		−0.024		−0.015
		(0.070)		(0.076)
BDC FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	.352	.4	.431	.491
N	172	172	172	172

B. Debt issuance

	Yield		Gross Spread	
	(1)	(2)	(3)	(4)
Post × Treated	0.364	0.094	0.921*	1.098**
	(1.576)	(1.665)	(0.463)	(0.504)
$Ln(Assets_{t-1})$		1.449		0.315
		(1.707)		(0.517)
$Debt/Assets_{t-1}$		0.052		−0.015
		(0.052)		(0.016)
Net Int. Inc./$Assets_{t-1}$		0.406*		0.034
		(0.212)		(0.064)
BDC FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	.265	.323	.312	.328
N	92	92	92	92

The panels report the estimated coefficients from panel regressions using OLS:

$$y_{i,t} = \beta_1 Post_t + \beta_2 Treated_i + \beta_3 Post_t \times Treated_i + \delta X_{i,t-1} + \epsilon_{i,t},$$

where the dependent variable is the BDC cost of equity issuances in panel A and debt issuances panel B. $Post_t$ is a dummy variable that equals one starting from 2014 and zero otherwise. $Treated_i$ is an indicator that equals one if a BDC i has preshock mutual fund ownership above the median level. All spreads and fees are expressed as a percentage of the principal amount. The data cover BDC debt and equity issuances from 2011 to 2016.

we measure the direct issuance costs using gross spreads. To disentangle the effect of the changes in fees, we also report gross spreads net of management fees, underwriting fees, and selling concessions for equity issuance and yields for debt issuances. All quantities are expressed in percent of the principal amount. Table F.1 presents the estimation results of regression (1) with issuance costs as a dependent variable. We document a 1.0–1.2 p.p. larger increase in equity issuance costs for treated BDCs relative to control BDCs in the post-shock period (see panel A of Table F.1). However, this effect seems to be driven by an increase in underwriting and management fees, as it becomes difficult to place an issuance. The coefficient estimates in panel B of Table F.1 imply that the similar conclusions apply to BDC debt issuances. While the differential changes in yields are statistically insignificant, we find a 0.9–1.1 p.p. larger increase in gross spreads for treated BDCs compared to control BDCs following the index exclusion. Overall, these results suggest that BDCs indeed faced an increase in costs of raising additional capital for their investments. Our estimation results are based on a relatively small number of observations and therefore should be treated as a suggestive evidence.

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