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Young Soo Jang
Dasol Kim
Amir Sufi
Xiangyu Chen

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ABSTRACT

We compare the lending technology of direct lenders, banks, and finance companies using a unique data set on secured borrowing by the universe of U.S.-based private middle market firms. The dramatic rise of direct lenders over the past 20 years is due to their comparative strength in providing enterprise-value based loans to private equity-backed firms in intangible capital industries. The rise in direct lending is also partially explained by a pull-back in bank lending due to stronger post-Global Financial Crisis banking regulation, but the strength of this channel is quantitatively weaker. Direct lenders write collateral claims more focused on the continuation value of firms after default, especially when the firms operate in intangible capital industries. Direct lenders are more highly specialized by industry than banks. The evidence supports the view that direct lenders have a relative advantage in lending to higher risk borrowers where there is a large gap between continuation value and liquidation value in the event of default.

Young Soo Jang
The Pennsylvania State University
ykj5180@psu.edu

Dasol Kim
U.S. Department of the Treasury
dasol.kim@ofr.treasury.gov

Amir Sufi
The University of Chicago
Booth School of Business
and NBER
amir.sufi@chicagobooth.edu

Xiangyu Chen
Xiangyu.Chen@chicagobooth.edu

The stunning rise of direct lending–the main strategy within the broader private credit universe–challenges traditional views on financial intermediation. Direct lenders specialize in relationship-based information-sensitive lending to private middle market firms. They do so despite significant disadvantages relative to banks. For example, direct lenders lack a branch network and cannot obtain information through cash management services to their business borrowers. Scholarship in financial intermediation argues that deposit-financed banks are best positioned to do information-sensitive lending due to their comparative advantages in information and monitoring technologies, liquidity provision, and loan sourcing (e.g., Diamond (1984); Berger and Udell (1995); Diamond and Rajan (2001); Kashyap, Rajan and Stein (2002); Berger, Miller, Petersen, Rajan and Stein (2005); Degryse and Ongena (2005)).

Despite these disadvantages, direct lenders as an industry currently hold loans worth approximately $800 billion in the United States.[1] How? What is their comparative strength relative to traditional middle market business lenders such as banks and finance companies? What is the lending technology of direct lenders?

A central challenge in answering these questions is data availability. Middle market firms are mostly private companies with little public information on the sources of their financing, and the portfolios of direct lenders are largely unobservable in readily available data sources. Furthermore, there are few data sets that jointly track loans made by banks, finance companies, and direct lenders, thereby limiting the ability to directly compare the borrowers of these distinct intermediary groups.

This study builds a novel dataset to meet this challenge. The backbone of the dataset is the National Establishment Time Series (NETS) database produced by Walls & Associates from Dun & Bradstreet records. This dataset covers the near-universe of business establishments in the United States, which allows for the construction of a data set of middle market firms (e.g., Neumark, Wall and Zhang (2011); Denes, Howell, Mezzanotti, Wang and Xu (2023)).[2] The NETS dataset is matched to Business Development Corporation (BDC) investments, private credit investment information from PitchBook, and Uniform Commercial Code (UCC) filings, which are filings a creditor submits to a state to publicly declare a security interest in a borrower's collateral (e.g. Gopal and Schnabl (2022)). Data from PitchBook and Preqin are used to identify which lenders are direct lenders, and data from Capital IQ and PitchBook are used to measure which borrowers are backed

[1]This estimate is based on data from U.S. private credit funds with Form PF filings and from BDCs, which we describe in more detail in Section 1.

[2]Throughout the analysis, the "middle market" is defined as firms employing between 21 and 1000 workers.

by a PE sponsor.

There are several advantages of this data set relative to the existing literature. First, because the backbone of the data set is the universe of all U.S. businesses, the data set allows for measurement of the firms that do and do not borrow from direct lenders. This is crucial to understanding the overall penetration of direct lenders across the U.S. economy, and many of the statistics we provide in this regard are new to the literature. Second, the UCC filings offer a more comprehensive view of the borrowers of direct lenders relative to data on Business Development Companies (BDCs) or PitchBook. Third, the data set measures the set of firms that are owned by a private equity sponsor more comprehensively than previous analyses. Private equity is a crucial part of the direct lending strategy; accurate measurement of private equity is an important part of any analysis of direct lenders.

Two main hypotheses have emerged to explain the success of direct lenders. The first proposes that direct lenders have gained market share due to a pull-back in lending by banks driven by tighter banking regulation and supervision in the aftermath of the Global Financial Crisis.[3] The second argues that direct lenders have succeeded by focusing on continuation-value-based lending to intangible-capital-intensive private equity-backed borrowers for which bank loans are ill-suited.[4] The central finding of this study is that both hypotheses are supported in the data, but the second hypothesis is quantitatively stronger.

One supporting piece of evidence in favor of the second hypothesis is that the firms that borrow from direct lenders are distinct from those that borrow from banks and finance companies, and the differences are quantitatively large. The borrowers of direct lenders tend to be younger, riskier (in terms of a business credit score), more likely to be in intangible capital-intensive industries such as business services and software, more likely to be in the largest cities in the United States, and larger on average in terms of total employment. The difference in the industry focus is especially striking. For example, 27% of the borrowers of direct lenders are in the intangible-capital intensive

[3]For example, Morgan Stanley notes that "the direct lending market has grown, but we firmly believe that growth is defensible. At the macro level, direct lending has effectively stepped in to fill the void left by banks that have generally retreated from mid-market lending post-crisis." Similarly, PGIM, Inc emphasizes that "direct lending has grown dramatically over the last 10 years and we believe will likely continue … With the GFC and Dodd-Frank reform, enhanced rules and regulatory requirements decreased banks' ability and willingness to issue loans to middle-market companies."

[4]For example, the law firm O'Melveny states that "unlike regulated banks, many direct lenders approach underwriting from an enterprise value perspective rather than traditional asset-based underwriting … private credit funds may have more flexible mandates and are more likely than banks to view these loans as long-term investments (i.e., from 'cradle to grave').

industries of business and information services, compared to only 14% of the borrowers of banks and finance companies. The large differences in the composition of borrowers of direct lenders cast doubt on the view that direct lenders are a general substitute for traditional lenders such as banks and finance companies.

Furthermore, direct lenders lend disproportionately to firms backed by a PE sponsor. The fact that direct lenders focus so heavily on PE-backed firms is widely understood from both survey evidence from the academic literature (e.g., Block, Jang, Kaplan and Schulze (2024)) and industry research. However, the data set constructed here allows for a direct comparison: when weighted by employment, almost 70% of the middle market borrowers of direct lenders are PE-backed, whereas only 12% of the borrowers of banks are PE-backed.[5]

Using the underlying firm-level data, we construct a 2-digit NAICS industry-by-city data set to quantitatively test which of the following factors better explains the rise in direct lending: (1) A pull back in bank lending due to the GFC and the subsequent tightening of bank regulation or (2) the presence of middle market PE-backed firms.[6] We refer to these industry-by-city observations as "lending markets." There is a large amount of variation across lending markets in both the fraction of firms borrowing from a direct lender as of 2022, and the rise in direct lending from 2010 to 2022. For example, for the business services industry (NAICS code 54) in Boulder, Colorado, the fraction of middle market firms borrowing from a direct lender rose by 8 percentage points from 2010 to 2022. For construction firms (NAICS code 23) in El Paso, Texas, there was no change whatsoever. The empirical analysis seeks to uncover what factors explain this variation across lending markets in direct lender penetration.

The private equity channel is tested using the strong persistence over time in the variation across markets in the presence of PE-backed firms. The fraction of firms that are backed by a PE sponsor in 2007 in a given market is a strong predictor of the same variable as of 2022. Private equity presence in 2007 is a relatively clean source of variation in explaining the rise in direct lending given that direct lending was a small part of the overall lending landscape as of 2007. The bank pull-back channel is tested using detailed information from UCC filings on the share of firms in a given market that were borrowing from banks that subsequently faced heightened regulatory and supervisory scrutiny through the Comprehensive Capital Analysis and Review implemented in 2009. Consistent

[5]The corresponding figures for the equal-weighted calculation are 58% PE-affiliated for direct lenders and 6% for banks.

[6]The geographic unit used is a CBSA, which we refer to as a "city" throughout the text.

with the existing literature (e.g. Acharya, Berger and Roman (2018); Berrospide and Edge (2019); Cortés, Demyanyk, Li, Loutskina and Strahan (2020)), the fraction of firms borrowing from CCAR banks is a strong predictor of the decline in bank lending. The empirical strategy exploits these two sources of ex ante variation to see which more strongly predicts the rise in direct lending from 2010 to 2022.

The analysis shows that both channels are operative: markets experienced a larger increase in direct lending from 2010 to 2022 if there was larger ex ante PE presence or if the firms were ex ante borrowing more from banks that were subsequently more tightly regulated. However, when comparing the quantitative magnitude of the two channels, the PE channel is between two and three times larger. The rise in direct lending is driven more by specialization in lending to PE-backed firms relative to a general pull back in bank lending due to heightened post GFC regulation.

Private equity is present across the industry distribution, including both tangible and intangible capital industries. This allows for tighter empirical test on the underlying mechanism that matches direct lenders with private equity firms: the predictive power of PE presence in 2007 on the rise in direct lending from 2010 to 2022 is entirely concentrated in intangible capital industries. More tangible capital industries with strong PE presence, such as oil and gas exploration or pipeline transportation, witness no rise in direct lending from 2010 to 2022.

The focus of direct lenders on PE-backed intangible capital firms is a robust feature of the data. PE-backed firms tend to have high leverage ratios (e.g., Haque, Jang and Mayer (2026)) implying a higher default probability, and firms in intangible capital industries tend to have low liquidation values in the event of default (e.g., Kermani and Ma (2023)). As such, the high direct lender share in PE-backed intangible capital-intensive industries suggests that a key comparative advantage of direct lenders is their ability to lend to firms that have a large gap between continuation and liquidation value in case of default. The findings presented here are consistent with the survey evidence from Block, Jang, Kaplan and Schulze (2024): when private credit managers are asked why their borrowers cannot get bank financing, the most common answer in Europe and the second most common answer in the United States is that the "firm has a low amount of tangible assets as quality collateral."

This conclusion is also supported by the fact that direct lenders heavily rely on so-called "blanket liens." Unlike liens on specific types of physical capital, the value of a blanket lien is more closely linked to the going-concern value of a company that defaults (e.g., Lian and Ma (2021), Caglio, Darst and Kalemli-Özcan (2021)). Hence, the value of a blanket lien to a lender depends on the

continuation value of the overall firm in the event of default as opposed to the liquidation value of separable assets.[7] As of 2022, the mean share of loans secured by blanket liens for direct lenders is 79%; it is 15% for banks and 3% for finance companies. Banks are more likely to place a lien on current assets, such as accounts receivable and inventory, and fixed assets, such as equipment and vehicles. Furthermore, industries with high PE presence and intangible capital see a larger share of direct lender loans that are secured with a blanket lien; the same is not true for banks or finance companies.

Further support for the idea that direct lenders specialize in lending against the continuation value of a firm after default is their high degree of industry specialization. Blickle, Parlatore and Saunders (2023) show that banks concentrate their lending disproportionately in a few industries, consistent with the importance of a bank's industry-specific knowledge. Using similar measures of industry specialization, this study shows that direct lenders are significantly more industry-specialized than banks. The magnitude is large; relative to banks, direct lenders have an excess specialization of 7.5 pp more than banks. Furthermore, the industries in which direct lenders have the highest specialization have 20 pp higher ratio of intangible capital to total capital relative to the industries in which banks have the highest specialization.

Related literature

This study is most closely related to the substantial body of recent research on private credit (e.g., Acharya, Cetorelli and Tuckman (2024); Albuquerque and Zawadowski (2025); Aldasoro and Doerr (2025); Avalos, Doerr and Pinter (2025); Boni and Manigart (2023), Block, Jang, Kaplan and Schulze (2024); Cai and Haque (2024); Chernenko, Ialenti and Scharfstein (2025); Davydiuk, Erel, Jiang and Marchuk (2024a); Davydiuk, Marchuk and Rosen (2024b); Davydiuk, Marchuk and Rosen (2024c); Ellias and de Fontenay (2025); Erel, Flanagan and Weisbach (2024); Fritsch, Lim, Montag and Schmalz (2022); Gonzales-Uribe and Balloch (2021); Haque, Jang and Wang (2025b); Haque, Mayer and Stefanescu (2025a); Hinzen, Mondini, Rintamaki and Steffen (2026); Ivashina (2025); Ivashina, Rotermund and Wallace-Wright (2026); Jang (2025); Jang and Kim (2025); Jang, Kim and Sufi (2025); Jang, Mittal and Song (2026); Levin and Malfroy-Camine (2025); Loumioti (2022); Matvos, Piskorski and Seru (2026); Munday, Hu and Zhang (2018); Rintamäki (2024); Rin-

[7] For a more detailed explanation of the difference between debt secured by physical assets and debt secured by going concern value, see Lian and Ma (2021), Kermani and Ma (2020), and Hartman-Glaser, Mayer and Milbradt (2025).

tamäki and Steffen (2025); Robinson and Wallskog (2025); Rotermund (2026); Suhonen (2024)). Relative to this literature, this study makes three main contributions.

First, to the best of our knowledge, this study is the most extensive examination of the borrowers of direct lenders, and how they compare to the borrowers of banks and finance companies. This follows from the use of UCC filings; given the commonality of this filing across banks, finance companies, and direct lenders, the UCC filings allow us to directly compare the lending strategies of these different intermediaries. Section 2.5 below compares the use of UCC filings versus BDC filings or data from commercial data providers, and it provides evidence that the UCC filings data are more comprehensive. This study is also the first, to our knowledge, to measure the share of firms that borrow from direct lenders across the entire United States, which we are able to do given the match between NETS and measures of direct lending.

The study by Haque, Mayer and Stefanescu (2025a) compares loans by direct lenders and banks for the same borrowers, which they call "dual" borrowers, and they find that banks often provide a line of credit while direct lenders provide riskier and more junior term loans. Chernenko, Erel and Prilmeier (2022) focus on a sample of 750 publicly traded middle-market firms, and they find that non-banks lend to lower EBITDA and more levered firms. In a sample of loans for which direct lenders are present either as a lead arranger or as a participant lender, Jang (2025) compares the loans arranged by banks versus direct lenders. The focus of Jang (2025) is on the terms of the loan contracts and monitoring intensity of direct lenders versus banks. The focus here is complementary: this study shows differences between direct lenders loans and bank loans in terms of geography and industry focus, and use of collateral.

Second, to the best of our knowledge, this study provides the most extensive evidence that the rise in direct lending is concentrated in intangible-capital-intensive industries in which private equity has a large presence. Block, Jang, Kaplan and Schulze (2024) survey a set of 191 private debt investors and find that 78% of firms borrowing from a U.S.-based private debt investor are owned by a private-equity sponsor. This study finds a similar fraction using the UCC filings matched to NETS, and it emphasizes broader implications of the focus of direct lenders on PE-owned companies. Davydiuk, Marchuk and Rosen (2024b) use BDC data and emphasize that the portfolio firms of BDCs are more likely to be in high-tech industries, which is related to our finding that direct lenders focus disproportionately on intangible capital-intensive industries. The use of NETS combined with UCC filings allows us to compare these figures directly with the borrowers of banks and finance companies, and it also allows us to show that direct lenders have a large presence in industries

traditionally targeted by PE sponsors.[8]

The fact that direct lenders focus on intangible-capital-intensive industries is related to recent research showing that banks are particularly ill-suited for lending based on intangible assets with low liquidation values (e.g., Dai, Muller and Verner (2025); Dell'Ariccia, Kadyrzhanova, Minoiu and Ratnovski (2021)). The findings on intangible capital and the use of blanket liens are closely related to the literature that makes a distinction between continuation-value based lending and liquidation-value based lending (e.g., Lian and Ma (2021); Kermani and Ma (2020); Kermani and Ma (2023); and Hartman-Glaser, Mayer and Milbradt (2025)).

Third, this study provides new evidence on how tighter regulation on banks in the aftermath of the Global Financial Crisis led to pull back in bank lending and helps explain the rise in direct lending. This is closely related to the broader literature on the rise in non-bank lenders in the aftermath of the Great Recession (e.g., Chen, Hanson and Stein (2017); Chernenko, Erel and Prilmeier (2022); Gopal and Schnabl (2022), Cortés, Demyanyk, Li, Loutskina and Strahan (2020)). In a seminal contribution, Davydiuk, Marchuk and Rosen (2024b) exploit variation across geographical areas in capital supply shocks related to the collapse of CIT Group, the 2009 Bank Stress Tests, and changes in bank accounting standards related to off-balance sheet lending; they use BDC data to show that BDCs are more likely to lend to areas more exposed to these shocks. The evidence from UCC filings presented here complements the evidence from Davydiuk, Marchuk and Rosen (2024b), and this data set allows us to show that bank lending did fall in areas subject to tighter regulation. We also directly compare the quantitative magnitude of this channel relative to the presence of private equity.

[8] A large body of literature examines the effects of private equity on firms, both in terms of real outcomes and capital structure. For research on real effects, see e.g., Bernstein and Sheen (2016), Boucly, Sraer and Thesmar (2011), Davis, Haltiwanger, Handley, Jarmin, Lerner and Miranda (2014), Davis, Haltiwanger, Handley, Lerner, Lipsius and Miranda (2021), Eaton, Howell and Yannelis (2020), Fracassi, Previtero and Sheen (2022), Gupta, Howell, Yannelis and Gupta (2021), Lerner, Sorensen and Strömberg (2011), Mittal (2025). For research on capital structure, see e.g., Axelson, Strömberg and Weisbach (2009), Axelson, Jenkinson, Strömberg and Weisbach (2013), Cohn, Hotchkiss and Towery (2022), Haque (2022), Haque, Jang and Mayer (2026), Haque, Mayer and Wang (2023), Kaplan and Stein (1993), Malenko and Malenko (2015), Shive and Forster (2023). A growing number of papers also study the effects of private equity on employees (e.g. Gornall, Gredil, Howell, Liu and Sockin (2025), Herkenhoff, Lerner, Phillips, Rebelo and Sampson (2025); Isen, Richmond, Smith and Yannelis (2025)). Related to the latter, substantial research has documented the economic benefits of repeated relationships between lenders and PE sponsors, primarily in bank-syndicated lending (e.g. Bernstein, Lerner and Mezzanotti (2019); Demiroglu and James (2010); Haque and Kleymenova (2023); Hotchkiss, Smith and Strömberg (2021); Ivashina and Kovner (2011)). In the direct lending market, Jang (2025) shows that close relationships between direct lenders and PE sponsors help sustain credit during periods of stress.

1 Direct Lending: Background and Measurement

Private credit is a major asset class in which non-depository institutions provide non-publicly traded debt financing to privately-held middle market firms.[9] The intermediaries are usually structured either as a private credit fund–which is a closed-end investment vehicle not registered as an investment company–or as a business development company (BDC)–which is a closed-end investment company created through the Small Business Investment Incentive Act of 1980.[10]

Direct lending refers to a specific loan strategy within the broader private credit fund universe. While definitions are in flux, direct lending typically refers to a strategy in which the lender provides first-lien senior secured debt financing to middle-market firms. Alternative private credit strategies include mezzanine debt financing, distressed debt financing, asset-backed credit financing (such as aviation financing and securitization strategies), and investments in the broadly syndicated loan market. Based on Preqin estimates and BDC filings, private credit assets under management grew from under $200 billion before the Great Recession to over $1.6 trillion in the U.S. by 2025. In a companion paper that uses the regulatory Form PF data, Jang, Kim and Sufi (2025) estimates an even larger figure, closer to $2.2 trillion. Subtracting dry powder, they estimate total private credit investments at around $1.7 trillion.

The primary focus of this study is direct lending. It is the largest strategy within the private credit universe, accounting for approximately $800 billion in outstanding investments as of 2025.[11] It is also the lending strategy that is closest to the relationship-based, information-sensitive business lending that has been historically the purview of deposit-financed commercial banks.

Measuring the middle-market firms that obtain such relationship-based, information-sensitive loans from direct lenders is a serious challenge. Existing studies have mainly relied on two sources of data. The first source is BDC Securities and Exchange Commission (SEC) filings, which are required given that BDCs are registered investment companies. The main advantage of BDC data is that the investments in portfolio companies are publicly available. However, in terms of assets

[9] See Cai and Haque (2024) for an excellent overview of the private credit industry.

[10] BDCs can then be classified as publicly traded, non-publicly traded, or privately offered.

[11] This estimate is based on direct lending investments by private credit funds (from Form PF filings) and by BDCs. According to Jang, Kim and Sufi (2025), total U.S. private credit assets under management in the Form PF data is $1.72 trillion as of 2025; applying a 35.6% direct lending strategy share and a 77.2% utilization rate in that paper yields $473 billion (= $1.72 trillion × 35.6% × 77.2%). BDCs held $535 billion in total investments as of 2025; applying a 60% share of non-BSL (broadly syndicated loan) debt from Chernenko, Ialenti and Scharfstein (2025) implies total direct lending by BDCs of $321 billion. The combined estimate is therefore $794 billion.

under management, BDCs represent only a limited fraction of the broader private credit universe. As of 2025, BDCs held about $561 billion in total assets, according to our data from BDC Collateral. According to Jang, Kim and Sufi (2025), the U.S. non-BDC private credit fund assets totaled $1.72 trillion. In other words, BDCs account for roughly one quarter of the combined total of private credit assets when both are considered together. Historically, BDCs' share was even smaller, $32 billion in 2013 compared to $350 billion in non-BDC private credit fund assets at the time.

Furthermore, some of the investments made by BDCs are not the relationship-based information-sensitive loans to middle market firms that can be viewed as a direct substitute for bank loans. For example, BDCs make substantial investments in the broadly syndicated loan market (Chernenko, Ialenti and Scharfstein (2025)). BDC investments are often mezzanine, hybrid, or even equity investments (e.g., Davydiuk, Erel, Jiang and Marchuk (2024a); Robinson and Wallskog (2025)).

A second source of data used in the existing literature is from the commercially-available data collected by PitchBook. PitchBook data is also heavily tilted toward BDC investments. For example, Haque, Mayer and Stefanescu (2025a) report that, out of about 17 thousand private credit loans in their PitchBook sample, approximately 11 thousand involve a BDC. This overlap reflects how PitchBook builds its coverage: the platform employs a vast web-crawling infrastructure that searches over online sources, including news articles, press releases, company websites, and regulatory filings, to identify private market deals.[12] Because this process depends on public visibility, PitchBook likely captures more transactions involving larger and more transparent firms, such as publicly listed firms, firms backed by well-known sponsors, or lenders subject to public reporting requirements such as BDCs.

The data set constructed for this study allows for a direct comparison of borrowers that are in the BDC and PitchBook universe compared to borrowers that obtain a loan with a UCC filing recorded from a direct lender. As discussed below, we believe the presence of a UCC filing is a more comprehensive and more accurate measure of the middle-market borrowers that obtain relationship-based information-sensitive loans from a direct lender.

[12] See https://pitchbook.com/help/pitchbook-research-process.

2 Data

2.1 National Establishment Time Series data

The primary firm-level data source for our analysis is the National Establishment Time Series (NETS) database, compiled by Walls & Associates from Dun & Bradstreet records. NETS provides comprehensive coverage of business establishments across the United States, enabling the construction of a detailed dataset of middle-market firms. The dataset spans from 1990 to 2022 and includes approximately 87 million establishments. At the establishment level, NETS records include key information such as the number of employees, sales, age, credit rating ("PAYDEX" score),[13] industry classification (NAICS and SIC), and geographic location (address, city, state, and ZIP code).

To construct our firm-level sample, we use the unique nine-digit identifier assigned by Dun & Bradstreet to each establishment, known as the *dunsnumber*, and the related *hqduns* field, which identifies the establishment's headquarter. Both fields are initially assigned by Dun & Bradstreet. However, many instances exist where an establishment listed as a headquarter (*hqduns*) reports another *hqduns* as its own parent. To address this, we apply the parent roll-up strategy described in Section 2.3.3 of Crane and Decker (2020), aggregating all linked establishments, directly or indirectly, under the highest-level headquarter that reports itself as its own *hqduns*. Applying this procedure to the 2022 NETS data aggregates 37,413,572 establishments into 35,101,180 firms, suggesting that most firms are single-establishment enterprises.

We further refine the sample by excluding firms owned by a foreign entity or operating in government (3-digit NAICS 921–928), religious and non-profit organizations (3-digit NAICS 813), educational institutions (3-digit NAICS 611), financial services (2-digit NAICS 52), or real estate and leasing (2-digit NAICS 53). We also remove any firm in the NETS data set that has 2 or fewer employees. This latter restriction is motivated by Crane and Decker (2020) who argue that there is considerable imputation of key variables for small firms in the NETS data.[14] With these restrictions, the sample of firms as of 2022 in the NETS data includes 7.6 million observations.

[13] A PAYDEX score, provided by Dun & Bradstreet, is a business credit rating that evaluates a company's financial reliability based on its punctuality in paying trade creditors. Scores range from 1 to 100, with higher values reflecting lower credit risk.

[14] Given that most of our analysis focuses on middle market firms, which are defined as firms between 21 and 1000 employees, this restriction does not materially affect the analysis.

For this sample, we also merge to Compustat to obtain information on whether the firm is publicly traded. The NETS data itself has an indicator variable for whether a firm is publicly traded, and this is highly correlated with whether the firm is in Compustat. We create a public firm indicator variable which is equal to one if the firm can be matched with Compustat or if NETS indicates that the firm is public.

The final sample for most of the analysis in this paper is private middle-market firms, which are defined as firms that are not publicly-traded, and that have between 21 and 1,000 employees. This final sample includes 450 thousand firms as of 2022. Most standard definitions of middle-market firms based on employment include firms with 50 to 1,000 employees; we utilize a more expansive definition to capture more of this market.

While NETS provides extensive coverage, several caveats should be noted. Sales data are often unreliable due to high rates of imputation and are therefore excluded from our analysis. Employment data, however, are generally reliable when analyzed using employment bins or ranges. As noted by Crane and Decker (2020), NETS is "reasonably representative of U.S. business activity in the static cross section," with strong correlations to official data in terms of size, industry, and geography, particularly when smaller establishments are excluded. Following their advice, our analysis focuses on middle-market firms and cross-sectional patterns across industry and geographic cells, rather than firm-level time-series dynamics. In line with Crane and Decker (2020)'s recommendation to study low-frequency dynamics, the only temporal component we consider is the long-term change (over ten years) across these cells.

2.2 Uniform Commercial Code filings

Our main data source for lending is UCC filings, which contain detailed information on non-real-estate secured loans across the United States. We obtain UCC filings from a commercial vendor covering all 50 U.S. states and Washington, D.C., from 2006 to 2022. Each filing record includes the filing date, borrower and lender information such as name, location (state, city, ZIP), and, in most cases, *dunsnumber* (which can be readily linked to NETS), and detailed collateral descriptions. Collateral information is classified across 41 categories, which we group into four broad categories: fixed asset liens (e.g., equipment, fixtures, buildings, vehicles), current asset liens (e.g., accounts receivable and inventory), blanket liens, and liens that otherwise cannot be easily placed into one of these three categories (e.g., a lien on "products and proceeds," "unspecified," or "other"). The

collateral code information is also missing for a number of observations in the UCC filings. The blanket lien designation is important in the analysis, and we discuss this in more detail in Section 5.3.

Given its excellent coverage of firm-lender relationships across a wide range of collateral types, the UCC data has been extensively used in prior literature to study important economic questions, such as bank and nonbank competition (Gopal and Schnabl, 2022; Minnis, Sutherland and Vetter, 2024), lender collateral expertise (Gopal, 2023), and capital reallocation across firms (Ma, Murfin and Pratt, 2022; Darmouni and Sutherland, 2024). Gopal and Schnabl (2022) provide a detailed description of the UCC data and show that it covers a large share of small business lending by banks and finance companies.

We examine whether the extensive coverage of UCC filings extends to middle-market lending. Using syndicated loan deal data from Dealscan and private credit deal data from PitchBook, KBRA Direct Lending Deals, and Jang (2025), we find that UCC filings capture nearly all borrowers across both broadly syndicated and direct lending markets. The filings also reliably identify lead lenders—both banks and direct lenders—indicating that UCC data provide comprehensive coverage of middle-market borrowers' primary lending relationships, especially in direct lending. Appendix A provides a detailed summary of this investigation.

We classify lenders into three main categories: a direct lender, bank, or finance company. Direct lenders are identified using lists of U.S. private credit funds from PitchBook and Preqin, supplemented with keyword searches.[15] Banks and finance companies are identified using NAICS codes from NETS, further augmented with keyword searches and a list of the largest known banks and finance companies. For banks, we also match their RSSD IDs assigned by the Federal Reserve and aggregate at the parent RSSD ID level using a dynamic parent-subsidiary crosswalk from the NIC (National Information Center). This step is particularly important given the large number of mergers in the banking sector and the complexity of bank holding structures often involving many subsidiary banks.

We retain filings that reflect ongoing lending relationships, including originals, amendments, continuations, assignments, subordinations, partial releases, and corrections, while excluding terminations and full releases, following Gopal and Schnabl (2022). Filings are then merged with NETS at the establishment level using *dunsnumber* before aggregating at the firm level. To identify a borrower's active lender, we consider filings over the previous five years, reflecting the require-

[15]There are private credit funds affiliated with banks. We classify these as banks rather than direct lenders.

ment that lenders renew security interests every five years. Detailed methods for processing and classifying lender types from the UCC filings data are documented in Appendix A.

Combining UCC filings with NETS yields a uniquely comprehensive view of middle-market lending in the United States. The dataset allows us to examine the full universe of non–real-estate secured loans across direct lenders, banks, and finance companies, with rich information on collateral types and the geographic distribution of lenders.

2.3 Measuring PE ownership

As shown in the survey evidence of Block, Jang, Kaplan and Schulze (2024), direct lenders primarily lend to PE-backed firms. Therefore, any study of direct lender activity using administrative data must utilize the best possible data on firms backed by a PE sponsor in NETS. We identify PE backing using two prominent commercial data sources used widely in the literature: Capital IQ and PitchBook. Both data sources provide excellent coverage of private equity deals (e.g. buyout, growth equity), along with detailed information on investor identities and deal characteristics.

We match each NETS firm to its corresponding entity in PitchBook and Capital IQ through a multi-stage procedure that combines text embeddings, cross-encoder reranking, phone-number matching, and LLM-based verification of borderline cases. Because both PitchBook and Capital IQ describe firms at the legal-entity level while NETS records establishments, we preserve a many-to-many structure throughout. The exact details of the matching process are summarized in Appendix B.

In our final matched middle-market sample, we identify a total of 17,919 firms with PE investment between 2013 and 2022. Among them, 13,995 firms are identified using PitchBook and 8,179 firms are identified using Capital IQ, where the number of overlapping firms is 4,255. The two datasets capture a substantial number of non-overlapping deals, highlighting the importance of using both sources to obtain broader and more representative coverage of private equity activity. For comparison, Isen, Richmond, Smith and Yannelis (2025) study 15,767 PE-backed firms between 1999 and 2023 by matching PitchBook with the universe of IRS tax records. Davis, Haltiwanger, Handley, Lerner, Lipsius and Miranda (2021) and Herkenhoff, Lerner, Phillips, Rebelo and Sampson (2025) study roughly 6,000 PE-backed firms between 1980 and 2013 by matching Capital IQ with the universe of US firms in Census micro data.

2.4 Additional data sets

Using PitchBook and BDC Collateral, we additionally identify firms that received private credit financing (e.g., Haque, Mayer and Stefanescu (2025a), Haque, Jang and Wang (2025b)). Compiled from mandatory SEC filings, the BDC Collateral dataset provides each BDC's quarterly portfolio holdings, including company names, investment amounts, security types, and valuations. Due to the SEC's quarterly disclosure requirement, BDCs have been extensively studied in the private credit literature (e.g., Davydiuk, Marchuk and Rosen (2024b)). We use these filings to identify middle-market borrowers receiving BDC financing (both debt and equity investments). Jang and Kim (2025) and Haque, Jang and Wang (2025b) provide detailed descriptions of the BDC Collateral data.[16] All external financing datasets (BDC Collateral, PitchBook, and Compustat) are carefully matched to NETS using firm name, address, and phone number information.

The NETS data set includes a NAICS code of every firm that is used to merge with 3-digit NAICS industry-level information from He, Mostrom and Sufi (2024) on the share of total capital that is intangible ($^{K_{IT}}/_{K_{TOT}}$). As described in He, Mostrom and Sufi (2024), intangible capital at the firm level is comprised of R&D related capital, sales and marketing-related capital, and externally acquired intangible capital. Physical capital includes property, plants, and equipment on the balance sheet. The ratio of intangible capital to total (intangible plus physical) capital is calculated at the firm level, and then the industry-level median is calculated from the firm-level data. It is the median industry-level variable that is used in the analysis below.[17] Also included is the total population of the Core-Based Statistical Area of each firm in the NETS data. These data are collected from the Census. We refer to a CBSA throughout the analysis as a "city."

2.5 Summary statistics and comparison with other data sets

In Table A2 in the appendix, we compare the total number of firms in the NETS data set as of 2022 that we are able to match to a UCC filing by a direct lender, an investment by a BDC, and a private credit investment as recorded in PitchBook. For all of these measures, a borrower counts as having

[16] Matching BDC portfolio companies to NETS is a challenge given that it is not easy to retrieve the address of the companies from SEC filings. We use a combination of information from N-2 filings and the Google Vertex AI platform to search for the exact addresses of every firm receiving a BDC investment.

[17] There are a few 3-digit NAICS codes for firms in the NETS data which are not in the He, Mostrom and Sufi (2024) data set based on Compustat. The nearest available industry is assigned for these industries: 113 and 115 are assigned as 111, 114 is assigned as 112, 487 is assigned as 711, 491 and 493 are assigned as 492, 551 is assigned as 541, and 712 is assigned as 711.

borrowed from one of these sources if there was an investment within the previous five years, (e.g., from 2018 to 2022). Across all three measures, there are a total of 19,622 firms as of 2022 with a private credit investment at some point between 2018 and 2022. The coverage by the UCC filings is significantly larger; there are 10,560 firms that are matched to a UCC filing but not matched to either a BDC investment or a private credit investment according to PitchBook. For the private middle market firm sample, the respective numbers are 7,246 total and 3,982 that only have a UCC filing by a direct lender. Relative to the PitchBook and BDC data, the UCC filings nearly triple the full sample of firms borrowing from a private credit firm and quadruple the corresponding private middle market sample.

The wider coverage of UCC filings, especially among lower middle market firms, should not be surprising. UCC filings are legal documents that any secured lender must submit to perfect a claim on collateral. As long as a filing is made, it appears in the data, regardless of whether the borrower is publicly visible or the transaction has been covered in the media. This makes UCC filings largely independent of information frictions that may affect data availability in other sources.

Table A3 in the appendix compares total employment and age for the different data sets recording a loan from a private credit firm. The PitchBook sample is heavily skewed toward larger and older borrowers. The median private credit borrower in PitchBook has 47 employees as opposed to 19 employees for the median borrower with a UCC filing from a direct lender. For the full sample, the borrowers of BDCs have a much higher variance of size relative to the UCC filings. For the middle market sample, BDC borrowers are substantially larger than borrowers with a UCC filing by a direct lender.

Tables A4, A5, and A6 in the appendix present summary statistics for the overall sample at the borrower-level, the lender-level, and the 2-digit NAICS industry by city level, respectively. Analysis below is conducted at one of these three levels. In the middle market sample, when weighting by employment, 45.5% of firms have a loan from a bank, finance company, or a direct lender. The employment-weighted average age of the middle market firms is 37.6 years. When weighting by employment, 7.5% of middle market firms received a private equity investment in the past 10 years. The lender-level sample is limited to lenders in the UCC data that have at least 10 borrowers. There are 2,555 such lenders (2,253 banks, 98 direct lenders, and 204 finance companies) with 140 borrowers on average between 2018 to 2022.

3 Motivating Facts

Fact 1: The fraction of firms borrowing from direct lenders, while significant, is substantially lower than banks and finance companies; however, it is likely that the amount conditional on borrowing is higher for direct lenders.

Table 1 presents the fraction of firms that borrow from direct lenders, banks, and finance companies for both the full sample and for the middle market sample of firms that have between 21 and 1000 employees. For the full sample, the UCC filings suggest that almost 8% of firms, when weighted by employment, have a loan by a direct lender at some point between 2018 and 2022. The comparable statistics for banks and finance companies are 46% and 33%, respectively. When using a broader definition of private credit that augments the UCC data with firms that borrow from either BDCs or who have a loan from a private credit firm recorded in PitchBook, the fraction rises to 12.6%. In the private middle market sample, direct lenders as measured by UCC filings have loans to 2.6% of firms when weighted by employment, compared to 41% for banks and 19% for finance companies. The broader definition of private credit suggests that 3.6% of middle market firms have a loan from a private credit lender when firms are weighted by employment.

The UCC filings only capture the extensive margin of lending relationships, not the amount of lending conditional on a relationship. There are reasons to believe that direct lenders have larger loans outstanding conditional on a relationship, which would imply a higher total share of loan amounts outstanding to middle market firms compared to the extensive margin shares shown in Table 1. The study by Haque, Mayer and Stefanescu (2025a) uses the Y-14 combined with data from PitchBook; it finds that loans from private credit firms are on average three times larger than loans from banks and they are more likely to be fully drawn term loans relative to revolvers. Furthermore, as shown below, direct lenders are more likely to lend to PE-backed firms, and those firms have significantly higher leverage ratios (e.g., Haque, Jang and Mayer (2026)).

Aggregate data provides some guidance in this regard. We estimate that total deployed capital of direct lenders to U.S. companies as of 2022 is $500 billion.[18] This estimate excludes syndicated

[18]This estimate is based on direct lending investments by private credit funds (from Form PF filings) and by BDCs. According to Jang, Kim and Sufi (2025), total U.S. private credit assets under management in the Form PF data is $1.25 trillion as of 2022; applying a 35.6% direct lending strategy share and a 77.2% utilization rate in that paper yields $340 billion. BDCs held $260 billion in total investments as of 2022; applying a 60% share of non-BSL (broadly syndicated loan) debt from Chernenko, Ialenti and Scharfstein (2025) implies total direct lending by BDCs of $160 billion. The combined estimate is therefore $500 billion.

loans. Total commercial and industrial loans for U.S. banks as of 2022 is $2.7 trillion. An estimate of the amount of this balance which reflects syndicated loans is $1.3 trillion, which would put the comparable amount of C&I lending of banks at $1.4 trillion.[19] So in the aggregate, the direct lending to comparable bank C&I lending ratio is ($500B/$1.4T =) 0.36. The ratio of the share of employment-weighted firms with UCC filings from direct lenders relative to banks is (0.08/0.45 =) 0.18, which is significantly lower. These ratios together suggest that direct lenders make significantly larger loans conditional on lending.

Fact 2: The firms that borrow from direct lenders are distinct from those that borrow from banks and finance companies

Table 2 presents the distribution of borrower characteristics in the portfolios of direct lenders, banks, and finance companies as of 2022 for five variables: (1) total employment of the borrower, (2) the age of the borrower, (3) the industry intangibility of the borrower, using the K_{IT}/K_{TOT} ratio from He, Mostrom and Sufi (2024), (4) the credit score of the borrower, according to the PAYDEX score by Dun and Bradstreet, and (5) the population of the city in which the borrower is headquartered. As noted above, a firm is recorded as having a loan from a given type of lender if there is a UCC filing recorded for that firm by the type of lender in question at some point from 2018 and 2022.

The borrowers of direct lenders are larger, younger, more likely to be in intangible capital-intensive industries, riskier, and more likely to be located in larger cities. The median borrower of a direct lender is 8 to 9 years younger than the median borrower of traditional lenders, and is operating in an industry that has a median K_{IT}/K_{TOT} that is 9 pp higher relative to banks and 20 pp higher than finance companies.

Figure 1 tests the statistical significance of these differences using the lender-level data set. This data set includes 2,555 lenders and records the mean characteristics of the borrowers in each lender's portfolio. At the lender level i, a regression relates the mean characteristics of the portfolio (Y_i) to an indicator variable of whether the lender in question is a direct lender (dl_i):

$$Y_i = \alpha + \beta * dl_i + \varepsilon_i \tag{1}$$

Each of the mean characteristics is normalized by one standard deviation of the same variable to

[19]The syndicated loan amount is estimated from Federal Reserve data on syndicated loan portfolios.

ease interpretation.

All of the differences in the characteristics of the borrowers are quantitatively large and statistically significant. The average borrower in the portfolio of a direct lender is a full standard deviation larger, nearly two standard deviations more intangible-capital intensive, and a full standard deviation younger. Borrowers of direct lenders are also riskier and located in larger cities.

Panel A of Table 3 highlights the industry differences in the portfolios in more detail. Panel A shows the 10 industries for which direct lender portfolio shares minus traditional lender portfolio shares are the most positive. Direct lenders have a portfolio share in NAICS code 541, Professional, Scientific, and Technical Services, that is 8 percentage points larger. This is among the most intangible capital-intensive industries according to the He, Mostrom and Sufi (2024) measure. Other notable intangible capital-intensive industries for which direct lenders have significantly larger portfolio shares include 513 (Publishing Industries, which includes many software companies), 325 (Chemical Manufacturing, which includes many bio-pharmaceuticals), and high tech manufacturing (334 and 339). On the flip side, traditional lenders have higher portfolio shares in more tangible capital-intensive industries such as 722 (Food services and Drinking Places), 236 (Construction of buildings), and 484 (Truck transportation).

Panel B of Table 3 shows the top 10 cities for which direct lenders have the highest portfolio shares relative to traditional lenders. These 10 cities are among the largest in the country, with New York City, Los Angeles, and Chicago all on the list. Compared to traditional lenders, the borrower portfolios of direct lenders are tilted away from smaller cities and toward larger cities.

Table 4 uses a Mahalanobis distance measure to show formally that the borrower portfolio of direct lenders is distinct from that of banks and finance companies. The Mahalanobis distance measure is similar to a simple Euclidean distance measure, except that it adjusts for the variance-covariance matrix of the characteristics in question. More specifically, the distance measure between the portfolios of lender type i and lender type j is:

$$D_M(\vec{\mu^i}, \vec{\mu^j}) = \sqrt{(\vec{\mu^i} - \vec{\mu^j})^T \Sigma^{-1} (\vec{\mu^i} - \vec{\mu^j})} \tag{2}$$

where $\vec{\mu^i}$ is a 1×5 vector of the means of borrower employment, age, credit score, industry intangibility, and the population of the city in which the borrower is located for lender type i. The variance-covariance matrix Σ is a 5×5 matrix containing the variances and covariances of the five characteristics in question.

For the full sample of middle market firms, the distance between direct lenders and banks and the distance between direct lenders and finance companies is five times larger than the distance between banks and finance companies. Table 4 also displays the distances conditional on different parts of the size distribution. The relative magnitudes are similar, even conditional on size. Across all size categories, the distance between direct lenders and either banks or finance companies is four to seven times larger than the distance between banks and finance companies.

Fact 3: Direct lenders focus on PE-backed borrowers to a much larger degree than banks and finance companies

The left panel of Figure 2 shows the fraction of the borrowers in the portfolios of direct lenders, banks, and finance companies that are backed by a PE sponsor. A borrower is classified as being PE-backed if it received an investment within the past 10 years from a PE sponsor as recorded by PitchBook or Capital IQ. According to the employment-weighted measure, 69% of the borrowers of direct lenders are backed by a PE sponsor. Only 12% and 14% of the borrowers of banks and finance companies, respectively, are backed by a PE sponsor. The corresponding statistics when borrowers are equally-weighted are 58%, 6%, and 7%.

Is the same pattern true across all direct lenders, or are there some direct lenders that lend disproportionately to non-PE backed firms? The lender-level data set allows for the measurement of the share of borrowers in a given lender's borrower portfolio that is backed by a PE sponsor. The right panel of Figure 2 plots the probability mass function of the share of PE-backed borrowers across direct lenders, banks, and finance companies. Almost 85% of the direct lenders in the sample have a portfolio share of PE-backed firms that is above 0.40, and 93% are above 0.20. In contrast, 96% of banks and 92% of finance companies have a PE-backed share less than 0.20.

4 Explaining the Rise in Direct Lending

4.1 Empirical strategy

What explains the rise in direct lending? This section explores this question by conducting analysis at the industry-by-city level. A large body of research shows that lending in information-sensitive markets is shaped by geographic proximity (e.g., Petersen and Rajan (1995), Degryse and Ongena

(2005), Mian (2006)) and industry specialization (e.g., Blickle, Parlatore and Saunders (2023)). This is consistent with the facts shown above: direct lender penetration is higher in large cities and in intangible-capital intensive industries. We define a lending market at the 2-digit NAICS industry by CBSA level. For example, information services (NAICS code 51) in the Boston-Cambridge-Newton, MA-NH metropolitan area (CBSA code 14460) would be defined as a market, as would construction (NAICS code 23) in Ogden, Utah (CBSA code 36260). There are 938 CBSAs in the sample and 20 2-digit NAICS codes, which yields a total of 18,760 potential markets. Many of these markets have no firms, and so the final sample size is 14,594 markets. Given that the number of firms varies substantially across markets, all analysis and results are weighted by the number of firms in each market.

The goal of the empirical framework is to explain the variation in direct lender penetration across these markets. Figure 3 shows this variation. The left panel sorts lending markets by the share of firms in the market with a direct loan as of 2022. There is a large amount of variation. In the bottom quintile, there is no direct lender presence, whereas in the top quintile almost 4% of firms borrow from a direct lender. The right panel sorts lending markets by the change in the share of firms that borrow from a direct lender from 2010 to 2022.[20] The bottom quintile witnesses a slight decline in the share of firms with a direct loan, whereas the top quintile experiences a rise of 3.2 pp.

The two main explanatory variables explored below are the presence of PE sponsors across markets, and the degree to which markets are exposed to the pull-back in bank lending due to post-GFC tighter regulation and supervision. The goal of the analysis is to identify variation across markets in the strength of these forces, and then estimate their effect on the rise in direct lending.

4.2 The power of private equity

The power of private equity presence across markets in explaining the rise in direct lending is on display in Figure 4. The left panel presents a bin scatter of the share of firms with a direct loan as of 2022 against the share of firms in the market that are PE-backed as of 2022. The right panel uses the change in the share of firms that borrow from a direct lender as the outcome variable. In both panels, there is a positive relationship with narrow confidence bands. The first two columns of Table 5 Panel A confirm this strong relationship in a regression framework. A one unit increase

[20] As before, a firm is classified as a direct lender borrower if it has borrowed from a direct lender within the past five years. So for firms in 2010 that would be 2006 to 2010 and for 2022 it would be 2018 to 2022.

in PE share in a market is associated with a 0.21 increase in direct lender share and a 0.17 increase in the rise in direct lender share from 2010 to 2022. The first two columns of Panel B show that these results are similar with the inclusion of industry and city fixed effects.

The contemporaneous correlation is strong, but a concern is that omitted factors jointly explain the presence of direct lenders and private equity. To identify the effect of PE presence more directly, we exploit the fact that the PE share of a market is highly persistent over time. As shown in the left panel of Figure 5, the PE share of a market as of 2007 is a strong predictor of the PE share as of 2022.[21] Column 3 of Table 5 shows that a one unit increase in the 2007 PE share predicts a 0.95 increase in the 2022 PE share. This persistent PE presence is a useful source of variation in explaining the rise in direct lending, given that direct lending was a nascent market in 2007: It is highly unlikely that direct lender share in 2007 was a driver of PE share in the earlier time period.

The middle panel of Figure 5 shows a strong positive relationship between the direct lender share in 2022 and the PE share in 2007. Similarly, the right panel shows a strong positive relationship between the rise in the direct lender share from 2010 to 2022 and the PE share in 2007. Columns 4 and 5 of Panel A of Table 5 show the statistical power of the relationship in a regression framework. If one interprets the PE share as of 2007 as an instrument for the PE share in 2022, then the coefficient estimate in column 3 can be interpreted as a first stage and the coefficient estimates in columns 4 and 5 can be interpreted as the reduced form. Given that the first stage coefficient is close to one, the implied instrumental variable estimate is the same as the reduced form coefficients reported in columns 4 and 5.

Table 6 shows how both industry level and city level variation are identifying the coefficient in column 5 of Panel A of Table 5. For this table, industries are sorted by the PE share of the industry as of 2007 in the rows and cities are sorted by the PE share of the city as of 2007 in the columns. Each cell shows the average rise in direct lending from 2010 to 2022 for the markets in that cell. The rise in direct lending is almost fully monotonic moving either to the right or to the bottom of the table. The gap between the numbers in the northwest of the table and the southeast of the table is substantial. These results imply that any spurious factor driving this relationship would have to be present across both dimensions simultaneously.

Panel B of Table 5 reports estimates with both industry and city fixed effects. The coefficient estimate when relating PE share as of 2022 to the PE share as of 2007 in column 3 falls from 0.95

[21] As before, a firm is classified as being PE backed as of 2007 if they received an investment from a PE sponsor in the previous 10 years, so from 1998 through 2007.

to 0.37, which represents a smaller first stage coefficient. The decline in the first stage coefficient is explained mostly by the inclusion of industry fixed effects. This likely reflects the fact that PE has a strong industry focus even across geographic locations, and so the inclusion of industry fixed effects may be "over-controlling"; it removes variation from the first stage that does in fact reflect persistent PE presence over time across industries. In general, the inclusion of both industry and city fixed effects is an extremely parsimonious specification that absorbs all industry level and city level shocks that could explain the correlation between the PE share in 2007 and the outcome variables as of 2022.

The reduced form coefficients in columns 4 and 5 also fall to approximately one-third with the inclusion of city and industry fixed effects, which is to be expected given that the first stage coefficient falls to one-third. The ratio of the reduced form (columns 4 and 5) to the first stage (column 3) is similar in Panels A and B, and all coefficients are statistically distinct from zero at a high confidence level.

4.3 Post-GFC tighter bank regulation and supervision

What is the effect of the pull back in bank lending in the aftermath of the GFC on the rise in direct lending? The analysis in this sub-section relies on the richness of the UCC data in combination with insights from the existing literature to construct instruments at the market level for the decline in bank lending from 2010 to 2022 driven by GFC-related banking issues. More specifically, the existing literature points to a variety of factors that affected some banks more than others, and markets were differentially exposed to these banks. If GFC-related banking issues were responsible for the rise in direct lending, we would expect markets that were more exposed to affected banks to have seen a disproportionate rise in direct lending.

The empirical strategy uses four measures of a bank's exposure to GFC related issues: (1) whether a bank was co-syndicating with Lehman Brothers prior to the GFC (e.g., Ivashina and Scharfstein (2010)), (2) the exposure of a bank to the ABX index from late 2005 (e.g., Chodorow-Reich (2014)), (3) whether a bank is within the top four largest banks, which Chen, Hanson and Stein (2017) show reduced small business lending considerably in the aftermath of the Great Recession, and (4) whether a bank is subject to the Comprehensive Capital Analysis and Review (e.g., Acharya, Berger and Roman (2018); Berrospide and Edge (2019); Cortés, Demyanyk, Li, Loutskina and Strahan (2020); Davydiuk, Marchuk and Rosen (2024b)). For the first two measures, banks are

ranked and then the top 15 are chosen as being exposed.[22] For each of these measures, a given market's exposure is calculated as the fraction of firms in the market that borrowed from the banks receiving the shock in question.[23]

With these four market-level exposure measures to post-GFC banking-related issues in hand, Table 7 shows that markets more exposed experienced a relative decline in the fraction of firms receiving a bank loan between 2010 and 2022. All market exposure measures are standardized by dividing by one standard deviation of the respective measure to make the quantitative magnitudes comparable. Panel A presents the OLS estimates, and Panel B presents the estimates when including industry and city fixed effects.

Across the eight specifications, seven of the coefficients on the market exposure variables are negative and statistically significant. To the best of our knowledge, this is the first study to use the UCC data to examine the effects of the GFC on bank lending, and the results offer a powerful confirmation of the argument that the GFC had long-lived effects on middle market business lending by banks. The regression specification reported in column 5 explores the relative statistical power of each of the four exposure measures. A market's exposure to banks subject to CCAR is the strongest predictor of a decline in bank lending, both statistically and quantitatively. Given the relative power of the CCAR exposure measure, this is the main measure utilized below to predict the rise in direct lending.

Table 8 relates the direct lender share of a market as of 2022 to the market's exposure to CCAR-subject banks. The evidence supports the view that the pull-back in bank lending due to post-GFC related banking regulation and supervision explains the rise in direct lending. In terms of quantitative magnitude, the estimate in column 3 implies that a one unit increase in the share of borrowers with a loan from a CCAR-subject bank leads to a 0.024 unit increase in the change in the direct lender share from 2010 to 2022. If we interpret column 1 as a first stage, then the interpretation is that a one unit decline in bank lending driven by CCAR-related regulation led to a (0.024/0.110=) 0.22 increase in change in the direct lending share from 2010 to 2022. This suggests a rate of substitution to direct lenders of almost one quarter for every one less bank loan.

[22] We obtain the list of these banks from the public data disclosed by Chodorow-Reich (2014).

[23] More concretely, for the first three measures, we compute each bank's market share based on its UCC filings between 2006 and 2008, as our UCC data begin in 2006. For the CCAR measure, we use the 18 banks (excluding Metlife, which is an insurance company) that first became subject to the CCAR tests in 2011 and compute each bank's market share based on its UCC filings between 2006 and 2010.

4.4 Comparing the two channels

Table 9 relates the direct lender share of a market to both the ex ante PE share and the market's exposure to banks subject to the CCAR. To ease the comparison of magnitudes, all variables are scaled by their respective standard deviation. Column 1 shows that a one standard deviation increase in the PE share of the market as of 2007 is associated with a 0.28 standard deviation increase in the direct lender share as of 2022. The similar calculation for a market's exposure to CCAR-regulated banks is 0.14. Column 4 of Table 9 shows a similar relative magnitude between the PE channel and the CCAR-associated bank regulation channel when the left hand side variable is the change in the direct lender share of a market from 2010 to 2022. Once again, the PE channel is roughly twice as large as the bank regulation channel.

The addition of industry and city fixed effects in columns 2 and 5 changes the absolute magnitude of the coefficients, but the relative strength of each channel is roughly similar. The relative magnitude of the PE channel is almost three times as large in the specification reported in column 5. Across all specifications, the PE channel is the more quantitatively powerful explanation for the rise in direct lending over the sample period.

A natural question is whether there is an interactive effect. That is, perhaps the rise in direct lending is largest in markets that have large PE presence and that are most negatively affected by tighter banking regulation. Columns 3 and 6 test for an interactive effect of the two channels, but the estimates on the interaction term are close to zero. The estimates imply that the PE channel and the CCAR-associated bank regulation channel are separate explanations for explaining the rise in direct lending.

5 The Continuation Value Advantage of Direct Lenders

5.1 Lending based on continuation value versus liquidation value

Both academic research and industry practice suggest a distinction between two types of secured business lending. On one hand, lenders underwrite loans based on the liquidation value of the assets in the event of default (e.g., Hart and Moore (1990), Hart (1995), Benmelech and Bergman (2008), Benmelech (2009), Benmelech, Kumar and Rajan (2025)). On the other hand, lenders underwrite loans based on being able to obtain the continuation value of the overall enterprise in the event of

default (e.g., Aghion and Bolton (1992), Lian and Ma (2021), Kermani and Ma (2020), Hartman-Glaser, Mayer and Milbradt (2025)). Industry participants use a variety of phrases to capture this distinction. Liquidation-value based lending is often called "asset-based finance" and continuation-value based lending is often called "cash-flow-based lending" or "going-concern-based lending."

The key theoretical distinction, as argued by Kermani and Ma (2020), is that continuation-value-based lending involves a transfer of control rights over the entire enterprise, which is worth more to the lender than the liquidation value of the assets (as long as the creditor intervenes early enough). The classic Aghion and Bolton (1992) model captures this intuition, as control rights over the firm are transferred to the creditor after a verifiable signal of performance deteriorates beyond a threshold. The model in Kermani and Ma (2020) makes the intuitive argument that continuation-value-based lending is especially valuable if the positive gap between the continuation value of the assets and the liquidation value of the assets is large. This gap is largest for intangible capital industries such as information and business services, given that the value of the enterprise in these industries depends on keeping the assets within the same firm.

Direct lenders are especially well positioned to underwrite loans based on continuation value. The investment mandates of private credit funds typically allow fund managers to invest in more equity-like instruments such as warrants, and they do not typically prevent the fund from owning the equity in firms that have defaulted (e.g. Erel, Flanagan and Weisbach (2024)).[24] Anecdotal evidence from practitioners supports the view that direct lenders are willing to "take the keys" of the business in case of default. As mentioned in the introduction, the law firm O'Melveny states that "unlike regulated banks, many direct lenders approach underwriting from an enterprise value perspective rather than traditional asset-based underwriting ... private credit funds may have more flexible mandates and are more likely than banks to view these loans as long-term investments (i.e., from 'cradle to grave')." Matt Nacier of the private equity firm Lincolnshire Management says: "I think you're going to see a lot of cases where lenders are prepared and are going to be equipped to run these businesses or have the third-party resources to help in terms of getting things turned around. They are smart and they are sophisticated counterparties...". Akila Grewal of Apollo Global Management, Inc says: "there will likely be the opportunity for private debt investors who have the capabilities to touch businesses and help build them or refinance them or take the keys candidly and

[24] See for example, the report by Cambridge Associates: "While it is not the intent of the fund to own the company, the manager is prepared to take equity through a restructuring and own that equity for a period of time." And also: "These managers are adept at drafting their own documents and are comfortable assuming either EV [enterprise value] risk or specific asset risk."

try to get them into a better stead."

Banks, on the other hand, face major restrictions in underwriting loans based on enterprise value. The Bank Holding Company Act of 1956 prohibits banks from owning the equity in non-financial firms. There are "debt previously contracted" (DPC) exemptions for banks receiving equity in a debt restructuring, but even those exemptions are temporary. Banks must actively work toward disposing of equity once they receive it, and they have an initial two-year mandatory divestiture period that can be extended to a maximum of five total years.

Furthermore, bank supervisors discourage the use of enterprise value in underwriting loans. For example, a 2001 joint advisory letter from the OCC, the FDIC, the OTS, and Federal Reserve explicitly states: "Enterprise value is often relied upon in the underwriting of leveraged loans ... Consideration of enterprise value is appropriate in the credit underwriting process. However, enterprise value and other intangible values can be difficult to determine, are frequently based on projections, and may be subject to considerable change. Consequently, reliance upon them as a secondary source of repayment can be problematic."

All of these factors provide intuitive reasoning for why direct lenders are particularly well-suited to lend based on continuation value relative to banks. The rest of this section provides evidence supporting this view.

5.2 Private equity and intangible capital

Private equity sponsors target firms across the industry distribution, not just industries that rely on intangible-capital-intensive business models. For example, the PE share as of 2007 is large in mining and and gas exploration (NAICS code 21) and transportation (NAICS code 48), both of which are more tangible capital intensive industries. If direct lenders have a particular comparative advantage in lending based on continuation value, then we should expect that they have captured more market share in high PE share industries that are more intangible-capital intensive.

Table 10 provides this evidence. Column 1 presents coefficients from a regression specification in which the direct lender share of a market as of 2022 is related to the PE share of the industry in 2007 and the intangible capital intensity of the industry. The latter measure is $^{K_{IT}}/_{K_{TOT}}$ from He, Mostrom and Sufi (2024). Both variables strongly predict the direct lender share as of 2022. Column 2 presents estimates with the inclusion of an interactive term. The interaction is positive and statistically significant. Column 3 adds industry and city fixed effects. In column 3, the entire

effect of the PE share as of 2007 comes from more intangible capital industries. Columns 4 through 6 present estimates where the left hand side variable is the rise in the direct lender share from 2010 to 2022. The results are similar.

The rise in direct lending is concentrated in intangible-capital-intensive industries with a large presence of PE-backed firms. Figure 6 shows this result graphically. Specifically, to produce Figure 6, a data set at the 3-digit NAICS code is constructed, and then the sample is split by the median level of intangible capital intensity of the industries. The change in the direct lender share of an industry from 2010 to 2022 is related to the PE share of the industry as of 2007 separately for intangible and tangible industries. As the graph shows, there is strong positive relationship between the rise in direct lending and the PE share as of 2007 for intangible-capital-intensive industries. The relationship is close to zero for tangible-capital-intensive industries.

Columns 2 and 5 of Table 10 show a positive coefficient on industry intangible capital intensity even in the presence of the interaction term. While direct lender penetration is strongest in markets that have intangible capital and large PE presence, the level effect implies that direct lenders gained market share in intangible-capital-intensive businesses even when there is limited private equity presence. This result raises the possibility that direct lenders may be able to make inroads in intangible-capital-intensive industries even in the absence of private equity. We leave this question for future research.

5.3 Blanket liens

Another piece of evidence supporting the view that direct lenders specialize in lending based on continuation value is their much more extensive use of blanket liens. A blanket lien is a security interest by a lender in all of the borrower's assets, as opposed to a security interest in a particular type of collateral such as equipment or property. The idea behind a blanket lien is to ensure that the lender can obtain any value of the assets of the firm in case of default, including the value of the firm if it is to emerge from default as a financially healthy company. Both Lian and Ma (2021) and Caglio, Darst and Kalemli-Özcan (2021) argue that a blanket lien is a claim on the value created by combining the assets of the firm, which may also be referred to as going concern value, as opposed to the liquidation value of separable assets.[25]

[25] Lian and Ma (2021): "The collateral value of blanket liens in Chapter 11 is determined by the going-concern cash flow value of the firm (minus the liquidation value of specific assets pledged to asset-based debt)." Caglio, Darst and Kalemli-Özcan (2021): "The common property of accounts receivable and inventory and blanket lien collateral is that

The left panel of Figure 7 uses the lender-level data, and it plots the average share of loans that are secured with different types of liens across direct lenders, banks, and finance companies, where the lenders are weighted by the total number of loans they have made. Almost 80% of the loans made by direct lenders are secured with a blanket lien. In contrast, only 15% of loans made by banks are secured with a blanket lien, and only 3% of loans by finance companies are secured with a blanket lien. Instead, banks rely more heavily on liens written on fixed assets (e.g., equipment, vehicles) or current assets (e.g., inventory, accounts receivable). The right panel of Figure 7 plots the probability mass function across the distribution of blanket lien loan share for direct lenders, banks, and finance companies. Almost 75% of the direct lenders have a blanket lien loan share above 0.60, whereas 85% of banks and finance companies have a blanket lien share below 0.20. It is clear that direct lenders, relative to banks and finance companies, have a specialization in blanket liens.

There are two explanations for the higher reliance on blanket liens by direct lenders. PE-owned firms often have much higher leverage ratios relative to non-PE-owned firms, and therefore a higher probability of default (e.g., Haque, Jang and Mayer (2026)). As such, lenders to PE-backed firms have an incentive to ensure the strongest security interest possible to ensure that any residual value of the company in the event of default is acquired by the lender. Consistent with this, Haque, Jang and Mayer (2026) show that private equity ownership is strongly associated with borrowers' use of loans backed by blanket liens or unsecured debt. Another explanation is that, compared to banks, direct lenders are better positioned to obtain the going-concern equity value of a company after a default, and a blanket lien facilitates the acquisition of such value. In this view, both PE backing and intangible-capital intensity would explain why blanket liens are so commonly used by direct lenders.

Table 11 provides evidence in favor of the going concern explanation. In particular, it shows that the share of firms with a blanket lien loan from a direct lender is significantly higher in markets that have both higher intangible-capital intensity and a higher PE share as of 2007. In contrast, the PE share of an industry is positively related to the share of firms that have a blanket lien loan from a bank. But there is no evidence that this effect is stronger in intangible-capital intensive industries. This is consistent with the view that banks use blanket liens in high PE share markets

their values derive from firm operations, i.e, current fruit. In particular, firm sales combine ideas, intangible capital, marketing of products, etc., which are embedded in the value of the fruit they produce and become capitalized and pledgeable on the balance sheet as AR&I and blanket liens."

given the higher leverage and risk, but not because these industries are particularly intangible-capital intensive. Direct lenders have a unique specialty in extending blanket lien loans to industries with high PE share and an intangible-capital-intensive production function.

5.4 Industry specialization

The borrower portfolio of direct lenders relative to banks has a significantly higher degree of industry specialization. The measure of industry specialization used is the *excess specialization* measure of Blickle, Parlatore and Saunders (2023), which is defined as how 'over-weighted' the lender is in its most over-weighted industry relative to the 'diversified share' that a perfectly diversified lender would invest in that industry. Specifically, the measure is defined as:

$$ExcessSpecialization_l \equiv \max_i \left[\frac{Loans_{l,i}}{\sum_i Loans_{l,i}} - \frac{Loans_i}{\sum_i Loans_i} \right] \tag{3}$$

where $Loans_{l,i}$ is the total number of loans lender l makes in 3-digit NAICS industry i and $Loans_i$ is the total number of loans made in industry i by all lenders. For example, in the UCC data, Antares Capital has a loan share in the Professional, Scientific, and Technical Services (NAICS code 541) industry of 0.21. The share of all loans by all lenders to this industry is 0.12. The gap between 0.12 and 0.21 is larger for NAICS code 541 compared to any other industry. In this case, Antares Capital has an excess specialization of 0.09.

The first three columns of Table 12 present estimates from lender-level regressions of excess specialization on indicator variables of whether the lender is a direct lender or a finance company. Banks are the omitted group. As column 1 shows, direct lenders have an excess specialization measure that is on average 7.5 pp higher than banks. All estimates in the table come from regressions which also include 20 non-parametric indicator variables for the number of borrowers in a lender's portfolio. These variables are included in the regression to control for the mechanical relationship between the size of the lender's portfolio and its excess specialization in a given industry.[26] Even within narrowly defined size buckets, direct lenders have a higher industry specialization relative to banks.

Finance companies also have a higher industry specialization than banks, and even higher than direct lenders. This should not come as a surprise given that many of the finance companies are

[26]Inclusion of indicator variables for even finer size controls such as 40 or 60 size bins does not materially affect the results.

captive financing arms of the providers of specific types of equipment that are likely used heavily in certain industries. For example, Caterpillar Financial Services Corporation has a loan share in Heavy and Civil Engineering Construction (NAICS code 237) of 21.1%; the loan share for this industry in the entire sample is only 2.2%. The second and third column report estimates from regressions where the definition of excess specialization is varied based on different benchmarks of the bank overall portfolio or the direct lender overall portfolio. The results are broadly consistent. Across the different measures of excess specialization and the different levels of industry aggregation, direct lenders have higher industry specialization than banks.

The left hand side variable in the regression reported in column 4 is the intangible capital-intensity measure of the industry in which the lender has the highest excess specialization. The highest excess specialization industry for direct lenders has a $^{K_{IT}}/_{K_{TOT}}$ ratio that is 20 pp higher than banks.

Figure 8 shows these effects visually. The sample is split into five equally sized bins based on the total number of borrowers in the lender portfolio. The left panel shows the average excess specialization of direct lenders and banks. Across all five bins, the excess specialization of direct lenders is larger than banks. The right panel shows the average $^{K_{IT}}/_{K_{TOT}}$ ratio for the industry in which the lender is most specialized for direct lenders and banks. Direct lenders are more specialized in intangible capital industries in every size bin, and the difference is close to 20 pp across the distribution.

6 Conclusion and the Future

The lending technology of direct lenders is particularly well suited for PE-backed firms in intangible-capital-intensive industries. This is the most quantitatively important explanation for the rise in direct lending. Tighter regulation on banks in the aftermath of the GFC also explains the rise in direct lending, but the quantitative magnitude is weaker. Direct lenders make extensive use of blanket liens and are highly specialized in intangible capital industries, which supports the hypothesis that they are better positioned to make loans based on the continuation value of the enterprise in the event of default. Direct lenders have carved out an important niche in lending markets, and as such are likely to remain an important player going forward.

This study raises a number of questions for future research. Why exactly do direct lenders focus primarily on PE-backed companies, and will this continue to be the case going forward? One likely

answer relates to deal sourcing; direct lenders do not have a branch network nor a cash management business that would aid in finding new borrowers. However, this study finds evidence that direct lenders have made inroads into intangible-capital intensive industries even when private equity is not present (e.g., Table 10). One interesting recent trend are joint ventures between commercial banks and direct lenders. One such prominent example is Overland Advantage, a joint effort by Centerbridge and Wells Fargo. The press release announcing the the relationship highlights that it "includes differentiated origination sourcing from Wells Fargo's extensive middle market customer base ...", and that the relationship "represents a new paradigm in direct lending, bringing a relationship approach to direct lending and offering a much-needed capital solution in the large but underpenetrated non-sponsor U.S. middle market." This example highlights the difficulty that direct lenders have in sourcing deals outside the PE-sponsor market, and it also points to a potential solution in leveraging banks' clients.

Does the focus of direct lenders on PE-owned companies imply that the growth in private equity is a limit to the growth in direct lending? As of now, the aggregate AUM of private equity is significantly larger than the aggregate AUM of direct lenders; while estimates vary, it is safe to say that PE AUM is at least five times larger than direct lending AUM. But as the direct lending asset class grows, there is an interesting question of whether the close link to private equity will remain. For example, in recent years, private equity transactions have slowed considerably, which anecdotal evidence suggests has put pressure on direct lenders to invest in alternative asset classes such as broadly syndicated loans and asset-based financing.[27] Of course, providing debt financing in the broadly syndicated loan market to much larger firms, or lending against specific collateral rather than going-concern value, implies a different risk-return profile, which could present a challenge. This is closely related to a broader question: is direct lending more a relationship-based business or can it be transformed into a more arm's length debt market? It is clear that direct lenders rely on PE sponsors to a large degree, but the evidence from the literature suggests that direct lenders also conduct due diligence and monitoring (Jang (2025)). While relationship-based lending may offer more attractive returns, the costs of maintaining such relationships are likely higher. We look forward to research focused on these and related questions.

[27] As described in a recent report by Ion Analytics, "private credit funds, awash with record dry powder and starved of deal flow from private equity firms, are now courting listed companies once considered beyond their reach ...". A Bloomberg article also notes that the slowdown in private equity fundraising has prompted an expansion of private credit into providing asset-based financing to smaller businesses.

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Table 1: Fraction of Firms with a Loan, by Lender Type

	Full Sample	Private Middle Market	
	Emp-Weighted	Emp-Weighted	Equal-Weighted
Direct Lenders (UCC)	0.079	0.026	0.012
BDC Investment	0.047	0.008	0.003
Private Credit (PitchBook)	0.044	0.017	0.006
Private Credit (Broad)	0.126	0.036	0.016
Banks (UCC)	0.455	0.408	0.338
Finance Companies (UCC)	0.330	0.186	0.137

Fractions of firms borrowing from each lender type, computed for the full firm sample (employment-weighted) and the private middle market sample (both equal-weighted and employment-weighted). A firm counts as having borrowed from a given lender type if there is a UCC filing within the prior five-year window (i.e., 2018–2022 as of 2022).

Table 2: Borrower Characteristics, by Lender Type

	Mean	p10	p25	Median	p75	p90
Panel A: Employment						
Direct Lenders	133.6	26.0	37.0	67.0	150.0	334.0
Banks	77.2	23.0	28.0	41.0	75.0	153.0
Finance Companies	87.0	24.0	29.0	45.0	85.0	186.0
Panel B: Age						
Direct Lenders	30.1	8.0	14.0	24.0	40.0	59.0
Banks	37.2	11.0	19.0	32.0	49.0	71.0
Finance Companies	38.1	11.0	19.0	33.0	51.0	74.0
Panel C: Industry K_{IT}/K_{TOT}						
Direct Lenders	0.577	0.175	0.363	0.662	0.816	0.816
Banks	0.488	0.162	0.273	0.570	0.667	0.816
Finance Companies	0.463	0.162	0.280	0.466	0.662	0.816
Panel D: Credit Score (PAYDEX)						
Direct Lenders	68.3	51.0	63.0	72.0	78.0	80.0
Banks	69.3	53.0	65.0	74.0	79.0	80.0
Finance Companies	68.6	52.0	64.0	73.0	78.0	80.0
Panel E: City Population, Millions						
Direct Lenders	5.572	0.368	1.181	3.697	7.403	12.907
Banks	4.246	0.135	0.478	2.209	6.252	12.907
Finance Companies	4.048	0.118	0.411	2.078	6.211	12.907

Table 3: Borrower Portfolio Differences: Direct Lenders vs. Banks/Finance Companies

Panel A: Industry Distribution

Industries with Higher Direct Lender Portfolio Share

NAICS-3	Industry	Direct Lender	Bank/FC	Difference	Industry K_{IT}/K_{TOT}
541	Professional, Scientific, and Technical Services	0.197	0.121	0.075	0.816
623	Nursing and Residential Care Facilities	0.049	0.019	0.029	0.064
513	Publishing Industries	0.025	0.006	0.019	0.893
621	Ambulatory Health Care Services	0.075	0.057	0.018	0.667
551	Mgmt of Companies	0.021	0.006	0.015	0.816
561	Administrative and Support Services	0.065	0.050	0.014	0.743
423	Merchant Wholesalers, Durable Goods	0.069	0.058	0.012	0.662
325	Chemical Manufacturing	0.020	0.008	0.012	0.871
334	Computer and Electronic Product Manufacturing	0.020	0.009	0.011	0.793
339	Miscellaneous Manufacturing	0.020	0.010	0.011	0.804

Industries with Higher Bank/FC Portfolio Share

NAICS-3	Industry	Direct Lender	Bank/FC	Difference	Industry K_{IT}/K_{TOT}
238	Specialty Trade Contractors	0.039	0.086	-0.047	0.574
441	Motor Vehicle and Parts Dealers	0.008	0.053	-0.045	0.315
722	Food Services and Drinking Places	0.028	0.060	-0.032	0.222
236	Construction of Buildings	0.007	0.032	-0.025	0.175
237	Heavy and Civil Engineering Construction	0.009	0.024	-0.015	0.281
484	Truck Transportation	0.007	0.020	-0.014	0.050
721	Accommodation	0.008	0.019	-0.011	0.159
445	Food and Beverage Retailers	0.008	0.017	-0.009	0.126
444	Building Material and Garden Equipment and Supplies Dealers	0.003	0.011	-0.008	0.218
332	Fabricated Metal Product Manufacturing	0.026	0.033	-0.008	0.466

Panel B: Geographic Distribution (City)

Metro Areas with Higher Direct Lender Portfolio Share

Metro Area	Direct Lender	Bank/FC	Difference	City Population, Millions
New York-Newark-Jersey City, NY-NJ	0.090	0.067	0.023	19.62
Los Angeles-Long Beach-Anaheim, CA	0.067	0.044	0.023	12.91
Boston-Cambridge-Newton, MA-NH	0.037	0.021	0.016	4.93
Dallas-Fort Worth-Arlington, TX	0.040	0.025	0.014	7.97
San Francisco-Oakland-Fremont, CA	0.029	0.016	0.014	4.60
Atlanta-Sandy Springs-Roswell, GA	0.030	0.017	0.013	6.25
Chicago-Naperville-Elgin, IL-IN	0.051	0.039	0.012	9.31
Denver-Aurora-Centennial, CO	0.018	0.010	0.009	2.99
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	0.030	0.022	0.008	6.25
San Jose-Sunnyvale-Santa Clara, CA	0.014	0.006	0.008	1.95

Table 4: Mahalanobis Distances of Borrower Portfolio, by Employment Size Category

	Employment					
	All	21-50	51-100	101-200	201-500	501-1000
Direct Lender-Bank Distance	0.823	0.661	0.570	0.489	0.472	0.492
Direct Lender - FC Distance	0.815	0.736	0.652	0.547	0.519	0.579
Bank - FC Distance	0.158	0.143	0.116	0.082	0.093	0.123

Table 5: Direct Lender Share, PE Share, and Persistence

	(1) DL Share 2022	(2) Δ DL Share 2010–2022	(3) PE Share 2022	(4) DL Share 2022	(5) Δ DL Share 2010–2022
Panel A: No Fixed Effects					
PE Share, 2022	0.208**	0.171**			
	(0.009)	(0.009)			
PE Share, 2007			0.954**	0.232**	0.158**
			(0.083)	(0.023)	(0.019)
Constant	0.004**	0.002**	0.028**	0.009**	0.007**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Industry FE	No	No	No	No	No
City FE	No	No	No	No	No
Observations	14,594	14,594	13,941	13,941	13,941
R-squared	0.267	0.163	0.261	0.098	0.041
Panel B: Industry and City Fixed Effects					
	DL Share 2022	Δ DL Share 2010–2022	PE Share 2022	DL Share 2022	Δ DL Share 2010–2022
PE Share, 2022	0.163**	0.154**			
	(0.009)	(0.010)			
PE Share, 2007			0.367**	0.083**	0.052**
			(0.062)	(0.016)	(0.015)
Industry FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Observations	14,594	14,594	13,940	13,940	13,940
R-squared	0.351	0.236	0.517	0.289	0.184

Each observation is a (2-digit NAICS) × CBSA market cell weighted by the number of firms in the cell. Outcomes are the direct lender share as of 2022 (DL 2022), the change in the direct lender share from 2010 to 2022 (DL Change 10-22), and the PE share as of 2022 (PE 2022). Panel A reports OLS estimates without fixed effects; Panel B adds industry and city fixed effects. Standard errors are double-clustered by industry and city. ** p<0.01, * p<0.05.

Table 6: Mean Change in Direct Lender Share 2010-2022, by 2007 PE Share Quartiles

	PE Share of City, 2007			
PE Share of Industry, 2007	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Quartile 1	0.004	0.005	0.008	0.008
Quartile 2	0.002	0.004	0.004	0.005
Quartile 3	0.005	0.011	0.014	0.017
Quartile 4	0.009	0.014	0.019	0.021

Each cell reflects the change in the share of firms in the cell that receive a direct loan from 2010 to 2022. Industries are sorted into quartiles by the 2007 share of firms with PE ownership (rows) and cities are sorted into quartiles by the 2007 share of firms with PE ownership (columns).

Table 7: Decline in Bank Lending and Exposure to Post-GFC Bank Shocks

	Δ Bank Share 2010–2022				
	(1)	(2)	(3)	(4)	(5)
Panel A: No Fixed Effects					
Exposed to Lehman (std)	0.001				0.003
	(0.002)				(0.002)
Exposed to ABX index (std)		-0.006**			-0.001
		(0.002)			(0.002)
Top 4 Exposure (std)			-0.010**		-0.001
			(0.002)		(0.002)
Exposure to CCAR Banks (std)				-0.012**	-0.011**
				(0.002)	(0.002)
Industry FE	No	No	No	No	No
City FE	No	No	No	No	No
Observations	14,594	14,594	14,594	14,594	14,594
R-squared	0.000	0.003	0.008	0.011	0.013
Panel B: Industry and City Fixed Effects					
Exposed to Lehman (std)	-0.005**				-0.001
	(0.001)				(0.001)
Exposed to ABX index (std)		-0.009**			-0.002
		(0.001)			(0.001)
Top 4 Exposure (std)			-0.016**		0.001
			(0.001)		(0.002)
Exposure to CCAR Banks (std)				-0.029**	-0.029**
				(0.001)	(0.002)
Industry FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Observations	14,594	14,594	14,594	14,594	14,594
R-squared	0.148	0.151	0.159	0.176	0.176

The dependent variable is the change in the share of firms with a bank loan from 2010 to 2022 in a (2-digit NAICS) $\times$ CBSA market cell. All exposure measures are standardized by their respective standard deviations. Panel A reports OLS estimates; Panel B adds industry and city fixed effects. Observations are weighted by the number of firms in the market cell as of 2007. Standard errors are double-clustered by industry and city. ** p<0.01, * p<0.05.

Table 8: Direct Lender Share and Exposure to CCAR-Subject Banks

	(1) Δ Bank Share 2010–2022	(2) DL Share 2022	(3) Δ DL Share 2010–2022	(4) Δ Bank Share 2010–2022	(5) DL Share 2022	(6) Δ DL Share 2010–2022
Exposure to CCAR Banks	-0.110**	0.034**	0.024**	-0.270**	0.010**	0.005*
	(0.016)	(0.003)	(0.003)	(0.014)	(0.002)	(0.003)
Constant	0.059**	0.007**	0.005**	0.084**	0.011**	0.008**
	(0.003)	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)
Industry FE	No	No	No	Yes	Yes	Yes
City FE	No	No	No	Yes	Yes	Yes
Observations	14,594	14,594	14,594	14,594	14,594	14,594
R-squared	0.011	0.036	0.017	0.176	0.267	0.168

The dependent variables are the change in the bank share from 2010 to 2022, the direct lender share as of 2022, and the change in the direct lender share from 2010 to 2022 (columns 1–3 without fixed effects, columns 4–6 with industry and city fixed effects). The independent variable is the share of firms with a UCC filing from a CCAR-subject bank as of 2010. Observations are (2-digit NAICS) $\times$ CBSA market cells weighted by the number of firms in the cell. Standard errors are double-clustered by industry and city. ** $p<0.01$, * $p<0.05$.

Table 9: Comparing the PE Channel and the Bank Regulation Channel

	DL Share (std) 2022			Δ DL Share (std) 2010–2022		
	(1)	(2)	(3)	(4)	(5)	(6)
PE Share, 2007 (std)	0.279**	0.107**	0.108**	0.179**	0.064**	0.068**
	(0.029)	(0.022)	(0.025)	(0.022)	(0.019)	(0.022)
CCAR Exposure (std)	0.138**	0.050**	0.050**	0.095**	0.024	0.025
	(0.016)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
PE 2007 (std) × CCAR (std)			-0.000			-0.002
			(0.008)			(0.006)
Industry FE	No	Yes	Yes	No	Yes	Yes
City FE	No	Yes	Yes	No	Yes	Yes
Observations	13,941	13,940	13,940	13,941	13,940	13,940
R-squared	0.117	0.290	0.290	0.051	0.184	0.184

The dependent variable is the direct lender share as of 2022 (columns 1–3) or the change in the direct lender share from 2010 to 2022 (columns 4–6). All variables are standardized by dividing by the respective standard deviation. Observations are (2-digit NAICS) × CBSA market cells weighted by the number of firms in the cell. Standard errors are double-clustered by industry and city. ** p<0.01, * p<0.05.

Table 10: Direct Lender Share, PE Presence, and Intangible Capital Intensity

	(1) DL Share 2022	(2) DL Share 2022	(3) DL Share 2022	(4) Δ DL Share 2010–2022	(5) Δ DL Share 2010–2022	(6) Δ DL Share 2010–2022
PE Share, 2007	0.169**	0.071**	-0.028	0.104**	0.018	-0.050*
	(0.018)	(0.025)	(0.017)	(0.015)	(0.029)	(0.025)
Industry Intangible Capital Intensity	0.024**	0.021**		0.020**	0.018**	
	(0.001)	(0.001)		(0.001)	(0.001)	
PE 2007 × Intangibility		0.173**	0.200**		0.154**	0.185**
		(0.049)	(0.042)		(0.054)	(0.050)
Industry FE	No	No	Yes	No	No	Yes
City FE	No	No	Yes	No	No	Yes
Observations	13,941	13,941	13,940	13,941	13,941	13,940
R-squared	0.159	0.162	0.292	0.080	0.083	0.186

The dependent variable is the direct lender share as of 2022 (columns 1–3) or the change in the direct lender share from 2010 to 2022 (columns 4–6). The intangible capital intensity measure is K_{IT}/K_{TOT} from He, Mostrom and Sufi (2024). Observations are (2-digit NAICS) × CBSA market cells weighted by the number of firms in the cell. Standard errors are double-clustered by industry and city. ** p<0.01, * p<0.05.

Table 11: Blanket Lien Loans, PE Share, and Intangible Capital Intensity, by Lender Type

	DL Blanket Lien Share (std)		Bank Blanket Lien Share (std)		FC Blanket Lien Share (std)	
	(1)	(2)	(3)	(4)	(5)	(6)
PE Share 2007 (std)	0.093**	-0.014	0.065**	0.075*	0.008	0.005
	(0.021)	(0.024)	(0.015)	(0.038)	(0.008)	(0.023)
PE 2007 (std) × Intangibility (std)		0.040**		-0.004		0.001
		(0.012)		(0.012)		(0.007)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,940	13,940	13,940	13,940	13,940	13,940
R-squared	0.243	0.245	0.327	0.327	0.121	0.121

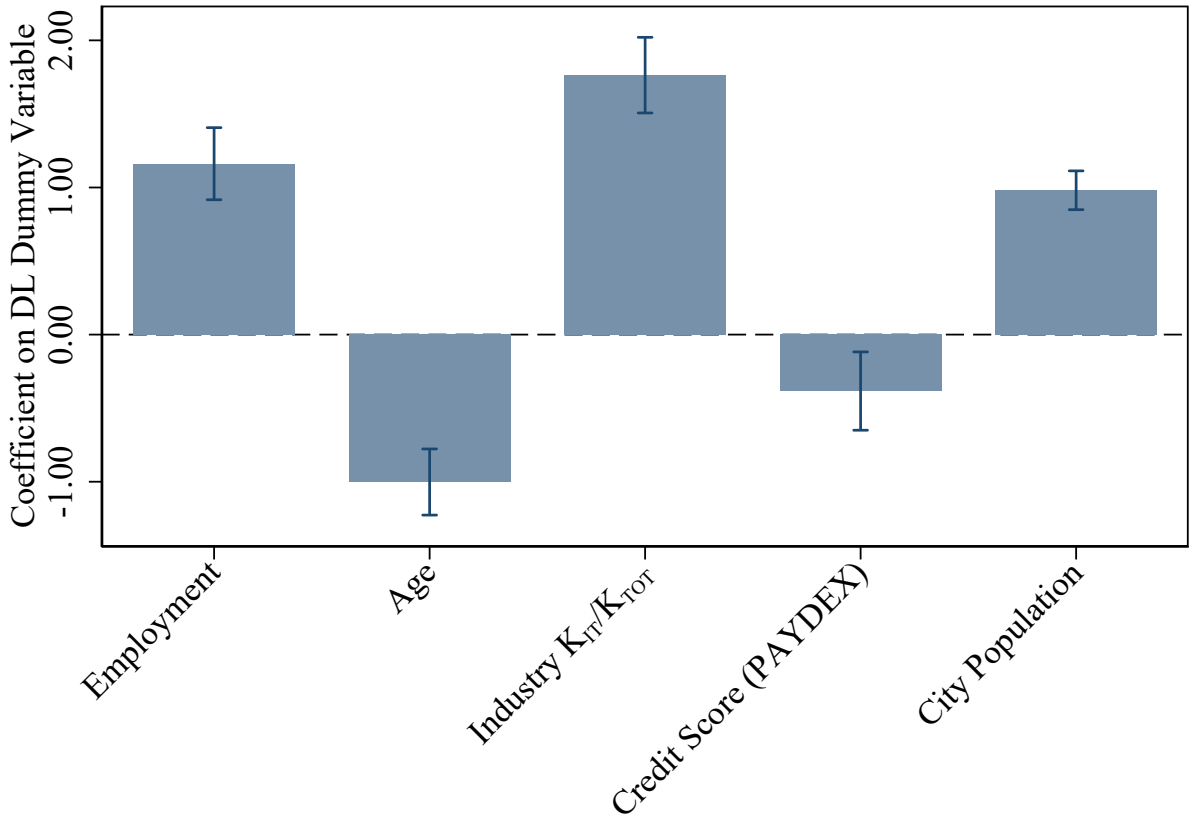
The dependent variable is the share of firms in a market cell with a blanket lien loan from a direct lender (columns 1–2), a bank (columns 3–4), or a finance company (columns 5–6). Independent variables include the PE share as of 2007, intangible capital intensity (K_{IT}/K_{TOT}), and their interaction. Observations are (2-digit NAICS) × CBSA market cells weighted by the number of firms in the cell. Standard errors are double-clustered by industry and city. ** p<0.01, * p<0.05.

Table 12: Direct Lenders and Industry Specialization

	Specialization			Intangible Capital Intensity
	(1)	(2)	(3)	(4)
Direct Lender	0.075**	0.073**	0.034**	0.201**
	(0.012)	(0.012)	(0.011)	(0.025)
Finance Company	0.145**	0.146**	0.140**	-0.051**
	(0.016)	(0.016)	(0.016)	(0.018)
Observations	2,555	2,555	2,555	2,555
R-squared	0.144	0.144	0.127	0.038
Benchmark	all	bank	dl	all

All regressions include size category dummies (not reported). Benchmark indicates which lender group is set as the reference category for calculating industry specialization. Heteroskedasticity-robust standard errors are reported.

Figure 1: Differences in Borrower Portfolio Characteristics for Direct Lenders



This figure reports coefficients on the direct lender indicator variable from lender-level regressions of borrower portfolio characteristics on a direct lender dummy. Each outcome variable is standardized by its standard deviation. Bars show the OLS point estimate; whiskers show 95% confidence intervals based on heteroskedasticity-robust standard errors.

Figure 2: PE Share of Borrowers, by Lender Type

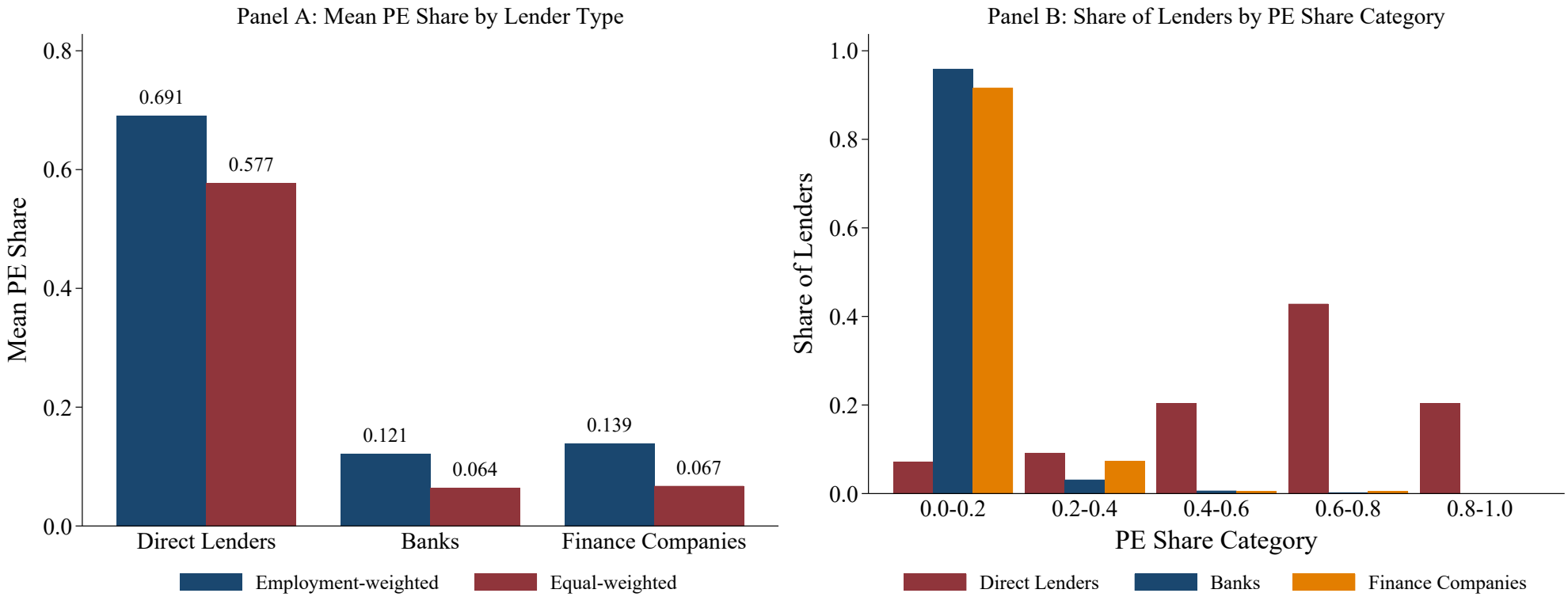
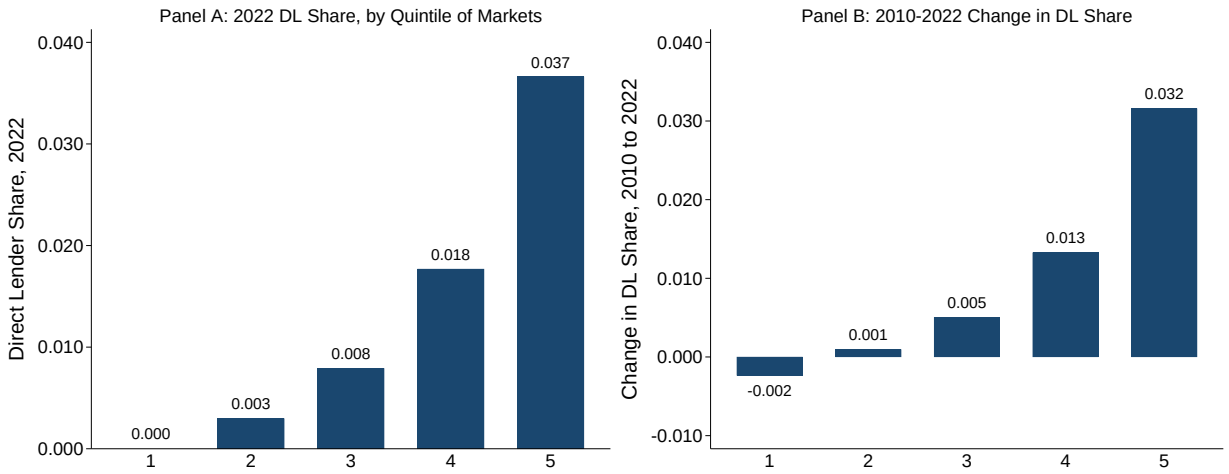
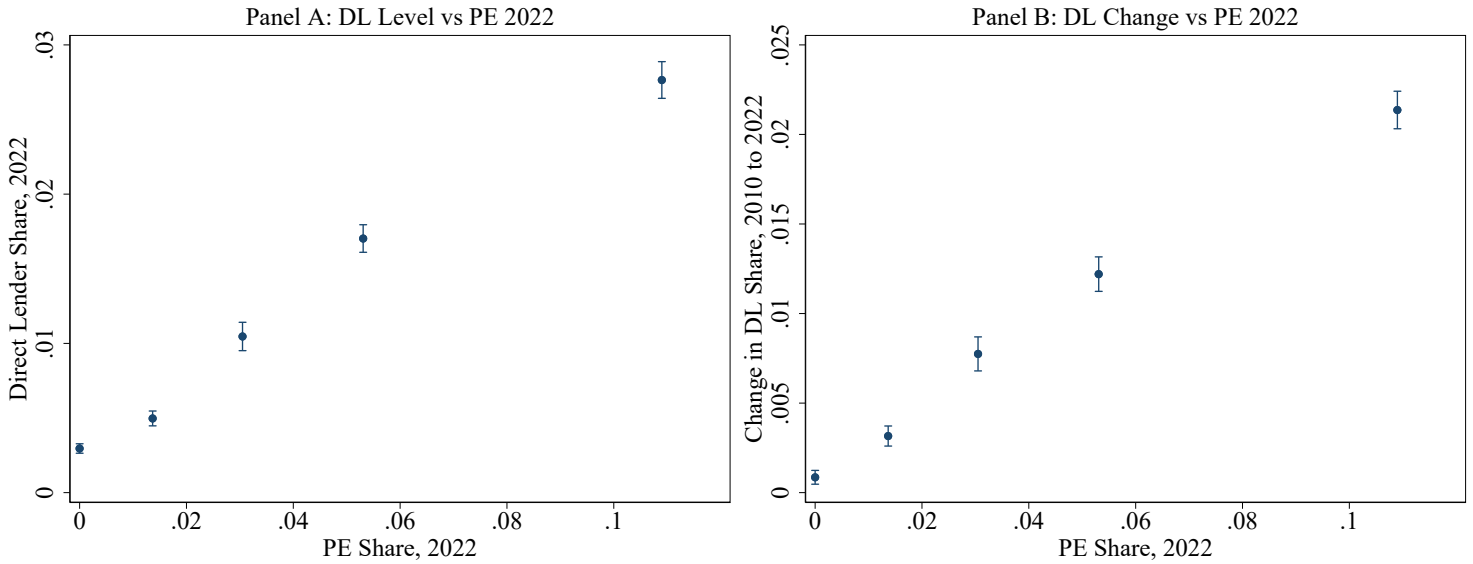


Figure 3: Variation in Direct Lender Share Across Markets



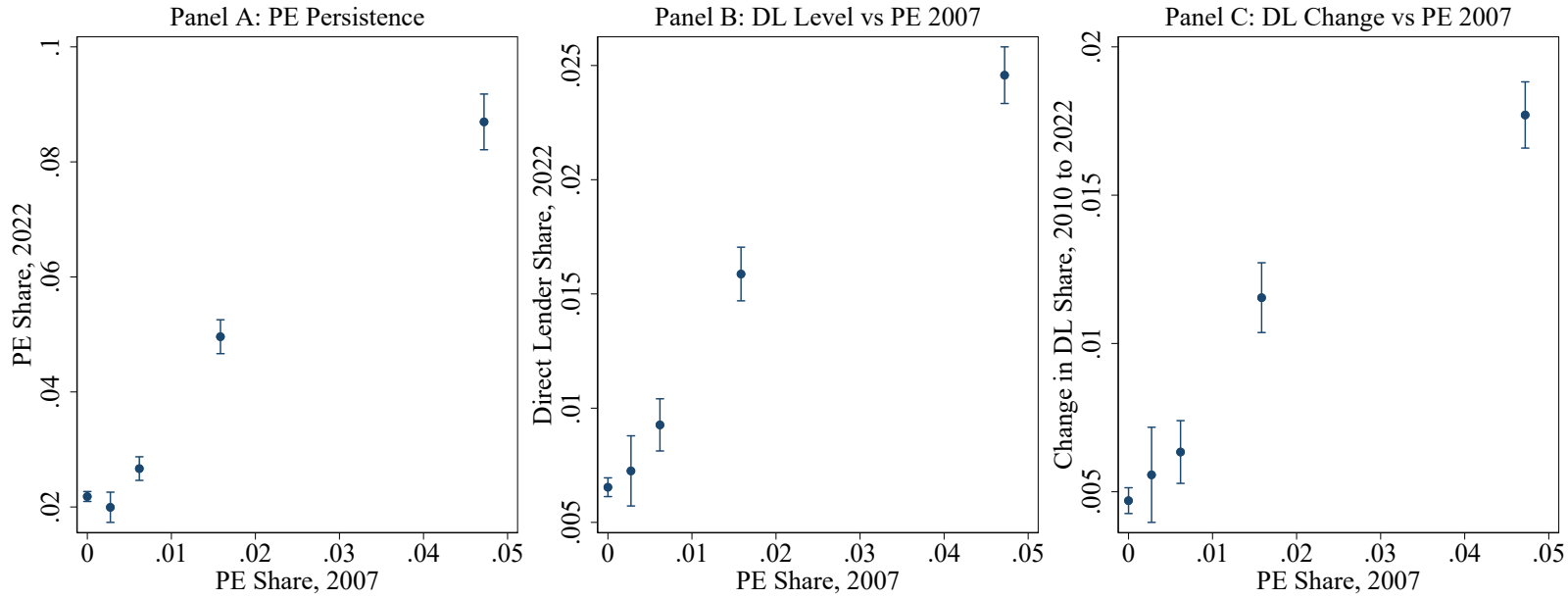
Lending markets are (2-digit NAICS) $\times$ CBSA cells. The left panel sorts markets into quintiles by the share of firms with a direct loan as of 2022, and reports the firm-weighted mean DL share in each quintile. The right panel sorts markets into quintiles by the change in the direct lender share from 2010 to 2022, and reports the firm-weighted mean of the change in each quintile.

Figure 4: Direct Lending and Contemporaneous PE Share



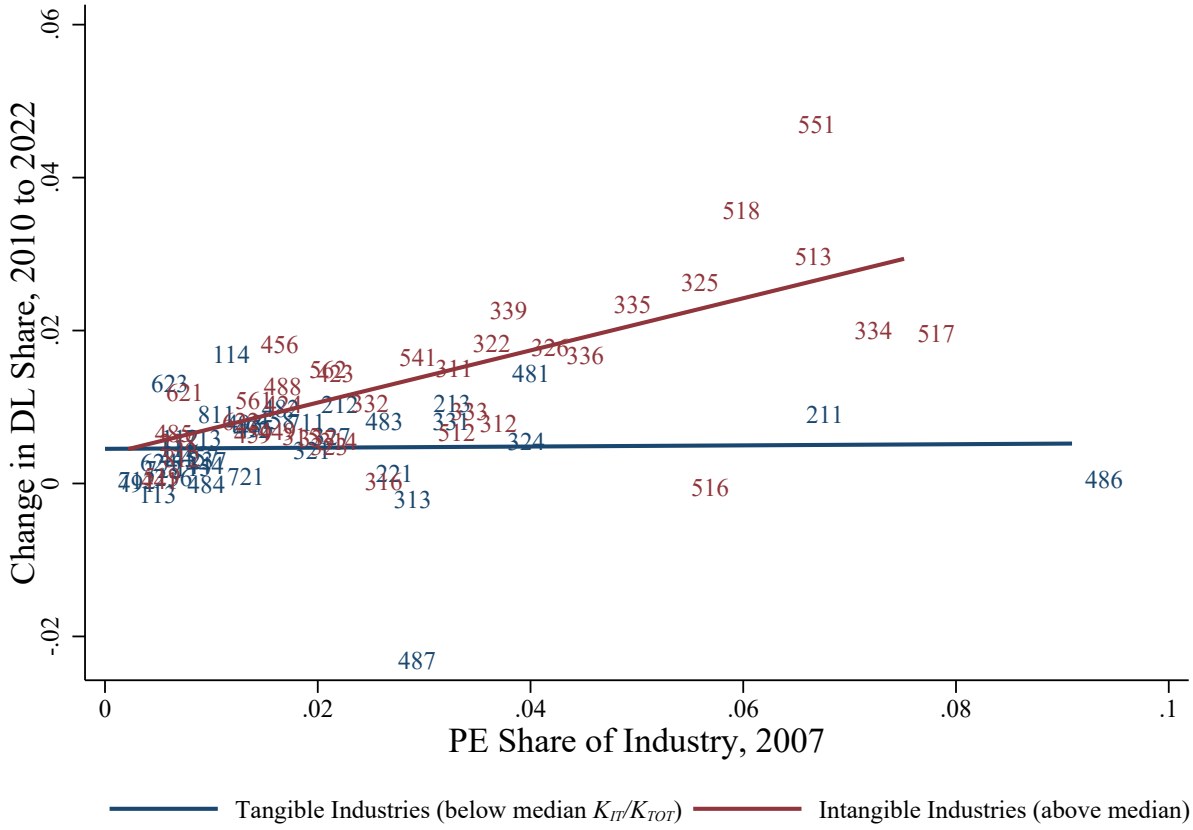
The two panels present bin scatters of the city-by-industry direct lender share as of 2022 (Panel A) and the change in the direct lender share from 2010 to 2022 (Panel B), both against the city-by-industry PE share as of 2022. Each observation is a (2-digit NAICS, CBSA) market cell weighted by the number of firms in the cell. Bins are 5 quantiles; whiskers show 90% confidence intervals.

Figure 5: Predicting Direct Lending with PE Share as of 2007



The three panels present bin scatters at the city-by-industry market level using the 2007 PE share as the running variable on the x-axis. Panel A shows the persistence relationship: PE share in 2022 against PE share in 2007 (the first stage). Panel B shows the direct lender share in 2022 against the 2007 PE share (the reduced form on levels). Panel C shows the change in the direct lender share from 2010 to 2022 against the 2007 PE share (the reduced form on changes). Each observation is a (2-digit NAICS, CBSA) market cell weighted by the number of firms in the cell. Bins are 5 quantiles; whiskers show 90% confidence intervals.

Figure 6: Direct Lending Growth, PE Presence, and Intangible Capital Intensity



Each marker is a 3-digit NAICS industry. The y-axis is the change in the direct lender share of the industry from 2010 to 2022; the x-axis is the PE share of the industry as of 2007. The sample is split at the median of industry-level intangible capital intensity (K_{IT}/K_{TOT} from He, Mostrom and Sufi (2024)): industries above the median ("intangible") are plotted in maroon, industries below ("tangible") in navy. Each color group has its own OLS best-fit line. Marker labels are 3-digit NAICS codes.

Figure 7: Blanket Lien Usage, by Lender Type

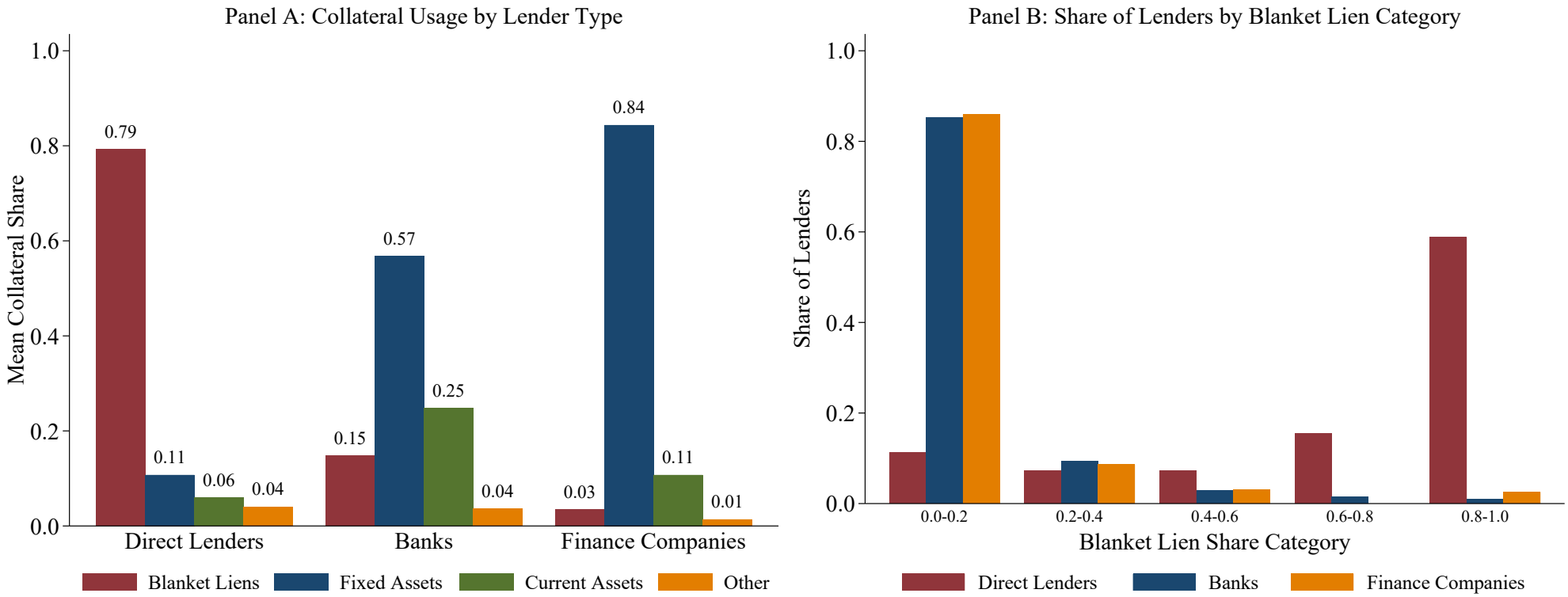
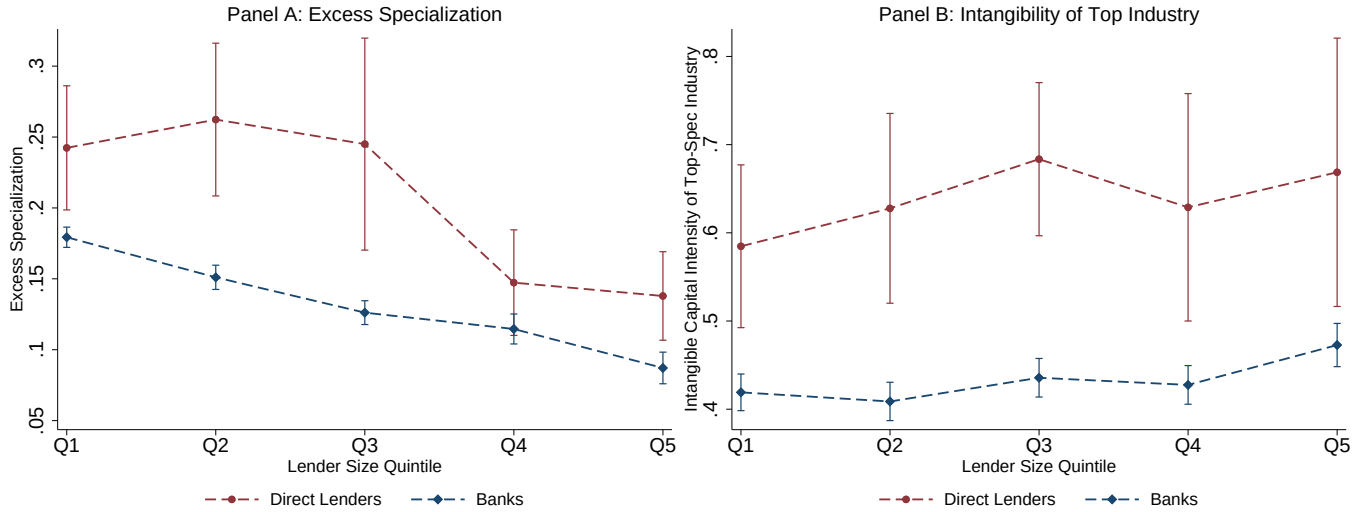


Figure 8: Lender Industry Specialization and Intangibility, by Lender Size



Lenders are sorted into five equally sized bins by the total number of borrowers in the lender's portfolio. The left panel reports the mean excess specialization of direct lenders versus banks within each size bin. The right panel reports the mean K_{IT}/K_{TOT} of the industry in which the lender is most specialized, again split by lender type and size bin.

Internet Appendix

A UCC Data Description

A.1 Representativeness of Middle-Market Lending

Gopal and Schnabl (2022) demonstrate that Uniform Commercial Code (UCC) filings capture a substantial portion of small business lending. An open question is whether this extensive coverage extends to the middle-market segment, which is the focus of our study. While small businesses often rely on bilaterally negotiated loans from banks, finance companies, and fintech lenders, middle-market firms also borrow through broadly syndicated loans arranged by banks and through direct lending by private credit funds and Business Development Companies (BDCs).

Despite the importance of these lending channels, the coverage and representativeness of UCC filings on the broadly syndicated and direct lending markets have not been systematically examined. This appendix addresses that gap by cross-validating the UCC dataset against established data sources widely used in the literature.

The goal of this study is to measure relationship-based, information-sensitive loans to middle market firms, where the lender in question is doing the monitoring and screening. Do UCC filings capture such loans by direct lenders? This is a challenging question to answer, as it requires data on a set of loans where we know for sure that a direct lender is originating the loan.

We test this using two datasets. First, we use the KBRA Direct Lending Deals (DLD) database, which collects information on US direct lending deals and identifies the lead lender on each deal, allowing us to verify that the loan is originated by a direct lender.[28] Because the database coverage begins in 2020, we draw a random sample of 100 direct loans to U.S.-headquartered borrowers in 2021. Second, we use a proprietary dataset from Jang (2025), which identifies direct loans as those arranged by a direct lender based on lead lender information extracted directly from credit agreements. Jang (2025) provides considerable evidence that the direct lenders on these loans are monitoring and screening the borrower. From this dataset, we randomly sample 100 direct loans made to US-headquartered borrowers between 2014 and 2022.

In the KBRA DLD sample, 98% of borrowers in appear in the UCC dataset. Among these, 87% (72%) have a filing by the lender within a five-year window (or within a year), and an additional 10% (9%) have a filing by another lender (within a year).[29] Turning to the Jang (2025) sample, 100% of borrowers appear in the UCC dataset. Of these, 87% (85%) have a filing by the lender within a five-year window (or within a year), and an additional 9% (6%) have a filing by another lender (within

[28] Following Sufi (2007) and Ivashina (2009), we define lead lenders as the administrative agent or, if not specified, one of the arrangers.

[29] We use this five-year lookup window to account for the fact that UCC filings may not be made every time the loan is originated or refinanced, although they must be renewed every five years.

a year). We view this as the strongest confirmation that direct lenders making relationship-based, information-sensitive loans file a UCC filing that we can measure.

In terms of syndicated loans, UCC filings are made by creditors who hold a secured claim on a borrower's collateral. Importantly, not every lender in a syndicate is required to file, raising several important questions: Which lenders within the deal syndicate typically file UCCs? Do relationship lenders tend to file, or are filings rather made by entities with limited economic exposure to the borrower? The value of UCC data in capturing borrower-lender relationships depends heavily on answering these questions.

To evaluate its coverage of the broadly syndicated loan market, we randomly sample 100 Dealscan deals involving US-headquartered borrowers between 2006 and 2023. Dealscan provides loan-level data at the lender level, yielding a sample of 100 lead lenders and 293 participant lenders.

We find that 95 out of the 100 borrowers (95%) appear in the UCC dataset. Furthermore, 62% of the lead lenders have a corresponding UCC filing dated within the five year window. In contrast, only 8.2% of participant lenders (24 out of 293) file within this window. These results suggest that UCC filings are effective at capturing the presence of lead lenders, who are the entities most likely to maintain long-term relationships with borrowers.

Finally, we evaluate UCC coverage of PitchBook private credit deals. Unlike the previous data sets, PitchBook does not distinguish between lender roles. Similar as before, we randomly select 100 private credit deals involving US-headquartered borrowers for manual verification. We find that 98% of these borrowers appear in the UCC dataset. In addition, 44% of borrower-lender pairs have a corresponding UCC filing within the five-year window. Prior research by Haque, Mayer and Stefanescu (2025a) shows that direct lenders also participate in syndicated deals. Consistent with this finding, we observe that 92% of the PitchBook borrowers have some UCC filing within the five-year window, 44% have a filing by the same lender within the window, and an additional 48% have a filing by another lender during the same period.

A.2 Processing Data

Our data vendor, MailingLists, provides two datasets: one including *dunsnumbers* for both borrowers and lenders, and one without. To maximize coverage, we sequentially applied a series of algorithmic procedures to supplement missing *dunsnumbers*: first, exact name matches (Algorithm 1); next, partial name and address matches using the first five letters (Algorithm 2); and finally, partial name and ZIP code matches using the first ten letters of the name (Algorithm 3). These sequential procedures substantially improved coverage, raising lender *dunsnumber* coverage to a yearly average of 95% and borrower *dunsnumber* coverage to a yearly average of 75%, compared with the original yearly averages of 58% and 39%, respectively. Table A1 reports the year-by-year improvements in coverage.

Table A1: Coverage Improvement in *dunsnumber*

	Lender *dunsnumber*				Borrower *dunsnumber*			
Year	**Original**	**Algo 1**	**Algo 2**	**Algo 3**	**Original**	**Algo 1**	**Algo 2**	**Algo 3**
2006	54.28%	94.62%	95.18%	95.47%	44.02%	73.05%	78.09%	79.49%
2007	48.65%	95.40%	95.93%	96.18%	41.32%	70.67%	75.66%	77.06%
2008	49.01%	95.58%	96.10%	96.35%	42.24%	71.54%	76.47%	77.92%
2009	59.45%	95.93%	96.44%	96.70%	54.21%	78.98%	84.70%	85.92%
2010	31.60%	95.88%	96.47%	96.70%	45.41%	77.39%	83.09%	84.39%
2011	56.03%	96.65%	97.17%	97.39%	46.76%	75.03%	80.66%	81.87%
2012	69.65%	96.77%	97.25%	97.59%	47.78%	72.85%	78.00%	79.19%
2013	70.97%	96.57%	97.06%	97.47%	45.12%	70.88%	76.92%	78.26%
2014	69.54%	96.37%	96.87%	97.32%	43.60%	70.07%	76.56%	78.06%
2015	67.56%	96.01%	96.52%	96.99%	41.83%	68.34%	74.52%	76.04%
2016	66.37%	95.46%	95.91%	96.34%	38.17%	67.93%	73.76%	75.18%
2017	70.34%	95.25%	95.73%	96.19%	39.27%	65.87%	71.82%	73.23%
2018	66.79%	94.56%	95.13%	95.54%	35.80%	63.82%	69.94%	74.47%
2019	55.49%	93.83%	94.51%	94.80%	27.11%	61.11%	67.47%	69.26%
2020	57.64%	94.87%	95.59%	95.80%	26.03%	57.13%	62.75%	64.59%
2021	55.03%	93.17%	94.11%	94.36%	22.90%	54.22%	60.30%	62.14%
2022	38.74%	86.65%	87.71%	88.07%	19.89%	54.70%	60.47%	62.33%

A.3 Lender Classification

We then classify direct lenders using a list of U.S. private credit funds from PitchBook and Preqin, matched to NETS through phone numbers and manual name verification. We supplement this with a keyword search for variations of "direct lending," "private credit," "debt fund," and "lending fund," and excluding obvious false positives such as "tax credit fund." Validation on a random sample of 200 filings suggests a false positive rate of only 1.5%.

Banks are identified using parent-level NETS NAICS codes (522110 Commercial Banking, 522130 Credit Unions, and 522180 Savings Institutions and Other Depository Credit Intermediation), keyword searches (e.g., names ending in "BK" or containing "bank," "credit union," "savings & loan," or "S&L"), and a list of some of the largest banks.[30] Validation on a random sample of 200 filings indicates a 0% false positive rate.

Finance companies are identified through parent-level NAICS codes (522220 Sales Financing,

[30]This list includes the top 25 banks from Call Reports (JP Morgan, Bank of America, Citi, Wells Fargo, Wachovia, US Bank, PNC, Truist, Capital One, TD, BNY Mellon, Charles Schwab, Morgan Stanley, State Street, Goldman Sachs, Fifth Third, Northern Trust, HSBC, Citizens, Mizuho, KeyBank, and Huntington) as well as Ally Financial, Credit Suisse, and Deutsche Bank.

423820 Farm and Garden Machinery and Equipment Merchant Wholesalers, and 522291 Consumer Lending), keyword searches (e.g., "leasing," "financial services," "equipment financ," "finance company"), and a list of some of the largest finance companies.[31] The false positive rate for finance companies on a random sample of 200 filings is 3.5%.

Compared with Gopal and Schnabl (2022), our data processing and lender classification approach achieves noticeably higher coverage, identifying 576,925 bank filings and 429,658 finance company filings in 2016, compared to 497,254 and 389,786, respectively, in their dataset.

A.4 Matching Banks with NIC

For each UCC bank lender, we assign a single, time-invariant NIC entity identifier (RSSD), and then resolve year by year its ultimate parent organization and highest-tier U.S. bank holding company. Holding the lender–RSSD link fixed across years reflects an institutional fact: the legal identity recorded on a UCC filing does not legitimately change from one year to the next, even as ownership, charter status, and trade names do.

Lender–RSSD assignment. For every NIC entity we assemble all name variants under which it has ever been observed: current legal and short names, historical names from FFIEC Call Reports and Y–9C filings, and predecessor and successor names of *non-merger* transformations (charter conversions, renamings, holding-company restructurings). Predecessor names of mergers are retained as aliases of the predecessor only and are not propagated to the acquirer; otherwise, the alias of a salient acquired bank would be falsely attached to its much larger acquirer. UCC lender names and NIC alias names are encoded with a multilingual text encoder, and for each UCC lender we retain the top NIC candidates by cosine similarity. We then score candidates with a composite that combines fuzzy similarity, embedding cosine, exact-name and state matches, and an entity-type rank that prefers operating bank charters over holding companies. A single RSSD is selected per lender by evaluating the score at the median sample year (2014). The result is then run through a 300-lender hand audit using LLM-driven research agents that retrieve evidence from the FDIC Institution Directory, NIC, NCUA, FFIEC press releases, and SEC filings; the audit produces 21 high-confidence corrections affecting roughly 1.1% of the panel.

Dynamic parent resolution. Given the lender–RSSD assignment, we resolve the ultimate parent and highest-tier U.S. bank holding company year by year by walking a unified edge list constructed from NIC's control relationships and transformation events. Sole-control edges are admitted regardless of equity share; shared-control edges are admitted only when the equity share is at least 50%.

[31] This list includes the top 10 finance companies from Gopal and Schnabl (2022) (John Deere, CNH Capital, Kubota, GE Capital, Caterpillar, Snap-On Credit, DLL Finance, AGCO Finance, Tower Loan, Toyota Motor Credit) as well as Republic Finance, Gulfco Mississippi, Volvo Finance, Mercedes-Benz Finance, First Heritage Credit, 1st Franklin Financial, Komatsu Financial, Rabo Agrifinance, and Automotive Finance Corp.

The 50% floor is essential: NIC records control-adjacent minority positions as shared-control edges (e.g., MUFG's 22% passivity-committed stake in Morgan Stanley); without the floor, the walker would attribute Morgan Stanley's downstream lenders to MUFG. Transformation events (mergers, conversions, reorganizations, consolidations) are admitted as upward edges from predecessor to successor with 100% ownership and an unbounded upper date, so that UCC filings under the predecessor's RSSD after a transformation are attributed to the successor.

Manual override layer. A small hand-curated table of 32 entries covers post-merger ultimate-parent assignments that NIC's preferred-parent register does not capture. Notable cases include Washington Mutual's 2008 FDIC seizure and sale to JPMorgan Chase, Bank of America's 2009 acquisition of the Merrill Lynch family, the 2019 SunTrust–BB&T merger into Truist, PNC's 2021 acquisition of BBVA USA, and U.S. intermediate-holding-company assignments for HSBC Bank USA and Santander Bank (without which the highest-BHC field would pick the foreign ultimate parent).

Validation. A 200-lender stratified audit of the final lender panel – 100 random lenders with at least three years of activity and 100 large lenders by total filings – yields error rates of approximately 4% and 9%, respectively. The four banks of the Chen et al. (2017) big-four are clean after audit, with corrections recovering $\approx$385K filings into their correct ultimate-parent identifiers.

B Identifying PE backing using Pitchbook and Capital IQ

This appendix describes the procedure used to match each NETS DUNS to its corresponding entity in PitchBook (PB) and S&P Capital IQ (CIQ). The DUNS-level matches are then rolled up to the firm level using the parent-rollup procedure described in Section 2.1.

Unified textual profiles. The first stage maps every record from each source into a single canonical text string – the *profile* – that concatenates labelled name fields and labelled address fields. PB companies, PB investors, and CIQ targets/investors/sellers each use a parallel template that surfaces equivalent fields (*also-known-as*, *former name*, *trade name*) under common labels regardless of source, so that semantically equivalent fields can be treated as synonymous in the downstream model. The templates for a PB company, a CIQ entity, and a NETS DUNS are:

PB company profile:

```
CompanyName: {CompanyName}
CompanyAlsoKnownAs: {CompanyAlsoKnownAs}
CompanyFormerName: {CompanyFormerName}
CompanyLegalName: {CompanyLegalName}
```

```
HQLocation: {City, State}
HQAddress: {Street}
```

CIQ entity profile:

```
CompanyName: {companyname}
HQLocation: {city}
HQAddress: {streetaddress}
```

NETS profile (current address):

```
CompanyName: {Company}
CompanyTradeName: {TradeName}
HQLocation: {City, State}
HQAddress: {Address}
```

PB investor profiles use the same template as PB companies, with investor-side name fields written under the same `Company*` keys, so that PB investors and PB companies live in the same labelled namespace and can be embedded jointly with NETS. The three CIQ universes (target, investor, seller) share the single CIQ template above. CIQ profiles contain less information than PB profiles – one name field, and a city field with no state – which is one reason the grey-zone verification band described below is tighter for CIQ than for PB. NETS profiles are produced both for each DUNS's current address and, separately, for each distinct previous address recovered from the NETS movement history. The latter captures entities that have relocated, which is otherwise a major source of false negatives in address-based matching.

Embedding retrieval and cross-encoder reranking. We encode each profile into a 384-dimensional dense vector using IBM's Granite Embedding model. For each PB or CIQ entity, we retrieve its top 20 NETS neighbours by cosine similarity, and rescore every retrieved pair using Alibaba's GTE Reranker, a cross-encoder that jointly attends to both profile texts and produces a calibrated score in $[0, 1]$. We refer to this as the *reranker score*; it is the primary quantity used to define matches and adjudicate conflicts. Pairs with a reranker score above 0.9 are admitted as embedding-based matches. Some entities have a large number of legitimate NETS counterparts (e.g., a multi-establishment retailer or a PE-backed roll-up); for these, we widen retrieval to the top 1,000 neighbours and rescore. This process allows one PB/CIQ company to be matched with multiple NETS companies, which generates the n:m matchings between them.

Phone-number supplementation. PB companies and NETS establishments both report headquarters phone numbers. We construct an alternative match set by parsing both phone strings to canonical national numbers and joining on equality, then rescoring the resulting pairs with the same cross-encoder. Pairs surviving a reranker score above 0.8 are admitted to the final company crosswalk. Phone matching is not used for CIQ (which does not report a comparable phone field).

Grey-zone verification by web search and LLM. Pairs whose reranker score lies in a narrow band just below the embedding-match threshold are precisely the borderline cases for which manual review is ordinarily required. We automate this review with a two-step search-and-verify procedure: for each grey-zone pair, we query a Google Search API for both the source-side profile and the NETS-side profile, concatenate the two organic result lists into a prompt, and submit the prompt to Google's Gemini 2.5 Flash, which returns a typed JSON response with fields *is_same_company*, *confidence*, and a free-text *reason*. The prompt explicitly enumerates rules for accepting identity variants (capitalisation, legal-suffix differences, trade name versus legal name) and for tolerating address differences within a metropolitan area or between suite-level and street-level addresses. The grey-zone band is $[0.80, 0.90)$ for the PB chain and $[0.85, 0.90)$ for the CIQ chain.

Name-only chain. Address-based matching fails when the same firm appears at different addresses in PB/CIQ and NETS, or when address fields are missing. We therefore re-run the embedding and reranking stages using profiles that contain the name fields only. Because name-only matching is inherently noisier, this chain is gated by an industry prior (the NETS industry of the candidate must fall in the top 10% most similar industries to the source-side industry, where industry similarity itself is computed by the same cross-encoder) and a fuzzy-matching verification on normalised names. Only *new* matches are written – matches whose source identifier does not already appear in the address-based crosswalk – and these are kept as a separate file so that downstream robustness exercises can include or exclude them at will.

Final assembly. The address-based final crosswalk for each chain is the union of the embedding, phone, and LLM-verified match sources, deduplicated on the (source identifier, DUNS) pair keeping the row with the highest reranker score. We additionally build a year-by-year PE/VC deal indicator panel from PB's deal records and left-join it onto the company crosswalk, providing a ready-to-use treatment indicator at the firm-year level.

Coverage. In our final matched middle-market sample, we identify 17,919 firms with PE investment between 2013 and 2022, of which 13,995 are identified through PitchBook and 8,179 through Capital IQ. The two sources capture a substantial number of non-overlapping deals, underscoring the value of using both. For comparison, Isen, Richmond, Smith and Yannelis (2025) study 15,767 PE-backed firms between 1999 and 2023 by matching PitchBook with the universe of IRS tax records. Davis, Haltiwanger, Handley, Lerner, Lipsius and Miranda (2021) study roughly 6,000 PE-backed firms between 1980 and 2013 by matching Capital IQ (supplemented by other deal sources) to the universe of U.S. firms in Census Business Register micro data, and Herkenhoff, Lerner, Phillips, Rebelo and Sampson (2025) build on that match, linking around 6,200 of these deals (from 1992 to 2013) to worker-level records in the LEHD.

C Appendix Tables and Figures

Table A2: Firm Counts by Private Credit Data Source

	Full Sample	Private Middle Market
1. Only UCC	10,560	3,982
2. Only BDC	3,748	545
3. Only PitchBook	2,542	1,042
4. UCC & BDC	359	189
5. UCC & PitchBook	1,608	1,050
6. BDC & PitchBook	374	171
7. UCC & BDC & PitchBook	431	267
Total firms with private credit	19,622	7,246

This table reports the number of firms identified as having private credit, broken out by data source: UCC filings (with a direct lender), BDC investment, and PitchBook private credit deals. Categories 1–7 enumerate the seven possible intersections of the three sources.

Table A3: Firm Employment and Age by Private Credit Data Source

	p10	p25	Median	p75	p90
Panel A: Full Sample					
Employment					
Direct Lenders (UCC)	3.0	6.0	19.0	73.0	263.0
BDC investment	3.0	3.0	8.0	80.0	743.0
PitchBook private credit	4.0	8.0	47.0	204.0	921.0
Age					
Direct Lenders (UCC)	5.0	8.0	17.0	32.0	51.0
BDC investment	3.0	5.0	11.0	25.0	51.0
PitchBook private credit	4.0	9.0	19.0	37.0	65.0
Panel B: Private Middle Market					
Employment					
Direct Lenders (UCC)	26.0	37.0	67.0	150.0	334.0
BDC investment	30.0	49.0	100.0	250.0	521.0
PitchBook private credit	30.0	49.0	100.0	244.0	501.0
Age					
Direct Lenders (UCC)	8.0	14.0	24.0	40.0	59.0
BDC investment	8.0	13.0	22.0	39.0	58.0
PitchBook private credit	8.0	15.0	26.0	42.0	64.5

This table reports summary statistics on the employment and age of firms identified as having private credit, broken out by data source (UCC filings with a direct lender, BDC investment, PitchBook private credit).

Table A4: Summary Statistics, Firm-level Data Set

	Full Sample		*Private Middle Market*		
	N	Employment-weighted Mean	N	Equal-weighted Mean	Employment-weighted Mean
Panel A: Firm Characteristics					
Employment	7,575,163	106135.6	446,013	63.8	186.5
Age	7,527,942	52.1	438,696	33.3	37.6
Credit Score (PAYDEX)	2,897,084	72.4	331,597	68.5	68.5
Industry K_{IT}/K_{TOT}	7,575,163	0.444	446,013	0.460	0.465
City Population, Millions	7,177,069	4.9	422,372	4.3	4.5
Public Company	7,575,163	0.201	446,013	0.000	0.000
Panel B: Lender Types					
Loan (Any)	7,575,163	0.483	446,013	0.379	0.455
Direct Lenders	7,575,163	0.079	446,013	0.012	0.026
Banks	7,575,163	0.455	446,013	0.338	0.408
Finance Companies	7,575,163	0.330	446,013	0.137	0.186
Private Credit (Broad)	7,575,163	0.126	446,013	0.016	0.036
Panel C: Collateral Type					
Blanket Liens	7,575,163	0.227	446,013	0.046	0.083
Fixed Assets	7,575,163	0.354	446,013	0.172	0.225
Current Assets	7,575,163	0.224	446,013	0.076	0.096
Other Assets	7,575,163	0.133	446,013	0.011	0.020
Missing Collateral	7,575,163	0.435	446,013	0.302	0.373
Panel D: Private Equity Owned					
PE-owned (10yr)	7,575,163	0.235	446,013	0.040	0.075

The data are as of 2022, and the variables for loans and private equity reflect whether the firm obtained the variable in question at some point between 2018 and 2022.

Table A5: Summary Statistics, Lender-Level Data Set

	N	Unweighted Mean	# Borrowers-weighted Mean
Panel A: Lender Characteristics			
Number of Borrowers	2,555	140.3	3388.7
Direct Lender	2,555	0.038	0.014
Bank	2,555	0.882	0.734
Finance Company	2,555	0.080	0.252
Panel B: Mean Borrower Characteristics			
Mean Borrower Employment	2,555	85.3	99.2
Mean Borrower Age	2,555	38.9	39.0
Mean Borrower Credit Score	2,555	69.1	69.3
Mean Industry K_{IT}/K_{TOT}	2,555	0.459	0.479
Mean Borrower City Population, Millions	2,555	3.2	4.1
Panel C: Private Equity Owned			
PE Share of Portfolio (10yr)	2,555	0.075	0.089
Panel D: Collateral Type (Share of Loans)			
Blanket Lien Share of Loans	2,434	0.111	0.128

The data are as of 2022, and reflect the portfolio of borrowers for each lender from 2018 to 2022. The data are for private middle market borrowers.

Table A6: Summary Statistics, 2-digit NAICS Industry By City Data Set

	N	Firm-Wt Mean	Firm-Wt Std
Direct Lender Share	14,613	0.013	0.019
Finance Company Share	14,613	0.134	0.104
Bank Share	14,613	0.336	0.148
Blanket Lien Share	14,613	0.047	0.044
Change in DL Share, 2010-22	14,613	0.009	0.020
Change in Bank Share, 2010-22	14,613	0.042	0.109
PE Share (10yr)	14,613	0.041	0.047
Lehman Top 15 Exposure (emp)	14,613	0.007	0.023
ABX Top 15 Exposure (N)	14,613	0.011	0.020
Top 4 Bank Exposure (N)	14,613	0.057	0.051
CCAR Bank Exposure (N)	14,613	0.155	0.106

The data are as of 2022, and are based on private middle market borrowers within each 2-digit industry by city cell.