Selling Innovation in Bankruptcy

The literature theorizes that asset allocation involves selling assets for more productive exploitations, and empirically show firms follow the principle and sell peripheral assets. Using bankruptcy cases between 1981 and 2012 and USPTO patent holding and transaction data, we find that bankrupt firms sell their core (i.e., technologically critical to their business), instead of peripheral innovation in bankruptcy. This result is stronger in industries with low competition and for patents with higher potential to preempt future competition. The intensity of selling core assets is also stronger in firms with no external financing, low liquidity with non-core assets, and strong secured lender control. Overall, the paper suggests that economic frictions in bankruptcy allow market competitors to acquire bankrupt firms' core assets.

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1. Introduction

Theories on asset allocation establish that firms should sell assets that are under-exploited internally and can be better redeployed after reallocation.[1] Empirically, the literature finds that firms follow this asset redeployment principle by selling assets that are peripheral to the firm—such as non-core divisions (Maksimovic and Phillips, 2001) and technologies that are less relevant to the core business (Akcigit, Celik, and Greenwood, 2016).

Corporate bankruptcies are periods that witness intense asset sales, and asset allocation in bankruptcy has direct implications not only for an individual firm's ability to recover from adverse situations but also for the functioning of the economy as a whole.[2] The principle of asset redeployment should apply to bankruptcies and indeed, one major function of the Bankruptcy Code is to facilitate asset restructuring in bankrupt firms (Gertner and Scharfstein, 1991; Aghion, Hart, and Moore, 1992). However, this process may be affected by frictions that are present in bankruptcy (Bernstein, Colonnelli, and Iverson, 2018b) and potential asset buyers' competitive behaviors (Lang and Stulz, 1992).

The point of departure of this paper is a surprising fact about asset allocation in bankruptcy—firms' *core*, rather than peripheral, assets are more likely to be sold during Chapter 11 corporate bankruptcies. This robust and ubiquitous finding differs from the views and the reallocation patterns in normal times that are discussed above. The latter half of the paper is devoted to rationalizing this fact by analyzing incentives from the buyer side and the frictions on the seller side in bankruptcies. Our evidence suggests that the presented pattern results from both the demand from market competitors' motive to acquire bankrupt firms' core assets, and the amplified frictions stemming from low asset liquidity, costly access to external finance, and strong secured lender influence during bankruptcy on the seller side.

Examining whether core or peripheral assets are sold in bankruptcy presents significant empirical challenges. It first requires a detailed "inventory list" of assets owned by the firm at the point of filing for bankruptcy. Moreover, to precisely identify reallocations, we need systematic records of asset transactions. Last but not least, it is necessary to construct asset-

[1] See Maksimovic and Phillips (2001); Eisfeldt and Rampini (2006); Hsieh and Klenow (2009).

[2] See, for example, Maksimovic and Phillips (1998), Pulvino (1998), Eckbo and Thorburn (2008), Benmelech and Bergman (2011), Gilson, Hotchkiss, and Osborn (2016), Granja, Matvos, and Seru (2017), Bernstein, Colonnelli, and Iverson (2018b) and Bernstein et al. (2018a).

level measures to categorize an asset as core or peripheral, and other individual characteristics that could affect the reallocation decision. We unfortunately generally do not observe those features on the real asset side.

Patent sales, on the other hand, offer all these desirable empirical features. Further, in today's economy, innovation typically determines the key competitive strength of a firm (Corrado and Hulten, 2010; Peters and Taylor, 2017). Patent protection provides the owner ability to further exploit the technology for productive purposes due to the legally protected monopolistic advantage (Scott Morton and Shapiro, 2013). Meanwhile, purchasing a patent is to obtain a right to exclude a third party from freely using certain unique technologies in production, which makes patents a type of strategic assets. This "exclusive right" nature of patents that can be used strategically, in addition to their productive aspect, enables a rich framework to analyze asset allocation in bankruptcy.

We construct a comprehensive data set that consists of all Chapter 11 cases filed by US public firms from 1981 to 2012, covering firms ranging from large corporations to small entrepreneurial companies that just went through an IPO. For each bankrupt firm, we identify its innovation portfolio as all patents it possesses in each year using data from the United States Patent and Trademark Office (USPTO). We retrieve detailed histories of each patent's transaction events, which serve as the base to identify patent sales in bankruptcy. In addition, we manually collect information on asset sales using US court documents that are obtained from Public Access to Court Electronic Records (PACER).

Tracking patent sales in bankruptcy reveals several interesting stylized facts. Patents are an actively traded asset class in bankruptcy. At the extensive margin, more than 40% of bankrupt firms sell parts of their patent portfolios from the date of bankruptcy filing to the date of confirmation of a reorganization/liquidation plan (i.e., during the bankruptcy reorganization process). At the intensive margin, firms sell 18% of their patent portfolios on average. The active sales of innovation in bankruptcy not only justifies the importance of this setting but also provides ample empirical variations for us to perform tests.

Our baseline analysis explores the type of patents that are sold during the bankruptcy process. For each patent, we follow the innovation economics literature and measure core and peripheral based on the technological proximity between a patent and the owning firm's core

innovation expertise (Akcigit et al., 2016; Brav et al., 2018). In contrast to the traditional view that firms should shed peripheral assets, firms in bankruptcy are more likely to sell their core patents. This is also in sharp contrast to the above literature, which uses the same measures, and show that non-distress firms and firms undergoing asset restructuring sell their peripheral patents—a pattern that is replicated in our non-bankrupt sample.

In specific, focusing on the set of patents owned by the bankrupt firm, we find that patents closer to the core expertise of the firm are associated with a higher probability of being sold during bankruptcy reorganization. Quantitatively, patents in the highest quantile is 2.5% more likely to be sold than those in the lowest quantile, which is equivalent to a 30% increase from the baseline selling rate. Our results stand with the inclusion of patent-level controls, such as age, citation-based quality, liquidity of the market for technologies, and are not driven by the piecemeal liquidation decisions or the prepackaged bankruptcy filings, which can introduce noise to the process of selling.

Why are core innovation sold in bankruptcy? We structure the analysis by separately studying the perspectives of potential buyers and the seller (the bankrupt firm and creditors). First, from the buyer's perspective, we propose that the incentive to mitigate industry competition motivates competitive firms to buy core patents from bankrupt firms. This idea is in the same spirit of the strategic patenting (Gilbert and Newbery, 1982) and killer acquisitions (Cunningham, Ederer, and Ma, 2018), in which firms produce or acquire innovation to strengthen competitive power in market to deter future entry. This incentive is amplified when a market participant goes bankrupt or even simply financially more fragile, leaving room to incumbents and entrants to compete aggressively (Bolton and Scharfstein, 1990; Chevalier, 1995; Phillips, 1995). A natural alternative, which will be separately assessed but obtain less empirical support, is that the buyers are potentially better at exploiting the technologies, and patent transactions are thus a ways to reallocation knowledge and technologies.

Consistent with this framework, we show that the intensity of selling core innovation in less competitive industries is three-times higher than that in highly competitive industries. This is inline with a general idea of the strategic motive—low ex ante competition increases the incentives for market incumbents to strategically produce or acquire patents to seize

additional market power. In addition, in the bankruptcy setting, low competition gives the potential buyers higher bargaining power in the asset sales process, leaving more room for them to exert more power to acquire desired core assets from bankrupt competitors.

Relatedly, we examine the role of patent litigation and assertion. Patent litigation, or assertion in broader terms, can be costly to the defendants and will change their operations. If the incentives to buy patents is to obtain exclusive rights than can help establish market power, we would expect the patent transactions to concentrate in cases when the patents have higher potential to be used in litigation and those have broader impacts on other firms (Galasso et al., 2013; Akcigit et al., 2016). We find that firms are more likely to sell patents in technology classes with higher litigation risks and patents that are more broadly exploited by other market participants, measured using the ratio of citations from firms other than the owning firm.

After establishing buyers' incentives to buy bankrupt competitors' core assets, we next examine why sellers—bankrupt firms—sell their own core assets. We explore conditions under which the bankrupt firms are more vulnerable to these strategic patent acquisitions from competitors, specifically, the roles of the liquidity of peripheral asset, access to external finance in bankruptcy, and senior creditor control.

First, asset liquidity exerts frictions on the asset selling process (Gavazza, 2011), and firms attempt to avoid such costs (Schlingemann, Stulz, and Walkling, 2002). If a firm's peripheral assets are more liquid, it would be more capable of allocating assets without sacrificing core assets. To test this channel, we follow the prior literature and construct *MFT Liquidity* for each patent in each year following Hochberg, Serrano, and Ziedonis (2018). We find that bankrupt firms are more likely to sell core assets when their peripheral assets have limited liquidity on the market.

Next, we examine how bankrupt firms' sale of core patents differ across their access to external capital, which is captured by debtor-in-possession (DIP) financing. Firms with DIP financing are less likely to sell patents, particularly core patents. This is consistent with the interpretation that DIP financing partially satisfies bankrupt firms' financing needs (Dahiya et al., 2003; Bharath et al., 2014; Li and Wang, 2016), thus providing bankrupt firms more time and discretion in marketing and selling their innovations free from the buying

competitors' pressure. In this case, bankrupt firms can better maintain their valuable core assets.

Moreover, prior studies suggest that the strengthening of senior secured lender control in bankruptcy results in more frequent and intensive asset sales during bankruptcy reorganization (Baird and Rasmussen, 2002; Eckbo and Thorburn, 2008; Ayotte and Morrison, 2009). Indeed, senior secured creditors' liquidation bias and their incentive to recover their claims may prompt them to pressure the bankrupt firm to sacrifice core assets that are important for long-term value. We show that senior secured creditors plays a significant role in driving core asset selling. When performing the main specification on subsample categorized by above median versus below median of secured debt ratio, we find that the pattern of selling core assets is almost purely driven by firms with strong secured creditors.

By far, all evidence points to the explanation that bankrupt firms sell core assets due to a combination of—on the buyer side, the demand from market competitors for core assets; on the seller side, the amplified frictions stemming from asset market liquidity, financial constraints, and creditor control. What left unexplored is the natural alternative but mutually non-exclusive motive, mentioned above, that the acquisition of patents involves active usage of the technologies, resulting from strengthened property rights.

To study this alternative, we focus on the human capital mobility and citation dynamics of sold patents. On the human capital side, inventors are likely to move with sold patents outside of bankruptcy, consistent with evidence that inventors and team-specific knowledge are valuable for innovation exploitation (Baghai, Silva, and Ye, 2017b; Jaravel, Petkova, and Bell, 2018). Interestingly, we find that inventors of patents sold in bankruptcy do not move. This suggests that buyers of the core assets in bankruptcy have weaker intentions to retain and use the knowledge from the inventor team.

With regard to the citation pattern of sold patents, we find that sold patents during bankruptcy experience a sharp decline of annual citations post-transaction, again consistent with that the purchase of core asset from bankrupt firms deters future usage of the patent by other firms. On the other hand, the citation of patent made by the seller remain stable for a short period of time, meaning that the patents sold are indeed core to the seller.

Overall, this paper makes three contributions. First, we provide a striking empirical

fact on asset allocation in bankruptcy—bankrupt firms sell core patents. The pattern is documented using sales of innovation assets, which are underexplored in the literature yet increasingly important for the economy. Second, we reconcile the empirical finding from both the demand (buyer) side and the supply (seller) side, highlighting the strategic acquisition motives of market competitors as well as the frictions in asset reallocation in bankruptcy. Third, we provide new evidence relating to trends and consequences of patent acquisitions on the market for technologies, which has implications for both the financial and the product markets.

The economic reasoning presented in the paper, arising from the preemptive motive of market competitors to obtain core assets and frictions faced by bankrupt firms, grants patents as the ideal setting to convey the idea. But the mechanisms can apply to other broader asset classes. For example, such strategically core assets may be trademarks, spatial locations that deters entrants, natural resource lands. As long as those assets can allow the owner to maintain certain market power by lowering the returns to competitors, we would expect the economic mechanism to be present.

This paper relates to studies of asset allocations in bankruptcy. Maksimovic and Phillips (1998), Pulvino (1999), Ramey and Shapiro (2001), and Bernstein et al. (2018b) study how trading frictions affect the costs and decisions of allocating capital. Benmelech and Bergman (2011), Meier and Servaes (2018), and Bernstein et al. (2018a) show that such costs not only affect the bankrupt firms but also spill over to other firms. Our paper complements this literature in several ways. First, our analysis focuses on the ex ante decision to sell or retain individual assets, as opposed to investigating the ex post costs of reallocation. In doing so, we uncover the economic forces that influence the reallocation decision of bankrupt firms. Second, our study focuses on the reallocation of patents, arguably the most important form of intellectual property for innovative firms, whereas the existing research largely studies specific types of tangible assets. As technological innovation becomes central to economic growth and leads to accelerated creative destruction, our findings are relevant in the long run.

This paper also speaks to the literature on the market for technology and its interactions with financial markets. A growing body of empirical literature studies how firms use the market for technology to reallocate innovation and create value (Serrano, 2010; Akcigit,

Celik, and Greenwood, 2016; Brav, Jiang, Ma, and Tian, 2018) and studies how patents are used as collateral in debt financing (Mann, 2017; Farre-Mensa et al., 2016; Hochberg et al., 2018). We provide empirical evidence that the redeployability and liquidity of patents are key determinants of innovation allocation during bankruptcy. Our findings can help us examine the debt capacity of innovative firms, and also have implications for the types of innovation that firms are incentivized to produce in order to minimize distress costs (Ederer and Manso, 2011; Manso, 2011).

The remainder of the paper is organized as follows: Section 2 provides background information; Section 3 discusses sample construction and measurements, and establishes basic facts for innovation sales in bankruptcy; Section 4 presents the baseline result of selling core assets in bankruptcy; Section 5 analyzes the economic rationale; Section 6 concludes.

2. Asset Sales in Bankruptcy Through §363

Sales of assets during Chapter 11 reorganizations are typically conducted through Section 363 (§363) of the Bankruptcy Code. The §363 intends to provide the bankrupt firm with a high degree of discretion and enhanced asset salability.

First, selling assets through §363 requires debtor's discretion and judge's approval, but not creditors' votes. Loan contracts often have restrictions and mandatory prepayment clauses on asset sales, and thus firms are given limited freedom to the type and quantity of assets to sell outside bankruptcy court. In contrast, a Chapter 11 firm possesses a large degree of freedom to what assets to redeploy under §363.[3]

Second, the "free and clear of liens and encumbrances" provision of §363 greatly improves the salability of the assets. Without §363, lenders may claim to have a lien on both the collateralized assets that are sold and the proceeds from the sale in asset transactions outside bankruptcy. Selling assets "free and clear of liens and encumbrances" through §363 restricts

[3]For example, §363(b) allows the sale of a debtor's assets outside of a firm's ordinary course of business in bankruptcy, after notice and a hearing. §363(c) further authorizes the sale of properties of the estate, in the ordinary course of the business, without notice or hearing, under certain conditions. These provisions authorize the sale without approval of creditors but require a "sound business purpose." However, dissident creditors may file objections to asset sales proposed by the debtor. These objections typically would not hinder judge's decision in approving the sale when the debtor can show that secured creditors' interests are adequately protected.

the lender to have security interest on the proceeds of the sale only (§552(b)), thereby exempting the buyer from the old lender's security interest (Ayotte and Skeel, 2013).[4]

[Insert Figure 1 Here.]

The sale process starts with the bankrupt firm filing a sale motion to the bankruptcy judge. A stalking horse—the initial interested buyer—is usually identified by the firm and notified to the judge. The bankrupt firm typically conducts private search of potential buyers or is approached by an interested buyer before filing the sale motion to the court. The advantages of starting the auction with a stalking horse is to set up a reservation price and encourage confidence in the value of the assets. The disadvantage is that the lockup agreement and breakup fee awarded to the stalking horse may discourage competing bidding (Gilson et al., 2016). Furthermore, Non-stalking horse bidders typically have less time to evaluate assets and may undervalue the assets due to the lack of information or liquidity. As a result, the stalking horse, more likely a strategic buyer, typically has strong bargaining powers in the selling process and is more likely to win the auction than subsequent bidders.[5]

The sale motion describes the bidding and selling procedures, which are up to the judge's approval. A public hearing date on the sale procedures is specified in the sale motion. Key stakeholders of the bankrupt firm, including secured creditors, unsecured creditors, and United States Trustees, among others, can file formal objections to the proposed sale to the bankruptcy judge under Rule 6004(b) of the Federal Rules of Bankruptcy. After the public hearing is held, the judge decides whether to approve the bidding procedure so that other potential buyers may submit bids. After the bankrupt firm solicits other potential bids and conducts an auction for the sale, the successful bidder is identified. A final sale hearing is held before the judge then approves the sale to the successful bidder. The whole §363 sale

[4]The provision for the debtor to use or sell collateralized assets free and clear of liens is explicitly laid out in §363(f) by the following statement: *"The trustee may sell property under subsection (b) or (c) of this section free and clear of any interest in such property of an entity other than the estate, only if—1. Applicable non-bankruptcy law permits sale of such property free and clear of such interest; 2. Such entity consents; 3. Such interest is a lien and the price at which such property is to be sold is greater than the aggregate value of all liens on such property; 4. Such interest is in bona fide dispute; or 5. Such entity could be compelled, in a legal or equitable proceeding, to accept a money satisfaction of such interest."*

[5]Gilson et al. (2016) show that in 77% of their sample cases assets are sold to the stalking horse bidder. There are competing bidders in only half of their cases. More than two thirds of the winning buyers are strategic buyers (operating companies that can potentially realize synergies from acquiring the assets) rather than financial buyers. The occurrence of credit bidding—creditors bidding up the assets—rarely frequent.

process generally takes a few weeks to complete. A graphic illustration of the sale process is provided in Figure 1.

Differing from transactions of other assets, patent sales are also recorded by the USPTO through the formal patent reassignment process. Graham, Marco, and Myers (2017) provide a detailed discussion on the USPTO patent reassignment records from the perspective of the data administrator. One potential limitation of this process is that recording a transaction in the USPTO is not mandatory. However, both statute and federal regulations provide strong incentives for reporting in order to claim property rights. These incentives to completely report are particularly strong for firms in distress and bankruptcy when clean property rights are crucial.

3. Data and Stylized Facts

3.1. The Bankruptcy Sample

We retrieve all Chapter 11 bankruptcies filed by US public firms from 1981 to 2012 from New Generation Research's Bankruptcydata.com. The sample firms are manually matched with Compustat using firm names and company information, and we remove firms that do not have a valid identifier in Compustat. This initial screening results in 2,169 Chapter 11 cases. We remove cases that were dismissed (146 cases), were pending as of mid-2016 (5 cases), were merged into another leading case (2 cases), and had unknown outcomes (158 cases). We also remove financial firms (161 cases), which are less relevant in a study of innovation. We then exclude cases with unavailable or incomplete dockets from Public Access to Court Electronic Records, i.e., PACER (74 cases). This process leaves us with a sample of 1,623 cases.[6]

The following key information is then collected for each case from Bankruptcydata.com and PACER: the date of Chapter 11 filing, the court where the case is filed, the judge overseeing the case, whether the case is prepackaged or renegotiated, assets at bankruptcy filing, the outcome of reorganization, the confirmation date and effective date of the reorganization or

[6]Our data set is the largest bankruptcy data set for US public firms with detailed case information, twice as large as that listed in the widely used UCLA-LoPucki Bankruptcy Research Database, which covers Chapter 11 filings by US public firms with $100 million in assets in constant 1980 dollars for the sample period. The ability to include smaller firms is particularly important because many smaller entrepreneurial firms own many innovation assets.

liquidation plan, and the conversion date for those cases converted to Chapter 7.

We determine whether a Chapter 11 firm obtains DIP financing using court dockets retrieved from PACER. We search for key phrases that can help to identify whether the debtor filed a motion on DIP financing and whether a judge approved it.[7] For cases with incomplete dockets, we search bankruptcy plans and news in LexisNexis and Factiva to verify whether the bankruptcy court granted DIP financing.

To measure senior creditor influence in the bankruptcy process, we follow Gilson et al. (2016) to construct *Secured Debt Ratio*, which is as the fraction of secured debt in total debt of the bankrupt firm. To compile detailed information on the debt structure and debt instruments on the firm's balance sheets immediately before bankruptcy filing, we resort to Capital IQ (capital structure details section) and last 10-K or 10-Q filings before Chapter 11 date. We manually identify the following debt types: drawn bank revolvers, term loans, secured bonds and notes, capital leases, other secured debt, unsecured bonds and notes, and total debt, and collect information on their security and seniority status. *Secured Debt Ratio* is defined as the sum of outstanding amount of drawn bank revolvers, term loans, secured bonds and notes, capital leases, and other secured debt, scaled by the total debt amount.[8]

We use Compustat for financial statement data reported as of the last fiscal year before the bankruptcy filing. The key financial variables we construct include leverage (debt in current liabilities and long-term debt, scaled by book assets), sales growth (sales of the current year minus sales of the previous year and scaled by the previous year's sales), ROA (the ratio of EBITDA to book assets), and R&D expenses scaled by book assets. All variables are winsorized at the 1% and 99% levels. Our main measure of product market competition is the Herfindahl-Hirschman Index (HHI) at the 3-digit SIC level. The HHI is calculated as the sum of squared market shares, using all available Compustat firms. The HHI is commonly used in the corporate finance studies (Giroud and Mueller, 2011).

[7]These key phrases include: *debtor-in-possession financing*, *DIP financing*, *post-petition financing*, *secured financing*, *secured lending*, *post-petition finance*, and *secured finance*.

[8]This variable is available for Chapter 11 firms that filed for bankruptcy after 1995 only due to availability of 10-K and 10-Q filings on EDGAR.

3.2. Patent Profiles and Patent Transactions

We construct patent-holding information of each firm using the National Bureau of Economic Research (NBER) patent database and Bhaven Sampat's patent and citation data, both of which are originally extracted from the USPTO. The combined data are linked to the public firm universe using the bridge file provided by NBER, allowing us to establish the full list of patents that a firm owns at each point in time between 1976 and 2012. The database categorizes each patent into one of 430 technology classes based on the underlying fundamental feature of the innovation. It also records the number of lifetime citations received by each patent as well as the source of those citations, which helps identify the level of utilization and potential users of each patent.

When owners sell their patents, they are required to file patent reassignment documents with the USPTO. The original USPTO patent reassignment database provides information useful for identifying patent transactions: the assignment date; the participating parties, including the transaction assignee ("buyer") and assignor ("seller"); and comments on the reason for the assignment. We merge the raw assignment data with the Harvard Business School inventor database and the USPTO patent database to gather additional information on the original assignees.

We then follow a procedure, similar to that of Ma (2016) and Brav et al. (2018), in which we identify patent transactions from all patent reassignment records from 1976 to 2015. Importantly, the identified patent transactions do not include cases involving an internal patent transfer, either from an inventor to his/her employer or between two firm subsidiaries. This step is crucial for our study because bankrupt firms are more likely to undergo organizational changes during this period. For example, we ensure that such cases as "General Motors Corporation" reassigning its patents to "General Motors Global Technology Operations" are not counted as patent transactions. We provide a detailed description of the data and methodology in Appendix Section A1.

We merge our sample of 1,623 Chapter 11 filings by US public firms with the USPTO patent database and require each Chapter 11 firm to own at least one patent at the time of bankruptcy filing. The screening results in a final sample of 518 innovative firms for our

study.

3.3. Key Variables

3.3.1. Core Patents. To measure whether a patent is core or peripheral to its owning firm, we follow Akcigit, Celik, and Greenwood (2016), who formalize the distance between a patent p and a firm i's overall technological expertise using a generalized mean of distances between p and each other patent in firm i's patent portfolio. In specific, we use the following definition:

$$d_t^{\iota}(p,i) = [\frac{1}{\|P_{it}\|} \sum_{p' \in P_{it}} d_{class}(Class_p, Class_{p'})^{\iota}]^{\frac{1}{\iota}}, \tag{1}$$

where P_{it} denotes the patent portfolio of all patents that are owned by firm i in year t ($\|P_{it}\|$ is the size of the portfolio). $\iota \in (0,1]$ is the power of the generalized mean operator. Following the prior literature, $\iota = 0.66$ is used to calculate the primary measure while all the results are both qualitatively and quantitatively similar using other ι parameters.

The key component in the definition, $d_{class}(Class_p, Class_{p'})$, stands for the distance between a patent p and p'. The distance operator $d_{class}(X,Y)$, as defined in Akcigit, Celik, and Greenwood (2016), is the symmetric distance metric between two technology classes, X and Y, and is calculated based on citation patterns of X and Y. Let $\#(X \cap Y)$ denote the number of all patents that cite at least one patent from classes X and Y simultaneously, and $\#(X \cup Y)$ denote the number of all patents that cite at least one patent from either class X or/and Y, and

$$d_{class}(X,Y) = 1 - \frac{\#(X \cap Y)}{\#(X \cup Y)}.$$

Intuitively, this measure means that if each patent that cites X also cites Y ($d_{class}(X,Y) = 0$), then X and Y are highly close in their role in the innovation space, and vice versa. $d_{class}(Class_p, Class_{p'})$ in formula (1), therefore, is calculated based on the technological classes of p and p'.

We define $1 - d^{\iota}(p,i)_t$ as the main *Core* measure of between patent p and firm i, and the higher this measure is, the closer the patent is to the firm's core innovation assets. We also create a dummy variable I(Core), which take value one if the patent is at the top quartile of

Core within the firm-year observation, and zero otherwise. Akcigit, Celik, and Greenwood (2016) and Brav et al. (2018) show that core patents are of greater strategic value to the firm. They also provide evidence, which will be reconfirmed in this paper, that firms outside of bankruptcy tend to sell patents that are less core.

3.3.2. Patent-level Control Variables. Serrano (2010) finds, in one of the first studies of patent transactions, that patent age and the overall quality determines the probability of selling. We use patent citations to measure the general quality of a patent. Specifically, our measure $Scaled\ Citation_p$ is defined as the number of citations received in the first three years of a patent's life, scaled by this three-year citation of patents from its own vintage and technology class. $I(YoungPatent)_{pt}$ is an indicator variable that equals one if the patent was granted up to six years before the bankruptcy filing.

$Redeployability_p$ is a patent-level measure that intends to capture the extent to which a patent p is redeployable and valuable to other potential users of the innovation. Specifically, we define patent-level $Redeployability_p$ as one minus self-cite ratio, where self-cite ratio is the share of citations that patent p receives from the follow-on patents issued to the same company. To be consistent with the literature (Lerner, Sorensen, and Strömberg, 2011), we focus on the self-citing intensity within three years of a patent being granted, a factor that is shown to be relevant in measuring such concepts. Higher *Redeployability* means that the patent is more applicable by outside users, thus bring higher value for a buyer whose intention is to purchase the patent for exclusion rights (Jaffe and Trajtenberg, 2002; Hoetker and Agarwal, 2007; Marx, Strumsky, and Fleming, 2009).

Patents are largely traded in decentralized markets, in which buyers and sellers face fixed costs to search for the right trading partner (Hagiu and Yoffie, 2013). Market thickness reduces search costs and facilitates reallocation, thus increasing the liquidity of capital. Gavazza (2011) shows that the thickness of the market and the liquidity of capital can be captured by the activeness of trading in this market. We use $MFTLiquidity_{pt}$, a patent-year-level variable, to capture the annual likelihood that a patent p could be sold in year t in the market for technology. We follow Hochberg, Serrano, and Ziedonis (2018) to compute this *MFT Liquidity* measure as the ratio of transacted patents over the patent population in each

technology class and issue year, which we can then uniquely map to each patent p at each time point t.

3.4. Stylized Facts: Selling Innovation in Bankruptcy

We first provide an overview of selling innovation in bankruptcy.

Stylized Fact 1: *Selling innovation in bankruptcy is pervasive.*

We investigate how often firms sell innovation during bankruptcy reorganization (from the bankruptcy filing to the confirmation of the reorganization or liquidation plan). Table 1 presents bankrupt firms' intensity of selling innovation, tabulated based on their industries, defined by the Fama-French 12 Industry categorization (Panel A), and based on the year of bankruptcy filing (Panel B). In each panel, we show the total number of Chapter 11 cases, the number of cases filed by innovative firms defined as those that own at least one patent when filing bankruptcy, the proportion of firms that sold patents during bankruptcy reorganization, and the percentage of patents sold.[9]

[Insert Table 1 Here.]

Selling innovation during bankruptcy is a surprisingly pervasive phenomenon. Forty percent of bankrupt innovative firms sell at least one patent in the reorganization process, and patents transacted account for about 18% of their patent stock. Cross-sectional comparison in Panel A suggests that the intensity of selling innovation in bankruptcy varies across industries. Health care, drug, and medical device companies sell their innovation more than any other industries, with 56% of firms conducting such activities and almost 30% of their patent portfolios being sold. But even in the industries that have the lowest patent selling intensities during bankruptcy (Wholesale and Retail, Consumer Non-durables), nearly 25% of firms sell more than 15% of their patent holdings. Time-series analysis in Panel B suggests that selling innovation, even though largely overlooked in academic studies, is not a new phenomenon. The proportion of firms that sell patents and the percentage of patents transacted has remained at a fairly stable level since the early 1980s.

[9]The ratio of sold patents is defined as zero for firms that sold no patents.

[Insert Table 2 Here.]

We also statistically examine the selling intensity of bankrupt firms compared to other patent-holding firms. We construct a firm-quarter panel of all US public firms that have at least one valid patent grant from the USPTO (that is, a firm is included in the sample after its first patent is issued). The key independent variable is a dummy variable, *I(In Bankruptcy)*, indicating whether the firm is undergoing a bankruptcy reorganization in that quarter.[10] The results are shown in Table 2 columns (1) and (3). The intensity of selling innovation during bankruptcy is significantly higher compared to the panel of innovative public firms that are not in bankruptcy. The 0.039 in column (1) indicates that bankrupt firms are 3.9% more likely to sell a patent in each quarter. This is a 76% increase from the base rate of patent selling outside bankruptcy. Those firms are predicted to sell approximately 2.2% more of their patent portfolios every quarter during bankruptcy reorganizations. Overall, we find that innovation is actively traded in bankruptcy.

Stylized Fact 2: *Innovation sales concentrate within a short time window after the bankruptcy filing.*

We extend the analysis to characterize the dynamics of selling innovation around bankruptcy. We exploit the following model in the same panel sample of firm i and quarter t:

$$Selling_{it} = \sum_{k=-4}^{4} \beta_k \cdot d[t+k]_{it} + \lambda \times Control_{it} + \alpha_i + \alpha_t + \varepsilon_{it}, \tag{2}$$

where the key difference is that the independent variables of interest are now the set of dummies, $d[t-4], ..., d[t+4]$, indicating whether the firm-quarter observation fits into the $[-4, +4]$ time frame of the bankruptcy event.

Results are reported in Table 2 columns (2) and (4). The effects are positive and significant from t to $t+4$. In column (2), the coefficient of 0.096 associated with $d[t+1]$ suggests that in the quarter immediately following the bankruptcy filing, the probability of selling a patent is 9.6% higher than the benchmark. Comparing coefficients of $t-1$ and $t+1$, we find that

[10] We categorize the dummy as one for cases in which the firm's bankruptcy process occurs in part of the quarter.

the probability of selling increases more than sixfold. The F-test suggests that the six-time increase in probability is statistically significant at the 1% level; at the intensive margin (column (4)), the increase is even more dramatic.

[Insert Figure 2 Here.]

The increase in post-filing innovation sales concentrates in the first two quarters after the bankruptcy filing, as indicated by the strongest results in $t+1$ and $t+2$, and it decays quickly afterward. Importantly, we do not observe any secular trends before bankruptcy filings when we visualize the regression estimates in Figure 2. In sum, firms sell innovation within a short time window after bankruptcy filing.

4. Main Results: Selling Core Patents in Bankruptcy

4.1. Summary Statistics

Table 3 Panel A reports summary statistics of the patent-level data set. This data set covers all patents owned by 518 innovative bankrupt firms that have non-missing values of key patent-level variables. The average of *Core* with parameter $\iota = 0.66$ is 0.444. The variable has large cross-sectional variations with a standard deviation of 0.274. Moving from the 25% to the 75% of the variable will increase the measure by more than three times. A similar pattern holds with parameter $\iota = 0.33$. The average value of redeployability is 0.783; this suggests that, on average, 78.3% of citations received by a patent are made by other firms, i.e., external citations. The average *MFT Liquidity* of a patent is 0.033, which means that, on average, 3.3% of patents in a technological class are transacted in a specific year. There is also a large cross-sectional variation in this liquidity measure, with standard deviations of around 0.022, and a large jump from the 0.021 at the 25th percentile to 0.039 at the 75th percentile.

[Insert Table 3 Here.]

Panel B of Table 3 describes the 518 innovative bankrupt firms in the sample. About 20% of the cases are prepackaged filings and more than half of our sample firms receive DIP

financing. The bankruptcy cases, on average, stay in the reorganization process for 511 days. The case outcomes are: 13% acquired, 12% converted to Chapter 7, 51% emerged, and 24% liquidated in Chapter 11. Our sample firms own, on average, 175 patents at the time of filing for bankruptcy; the median patent holding is 13, suggesting a highly skewed distribution of firm size and patent stock. The eventually liquidated firms are typically much smaller in size and patent holdings, so the results in the paper are primarily driven by the firms that eventually emerge. The distinction among all the outcomes will be controlled for in the empirical analyses. In addition, a typical firm in our sample experiences negative ROA and sales growth and carries high leverage at the time of Chapter 11 filing.[11]

4.2. Baseline Results

The baseline analysis examines the type of innovation sold in bankruptcy. The analysis is performed on a patent-level cross-sectional data set. Each observation is a patent p in a bankrupt firm i's patent portfolio in the year of filing. We estimate the following linear probability model:

$$Sold_{ip} = \beta \cdot Core_{ip} + \lambda \times Control_{ip} + \alpha_i + \varepsilon_{ip}. \tag{3}$$

$Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process by its owning firm i. The key explanatory variable is $Core$, for which both the continuous and categorical versions are used. We control for such patent characteristics as the scaled number of citations, patent age, *Redeployability*, *MFTLiquidity* as well as for firm-specific patent transaction intensities using firm-level fixed effects. In addition, time fixed effects are largely controlled for by the firm fixed effects because observations from each bankrupt firm are from the same filing year. Standard errors are clustered at the firm level.

[Insert Table 4 Here.]

[11] In Table A.1 we compare those innovative bankrupt firms with other bankrupt firms. Those firms are very similar to each other in terms of case and firm characteristics. Innovative bankrupt firms are, however, more R&D heavy, more likely to obtain DIP financing, and less likely to be converted from Chapter 11 to Chapter 7 liquidations.

Table 4 presents the regression results of equation (3). Column (1) shows that *Core* is a strong and positive determinant of whether a patent is likely to be reallocated during bankruptcy reorganization. The coefficient of 0.022 translates a one standard deviation change to a 0.83% (0.022×0.274) increase in the probability of selling, which is a 7.3% jump based on the unconditional probability (8.3%) as reported in Table 3.

In column (2), we exploit categorized variables by cutting patents into within-firm quartiles based on *Core* and creating dummy variables to indicate the quartiles. The dummy indicating the lowest quartile is omitted and this set of patents serve as an effective benchmark. Core (4th Quartile), later also denoted as I(Core), dominates the patent selling decision. Being one of the top-quartile core patent increases the probability of sale by 2.5%, which is a 30.1% jump based on the unconditional probability. In column (3), the analysis uses *Core* with parameter $\iota = 0.33$, and we find similar results.

In column (4) we add control variables to capture the influences of patent age and citation-based quality. Consistent with the prior literature, younger and highly cited patents are more likely to be transacted. In column (5) we also control patent redeployability and the liquidity of the market for technologies. Both of them strongly and positively affect the patent selling decisions, suggesting that bankrupt firms make asset selling decisions that intend to avoid the widely documented fire-sale costs.

In columns (6) and (7), we repeat the analysis using only firms that eventually emerged from the bankruptcy process and that were not prepackaged, respectively. The goal of the emerging-firm analysis is to mitigate the concern that firms that are eventually liquidated may place everything for sale without discretion.[12] The liquidation decision can then bias the estimation. Similarly, the goal of removing prepackaged bankruptcies is to exclude cases in which asset selling decisions are made through a prepackaged agreement between the debtor firm and the buyer before the bankruptcy filing.[13] The results are both qualitatively and quantitatively similar to the full sample presented in column (5). In Table A.2 we show that

[12]Appendix Table A.3 confirms that liquidated firms are more likely to sell and sell more of their patents before plan confirmation.

[13]A bankruptcy case is defined as prepackaged if the debtor drafted the plan, submitted it to a vote of the impaired classes, and claimed to have obtained the acceptance necessary for consensual confirmation before filing. If the debtor negotiates the plan with fewer than all classes or obtains the acceptance of fewer than all classes necessary to confirm the plan before the bankruptcy case is filed, then the case is regarded as prenegotiated. We exclude both prepackaged and prenegotiated cases from our analysis.

the innovation selling pattern is both economically and statistically similar when we estimate model (3) using a Logit model.

Note that Table 4 includes firm fixed effects in all analyses. Therefore, the relation between liquidity and the probability that a patent will be sold is identified using within-firm patent-level variations in characteristics rather than cross-firm variations. In other words, the results are unlikely to be driven by some invariant firm-level characteristics.

4.3. Differences Between In and Out of Bankruptcy

Table 4 is particularly striking given the evidence from Akcigit, Celik, and Greenwood (2016) and Brav et al. (2018) that firms sell peripheral patents during normal times. We temporarily deviate from our main specification (3) to highlight this point in Table 5. In this analysis, we expand our bankruptcy-only sample to patents owned by all patenting firms between 1981 and 2012. Effectively, the sample consists of repeated cross-sections of patent holdings p by firms i across years t. We use the following model:

$$\begin{aligned} Sold_{ipt} = \beta \cdot Core_{ipt} \times I(InBankruptcy)_{it} \\ + \beta_C \cdot Core_{ipt} + \beta_B I(InBankruptcy)_{it} \\ + \lambda \times Control_{ipt} + \alpha_i + \varepsilon_{ip}. \end{aligned} \tag{4}$$

The analysis connects the patent selling decision with $Core$, and use the interaction term $Core$×I(In Bankruptcy) to capture the deviation of the pattern during years in which a firm is in bankruptcy reorganization.

[Insert Table 5 Here.]

In Table 5 columns (1), we used the continuous $Core$ and control for firm and year fixed effects. Not surprisingly, firms are more likely to sell patents in bankruptcy years as shown by the coefficient of I(In Bankruptcy). Yet more importantly, the increase in selling during bankruptcy concentrates in core patents, and the 0.024 coefficient completely overturns the normal trend that core patents are less likely to be sold, captured by the -0.001 coefficient of $Core$. Similarly in column (2), when controlling for firm-by-year fixed effects, we obtain similar results qualitatively. In columns (3) and (4), we use the dummy variable I(Core) and

find similar results. Overall, Table 5 links the evidence in Table 4 to the earlier findings and highlights the uniqueness of selling core assets during corporate bankruptcies.

5. Why Are Core Assets Sold in Bankruptcy?

Now, why are core patents sold during the bankruptcy process? We explore from both the buyer's perspective and the seller's (bankrupt firm's) perspective, both of which are crucial for explaining the transactions.

From the buyer's perspective, we propose that market competitors have the incentives to acquire bankrupt firms' core assets to strengthen market power. The spirit of such motive can be traced back at least to Gilbert and Newbery (1982) who show that firms in low-competition markets have an incentive to maintain its market power by patenting new technologies that an preempt potential competitors. Scott Morton and Shapiro (2013) and Cunningham, Ederer, and Ma (2018) expand the argument to acquisition of innovation and argue that owning competitive innovation allows firms to exclude and terminate the development of competitors. Lang and Stulz (1992) show that the bankruptcy of competitors allow other market incumbents' to obtain more market shares, which may further incentivize strategic acquisitions of patents. We test this mechanism in Section 5.1.

But why are bankrupt firms willing to sell such assets during bankruptcy, given those are valuable assets that they retain during normal times. We argue that bankrupt firms face frictions that limit their ability to shed undesired assets: low asset market liquidity (Maksimovic and Phillips, 1998; Schlingemann et al., 2002; Bernstein et al., 2018b), senior secured lender control (Gilson et al., 2016), as well as access to finance (Dahiya et al., 2003). In combination, firms in bankruptcy are financially constrained and thus impatient to market illiquid assets, instead they have to sell core assets that are demanded by market competitors. Creditors, who are more concerned about short-term debt recovery rather than long-term firm value, may facilitate this process. We test those seller-side economic forces in Section 5.2.

Certainly, a potential alternative motive for the transaction is that the buyer firms are simply better users of the assets free from the argument of strategic patent acquisitions. We devote Section 5.3 to further assessing this alternative view by examining usage patterns of sold patents. Section 5.4 discusses generalizability of the results.

5.1. Buyer's Incentives: Strategic Patent Acquisitions

5.1.1. Industry Competition. Our first test involves examining the heterogeneity of core asset selling across different industry competitive levels. The central idea is that patent acquisitions can implicitly threaten both current and future competitors' product development and strengthen innovation exploitation. Such incentives are much stronger in a less competitive market, because incumbents in less competitive industry can extract more benefit from protecting market power through patent acquisitions (Gilbert and Newbery, 1982; Cunningham et al., 2018).

In Table 6, we split the sample based on the product market competition the bankrupt firm faces measured using HHI based on 3-digit SIC, and then run the main specification (3) separately for patents in more or less competitive markets categorized by median. We also present results in which we interact *Core* with the dummy indicating high HHI (low competition). As a result, the coefficient on *Core* × High tests whether the pattern of selling core assets is significantly different in markets with low versus high competition levels.

[Insert Table 6 Here.]

Columns (1) to (3) show that in both high and low HHI industry environments core patents are more likely to be sold. However, the likelihood that core assets are sold is 2.5 times stronger in high HHI industries (low competition). Columns (4) to (6), which adopt the dummy version of *Core*, present almost identical message but with easier magnitude interpretations. In low competitive markets, core assets are 3.6% more likely to be sold than those in low competitive markets. Thus, our analysis echoes the well-know intuition that low market competition provides incentives for market incumbents to perform activities that can protect their market power, highlighting the strategic motive of buyers.

5.1.2. Exclusive Rights of Patents. Litigation risk, both explicit litigation or unobserved assertion, can impose large costs to the litigated party (Scott Morton and Shapiro, 2013). Acquiring innovation gives buyers the legal right to sue for potential infringement, and patent litigations allow the firm to deter future entrants and sometimes even existing product market competitors (Galasso, Schankerman, and Serrano, 2013). If the buyer's incentive is mainly

for the deterrence of competition rather than productive usage of technologies, we would see core patents in high litigation risk industries to be more likely to be sold.

[Insert Table 7 Here.]

To capture a patent's litigation risks, we obtain data from Lex Machina, Derwent LitAlert, and the RPX database. We calculate the litigation risk of each technology class as the ratio of litigated patents over the total number of patents in the technology class. Table 7 presents the results, structured similarly as above, showing that the pattern of selling core is associated with the potential of litigating using purchased patents. Even though patent litigation is uncommon in our sample (1% of patents are in litigation), it has strong explanatory power in patent allocation in bankruptcy.

Related to above, an alternative way to measure the strength of market power that a patent can secure is to measure the usage of the patents in other firms' innovation. The idea is that if a patent represent a technology that is highly cited by external innovation, it means that there will be a higher probability that a patent right enforcement may influence a wider range of current and future market participants

[Insert Table 8 Here.]

To measure how useful a patent is for external users, we rely on the ratio of citations made by outside firms labeled as *Redeployability*. In Table 8, we split the sample based on the redeployability of each patent, and then run the main specification (3) separately for patents that are more or less exploited by other firms. We also present results in which we interact *Core* with the dummy indicating high redeployability. As a result, the coefficient on *Core* $\times$ High tests whether the pattern of selling core assets is significantly different on the bases of more or less redeployable patents. The results suggest that the intensity of selling core assets arise mainly from those core assets that have a higher ratio of external citations. Again consistent with that potential strategic values of the patents motivate buyers to acquire core assets.

5.2. Seller's Constraints: Frictions in Bankruptcy

Despite that Section 5.1 establishes why core assets are demanded by potential buyers, it is unclear why sellers are willing to sell it. Specifically, those assets are not sold during normal times—the question remains as to what frictions during the bankruptcy process that make firms willing to sell such assets at the cost of potential long term profitability?

5.2.1. Liquidity of Peripheral Assets. One source of pressure comes from the financing needs during bankruptcy which requires bankrupt firms to raise capital, typically within a short period of time, for debt repayment and working capital needs (Ayotte and Skeel, 2013; Edmans and Mann, 2018). As shown in the previous literature, asset liquidity exerts huge frictions in this process. As a result, bankrupt firms in need of financing but cannot raise through peripheral asset sales are more vulnerable to the demand of their core assets.

[Insert Table 9 Here.]

We test this seller-side mechanism by separately performing the main analysis in sample firms with high versus low peripheral asset liquidity. In Table 9 we present results that support the role of frictionless asset market. The message appears to be clear: if the firm's non-core assets are more liquid they are less likely to sell their core assets.

5.2.2. Bankrupt Firm's Access to External Finance. Another way to resolve the impatience of bankrupt firms is to provide external finance. We investigate whether bankrupt firms' innovation selling behaviors differ by their access to external finance, which we capture by whether a firm obtains debtor-in-possession (DIP) financing (Dahiya et al., 2003). Table 10 shows how technology proximity affects innovation reallocation decision in a subsample of firms with and without DIP financing. In firms with DIP financing, the sensitivity of selling patents to *Core* is lower. Column (6) provides the most direct economic magnitude interpretation—being a core assets is 4.3% less likely to be sold if the bankrupt firm receives DIP financing. This is more than half of the unconditional probability of selling.

[Insert Table 10 Here.]

Our results are consistent with the interpretation that access to DIP financing allows a firm to partially resolve its financial constraint and gives the firm more time to market its assets for sale, thus they obtain more flexibility and bargaining power facing the buyers. In contrast, firms without external finance may need to sell innovation quickly to raise cash for financing, and are more inclined to follow the demand (Ayotte and Skeel, 2013).[14]

5.2.3. Senior Creditor Influence. Prior studies document the strengthening of senior lender control in bankruptcy in the past decades. Their strong influence results in more frequent and intensive asset sales during bankruptcy reorganization (Baird and Rasmussen, 2002; Eckbo and Thorburn, 2008; Ayotte and Morrison, 2009). Gilson, Hotchkiss, and Osborn (2016) empirically document strong association between the fraction of secured debt in the capital structure and the likelihood of Chapter 11 firm selling assets through §363. However, it is not clear whether assets sold due to secured lender influence are pivotal to the selling firm for future growth and profitability. The evidence will shed light on the involvement of senior secured creditor as a key stakeholder in the asset redeployment process.

[Insert Table 11 Here.]

Table 11 shows that senior secured creditors plays a significant role in driving core asset selling. When performing the main specification on subsample categorized by above median versus below median of secured debt ratio, we find that the pattern of selling core assets is almost purely driven by firms with strong secured creditors. In fact, in firms with weaker secured creditors, core assets are either independent of or negatively related to the selling probability.

5.3. Innovation Sales and Future Usage

We would like to clarify that a potential alternative motive for the transaction is that the buyer firms are simply better users of the assets. In specific, the previous discussion

[14]Prior studies document that DIP loans often carry high interest and fees as well as stringent collateral requirements, covenants, and default clauses (See "Chapter 11: Debtor-in-Possession Lending Report," Debtwire Analytics, 2014; Skeel (2003), Ayotte and Morrison (2009), and Roe and Tung (2013)). Bankrupt firms, particularly those facing information problems (Edmans and Mann, 2018) and lenders' capital constraints, may seek asset sales as a compelling alternative for financing.

concentrates on the strategic motive, which is one way of using the technologies. One may wonder whether such innovation sales are associated with also better exploitation of the underlying technologies. To be clear, it is well established that peripheral assets are more likely to obtain efficiency gain through reallocation (Maksimovic and Phillips, 2001). In addition, such a motive is hard to be reconciled with the heterogeneity analysis provided in Section 5.1 and Section 5.2. However, we provide two additional analyses to further assess this argument.

5.3.1. Evidence from Human Capital Reallocation. We first seek evidence from the reallocation of inventors. We conduct the analysis in Table 12 using an inventor-firm-year-level data set extracted from the HBS Patent Database, and each observation is an inventor l in a firm i for a particular year t. We estimate the following specification:

$$\begin{aligned} InventorMobility_{lit} = \beta_1 \cdot I(PatentBeingSold)_{lit} \times I(InBankruptcy)_{it} \\ + \beta_2 \cdot I(PatentBeingSold)_{lit} + \beta_3 \cdot I(InBankruptcy)_{it} \\ + \lambda \times Control_{lt} + \alpha_l + \varepsilon_{lit}. \end{aligned} \tag{5}$$

$InventorMobility_{lit}$ is a dummy variable indicating whether inventor i at year t moves to another firm in the next three (or five) years. $I(PatentBeingSold)$ equals one if the inventor l has one or more patents sold in year t to a firm at which the inventor is not currently working. $I(InBankruptcy)$ indicates whether year t is the year that firm i files for bankruptcy.

[Insert Table 12 Here.]

Table 12 shows the results. Outside of bankruptcy, inventors of sold innovation leave the firm with a much higher intensity, which reflect the buyer firms' intention to redeploy the technologies through maintaining the original research team. This is consistent with earlier findings that inventor knowledge and team-specific capital is crucial for technology redeployment (Jaravel, Petkova, and Bell, 2018). Inventors also tend to leave a company after it files for bankruptcy—that is, there is a loss of talent and human capital (Graham et al., 2016; Baghai et al., 2017a). Interestingly, coefficients associated with $I(PatentBeingSold)_{lit} \times I(InBankruptcy)_{it}$ are negative and marginally significant. This evidence suggests that patent

buyers during bankruptcy are less knee to maintain human capital and team knowledge, thus technology exploitation appears to be less of a concern to those buyers.

5.3.2. Post-sale Citation Dynamics. We examine next the utilization pattern of patents sold in bankruptcy. Figure 3 plots the coefficients β_k from the following regression at the patent (p)-year (t) level:

$$Citation_{pt} = \sum_{k=-3}^{+3} \beta_k \cdot d[t+k]_{pt} + \gamma \cdot Controls_{pt} + \alpha_p + \alpha_t + \varepsilon_{pt}. \tag{6}$$

$Citation_{pt}$ is the number of new citations a patent receives in a given year, and we separately estimate using the total citations received by the patent (Panel (a)) and those received from the bankrupt firm itself (Panel (b)). The dummy variable $d[t+k]$ equals one if the patent observation is k years from the sale of the patent, and zero otherwise. We control for patent age, measured as the logarithm of the patent age in year t. We also include year and patent fixed effects, α_t and α_p. Standard errors are clustered at the firm level.

[Insert Figure 3 Here.]

We find two patterns. First, the overall utilization of the patents sold during the bankruptcy process experiences an "up and down" dynamic. Our interpretation is that bankrupt firms sell better-utilized hot patents (the "up" part) yet those patents do not necessarily better fit the buyer or are not necessarily better managed under new management, and therefore fall in total citations (the "down" part).

Second, the number of citations made by the bankrupt firm remains flat after the sale. The flat citation pattern suggests that those sold patents continue to be utilized by the firm in the short period post patent transactions. In other words, they remain an important technology for the firm. Moreover, despite patent licensing information being largely unavailable for our sample firms, we find anecdotal evidence that firms often license back the patents after the sale. This type of transaction is similar to the sale and leaseback mechanism for other types of assets that are used primarily for financing (Slovin, Sushka, and Polonchek, 1990; Sharpe and Nguyen, 1995).

5.4. Discussions on Generalizablility: Innovation vs. Other Assets

As discussed above, the fundamental differences between patents and most forms of real assets, such as real estate, is by definition a right to exclude a party, typically a market competitor. Moreover, patents are novel technologies that are not able to be replaced by an identical patent, in contrast to many assets like manufacturing equipments or aircrafts that can later be re-obtained. Transferring such irreplacable exclusion rights thus allows the many arguments in this paper.

However, the economic reasoning presented in the paper, arising from the preemptive motive of market competitors to obtain core assets and frictions faced by bankrupt firms, may apply to other broader asset classes. For example, such strategically core assets may be trademarks, spatial locations that deters entrants, natural resource lands. As long as those assets can allow the owner to maintain certain market power by lowering the returns to competitors, we would expect the economic mechanism to be at play. Moreover, it is typically these type of assets that define the competitive advantage of a firm, further highlighting the importance of the presented economic findings and mechanisms.

6. Conclusion

This paper analyzes asset sale decisions in bankruptcy using a novel setting of patent transactions. Bankrupt firms sell their core, instead of peripheral innovation in bankruptcy, inconsistent with asset reallocations outside of bankruptcy or theoretical predictions. The results concentrate in industries with low competition and patents with higher value of preempting future competition. The results are also stronger in firms with low access to finance, low asset liquidity and strong creditor control. Overall, the paper suggests that frictions in bankruptcy allow market competitors to acquire bankrupt firms' core assets.

Key Variable Definitions

Variable	Definition and Construction
	a. Patent-level Characteristics
Core	Calculated as the generalized mean between the patent and the whole patent portfolio owned by the firm, following Akcigit, Celik, and Greenwood (2016).
MFT Liquidity	A patent-year level variable, calculated as the ratio of transacted patents in the patent's technology class over the patent stock in that class.
Redeployability	Proxy for the degree to which the value of a patent is redeployable by other firms—measured as the share of citations to that patent within three years that are made by other firms (i.e., non-self citations).
I(Young Patent)	Equals one if the patent is granted no earlier than six years prior.
Scaled Citations	Citations received in the first three years of a patent's life scaled by this three-year citation of patents from its own vintage and technology class.
Litigation Risk	The ratio of litigated patents in a certain USPTO technology class.
	b. Bankruptcy Case Characteristics
Prepack	An indicator variable that takes a value of one if a bankruptcy is prepackaged or prenegotiated. According to the definition by LoPucki UCLA database, a case is prepackaged if the debtor drafted the plan, submitted it to a vote of the impaired classes, and claimed to have obtained the acceptance necessary for consensual confirmation before filing. On the other hand, if the debtor negotiates the plan with fewer than all groups or obtains the acceptance of fewer than all groups necessary to confirm before the bankruptcy case is filed, then the case is regarded as prenegotiated.
DIP Financing	An indicator variable that takes a value of one if the bankrupt firm receives court approval of debtor-in-possession (DIP) financing.
Secured Debt Ratio	The fraction of secured debt in total debt of the bankrupt firm. Secured Debt Ratio is defined as the sum of outstanding amount of drawn bank revolvers, term loans, secured bonds and notes, capital leases, and other secured debt, scaled by the total debt amount.
Duration	Number of days in bankruptcy, from the date of filing to the date of plan confirmation.
	c. Firm Characteristics
Assets	Total book assets in millions, adjusted to 2007 US dollars.
Size	The natural logarithm of total book assets, in millions, adjusted to 2007 US dollars.
Leverage	Book debt value scaled by total assets.
Sales growth	The growth of net sales from t to t-1.
ROA	Earnings before interest, taxes, depreciation, and amortization scaled by total assets.

HHI	Herfindahl-Hirschman Index calculated using sales at the 3-digit SIC code level
R&D/Assets	Research and development expenses scaled by total assets.

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Figure 1. Legal Process of Selling Innovation through §363 in Bankruptcy

This figure illustrates the legal process of selling innovation through §363 in bankruptcy. The starting point is when the §363 sale motion is filed, and the ending point is the judicial order approving the sale. The illustrated process can be generalized to sales of other assets.

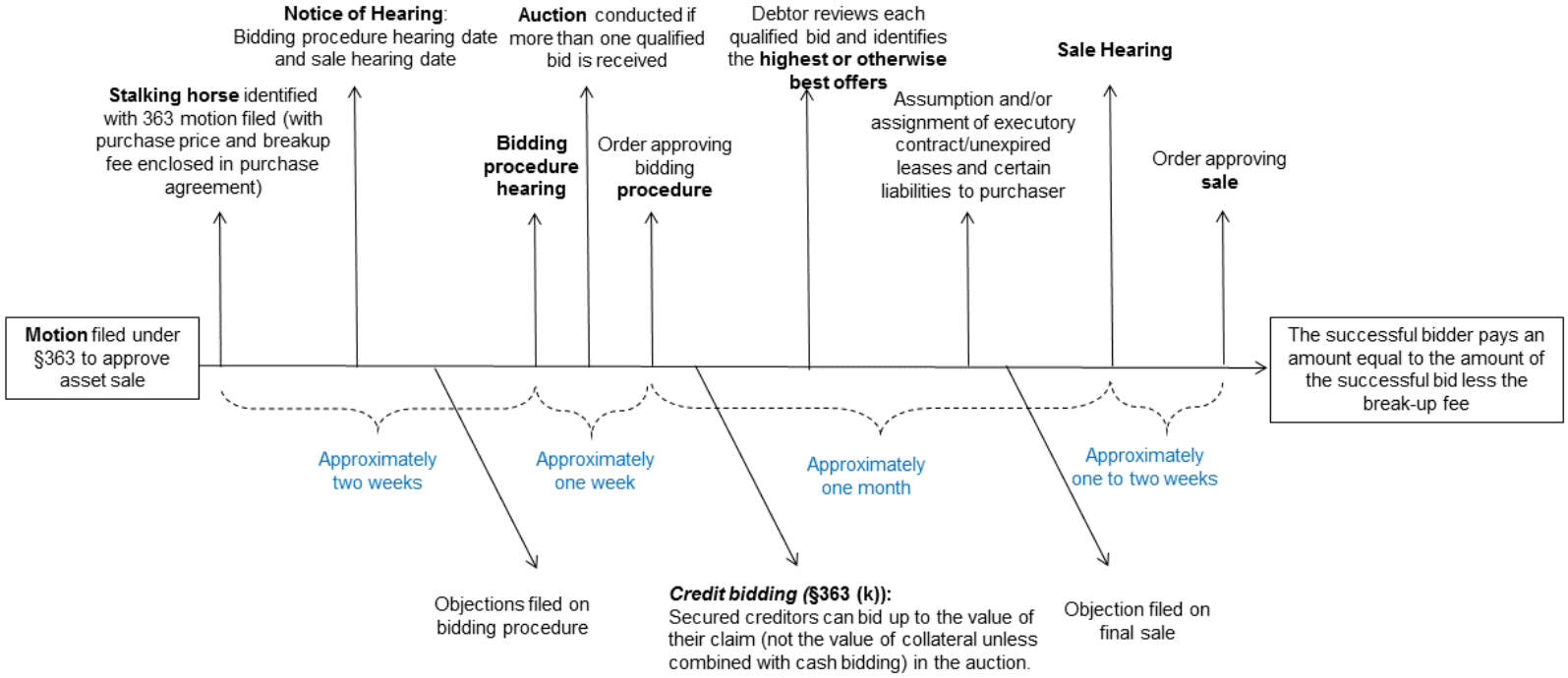
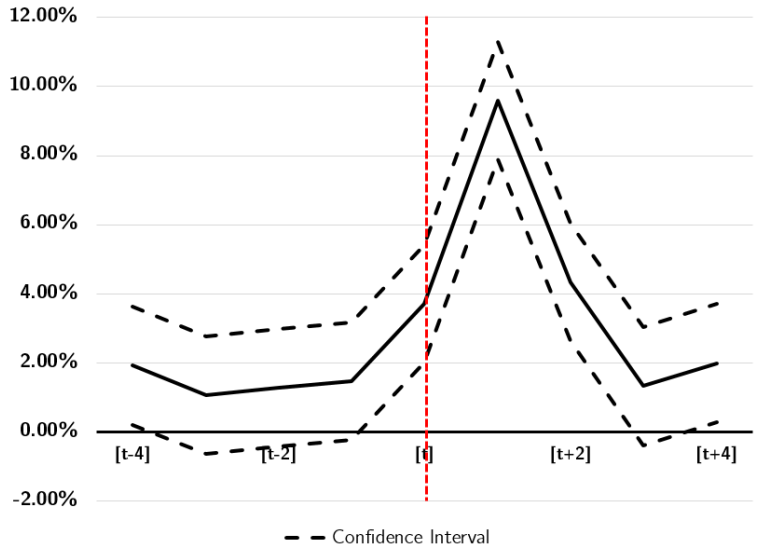


Figure 2. Selling Patents around Bankruptcy Filings

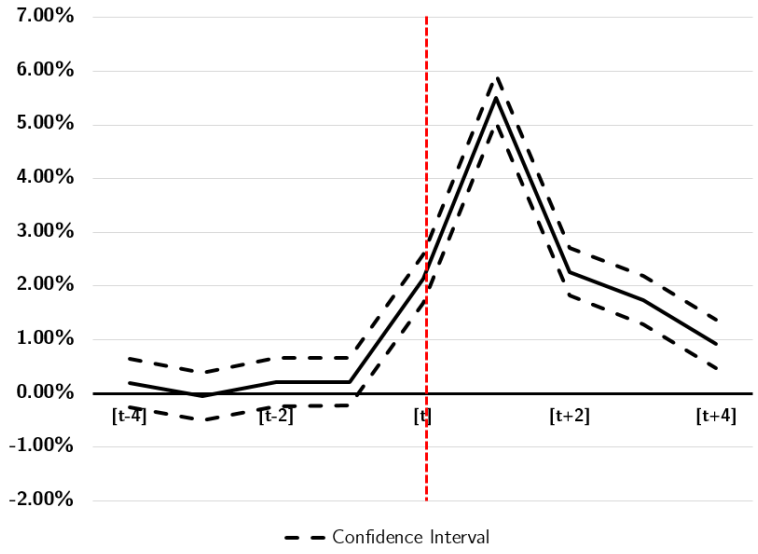
This figure presents the dynamics of the intensity of selling innovation from four quarters before the filing of bankruptcy to four quarters after the filing. We perform the analysis on a firm-quarter panel of all US public firms that have at least one valid patent grant from the USPTO (that is, a firm is included into the sample after its first patent is issued). Dependent variables are the dummy variable indicating whether the firm sold any patents in that quarter (Panel (a)) and the ratio (can be 0) of patents sold over the size of the firm's patent stock as of the beginning of the quarter (Panel (b)). The coefficients and 95% confidence intervals are estimated from the following specification:

$$Selling_{it} = \sum_{k=-4}^{4} \beta_k \; d[t+k] + \lambda \times Control_{it} + \alpha_i + \alpha_t + \varepsilon_{it}.$$

Independent variables of interest are the set of dummies, $d[t-4], ..., d[t+4]$, indicating whether the firm-quarter observation fits into the $[-4, +4]$ time frame of the bankruptcy event. We plot the β_k coefficients, which are the estimates representing the differences in trends in selling between bankrupt firms and the benchmark of public firms. We include both firm and year fixed effects in the estimation to absorb time-invariant selling intensity at the firm level, as well as time trends in the market for innovation. Standard errors are clustered at the firm level.



(a) Probability of Selling Innovation



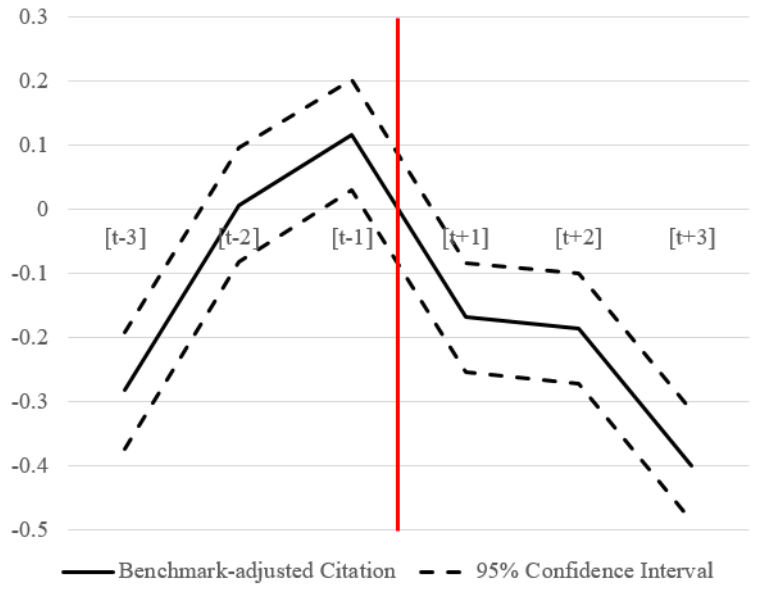
(b) Ratio of Innovation Sold (%)

Figure 3. Citation Dynamics around Patent Transactions of Bankrupt Firms

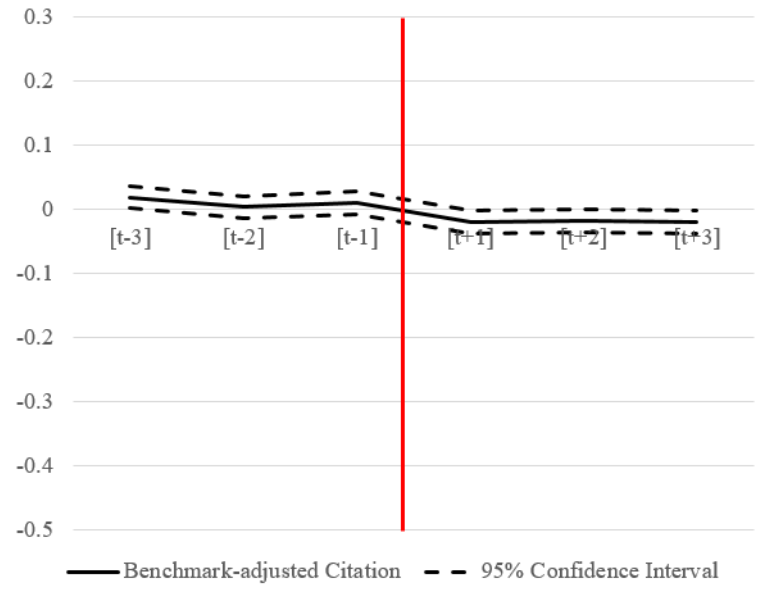
This figure plots the coefficients β_k from the following regression at the patent (p)-year (t) level:

$$Citation_{pt} = \sum_{k=-3}^{+3} \beta_k \cdot d[t+k]_{pt} + \gamma \cdot Controls_{pt} + \alpha_p + \alpha_t + \varepsilon_{pt}.$$

$Citation_{pt}$ is the number of new citations a patent receives in a given year, and we separately estimate using the total citations received by the patent (Panel (a)) and those received from the bankrupt firm that sold the patent (Panel (b)). The dummy variable $d[t+k]$ is equal to one if the patent observation is k years from the sale of the patent, and zero otherwise. We run the regression for patents sold by bankrupt firms around the bankruptcy filing. We control for patent age, measured as the logarithm of the patent age in year t. We also include year and patent fixed effects, α_t and α_p. Standard errors are clustered at the firm level.



(a) Total Citations Received by the Patent



(b) Citations Received from the Bankrupt Firm Itself

Table 1
Overview of Bankrupt Firms and Innovation Transactions

This table provides an overview of the sample of bankrupt firms and their innovation (patents)-selling activities during the bankruptcy reorganization process. The sample is tabulated by the Fama-French 12 industry classification (Panel A) and by year (Panel B). The sample covers all Chapter 11 bankruptcies filed by US public companies from 1981 to 2012, resolved as of mid-2016, and is manually matched with Compustat. We remove cases of financial corporations. Financial, operation, and case information is collected from Compustat/CRSP, CapitalIQ, case petitions and PACER. The patent-holding information of each firm from 1976 to 2006 is accessed using the NBER patent database; we extend that database to 2012 using Bhaven Sampat's USPTO patent and citation data. Patent transactions are obtained from the USPTO patent reassignment database from 1976 to 2015.

In each panel, we report the number of bankrupt firms in each industry/year and the number of innovative firms (defined as those owning at least one patent at the time of bankruptcy filing). We report the proportion of firms that sold at least one patent during bankruptcy periods, and the ratio of patents that were sold (the ratio of sold patents is defined as zero for firms that sold no patents). Patent-selling activities are reported for the bankruptcy reorganization process—that is, between the bankruptcy filing date and the confirmation date of the reorganizing plan.

Panel A: Bankruptcy Cases and Patent Transactions by Fama-French 12 Industries

	Number of Observations		Selling [Filing, Confirmation]	
	Full Sample	Innovative Sample	% of Firms	% of Patents
Consumer Non-durables	132	49	29%	18%
Consumer Durables	77	44	52%	11%
Manufacturing	192	117	33%	10%
Oil	68	5	40%	40%
Chemicals	36	16	38%	6%
Business Equipment	231	127	46%	24%
Telecommunication	126	16	38%	31%
Utilities	24	9	44%	24%
Wholesale and Retail	305	33	24%	15%
Health care	127	48	56%	29%
Other Industries	305	54	35%	15%
Total	1,623	518	40%	18%

Panel B: Bankruptcy Cases and Patent Transactions by Filing Year

	Number of Observations		Selling [Filing, Confirmation]	
	Full Sample	Innovative Sample	% of Firms	% of Patents
1981	0	0	-	-
1982	3	1	0%	0%
1983	1	0	-	-
1984	0	0	-	-
1985	5	2	0%	0%
1986	8	4	50%	17%
1987	6	2	100%	29%
1988	14	5	20%	10%
1989	20	6	50%	21%
1990	30	10	20%	10%
1991	40	11	18%	9%
1992	41	11	18%	1%
1993	48	12	33%	5%
1994	34	8	38%	26%
1995	44	6	67%	20%
1996	43	13	31%	14%
1997	42	7	57%	36%
1998	61	18	33%	20%
1999	99	21	48%	21%
2000	118	33	52%	23%
2001	187	49	45%	22%
2002	160	57	39%	21%
2003	113	48	44%	22%
2004	62	25	32%	15%
2005	59	27	44%	15%
2006	42	17	47%	15%
2007	38	15	27%	17%
2008	67	24	25%	15%
2009	122	52	50%	16%
2010	45	11	18%	12%
2011	40	14	14%	10%
2012	31	9	67%	43%
Total	1,623	518	40%	18%

Table 2
The Dynamics of Innovation Sales in Bankruptcy

This table tests whether bankrupt firms are more likely to sell patents during bankruptcy and the time-series dynamics of such transactions. We construct a firm-quarter panel of all US public firms that have at least one valid patent grant from the USPTO (that is, a firm is included in the sample after its first patent is issued). The dependent variable is the dummy variable indicating whether the firm sells any patent in that quarter (columns (1) and (2)) and the ratio (can be 0) of patents sold over the size of the firm's patent stock as of the beginning of the quarter (columns (3) and (4)). In columns (1) and (3), the key independent variable is a dummy variable, *I(InBankruptcy)*, indicating whether the firm is undergoing bankruptcy in that quarter (between the bankruptcy filing and the confirmation of the reorganization plan). Specifically, we exploit the following model:

$$Selling_{it} = \beta\ I(InBankruptcy)_{it} + \lambda \times Control_{it} + \alpha_i + \alpha_t + \varepsilon_{it}.$$

In columns (2) and (4), the analysis is extended to characterize the dynamics of selling innovation around bankruptcy. Specifically, we exploit the following model:

$$Selling_{it} = \sum_{k=-4}^{4} \beta_k\ d[t+k]_{it} + \lambda \times Control_{it} + \alpha_i + \alpha_t + \varepsilon_{it}.$$

Independent variables of interest are the set of dummies, $d[t-4], ..., d[t+4]$, indicating whether the firm-quarter observation fits into the $[-4, +4]$ time frame of the bankruptcy filing. We include both firm and year fixed effects to absorb time-invariant selling intensity at the firm level, as well as time trends in the market for innovation. The t-statistics based on standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
	Patent Being Sold		% of Patents Sold	
I(In Bankruptcy)	0.039***		0.022***	
	(10.828)		(23.784)	
d[t-4]		0.019**		0.002
		(2.192)		(0.842)
d[t-3]		0.011		-0.001
		(1.219)		(-0.245)
d[t-2]		0.013		0.002
		(1.465)		(0.948)
d[t-1]		0.015*		0.002
		(1.695)		(0.969)
d[t]		0.037***		0.021***
		(4.274)		(9.427)
d[t+1]		0.096***		0.055***
		(11.054)		(24.207)
d[t+2]		0.043***		0.023***
		(4.984)		(9.961)
d[t+3]		0.013		0.017***
		(1.521)		(7.621)
d[t+4]		0.020**		0.009***
		(2.273)		(4.012)
Observations	732,208	732,208	732,208	732,208
R-squared	0.246	0.246	0.021	0.021
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
F-Test				
d[t]-d[t-1]		3.349		36.12
p-value		0.067*		0.000***
d[t+1]-d[t-1]		44.28		273.10
p-value		0.000***		0.000***
d[t+2]-d[t-1]		5.484		40.97
p-value		0.019**		0.000***

Table 3
Summary of Bankrupt Firms and Their Patents

This table reports summary statistics of bankrupt firms and their patents owned at the time of filing bankruptcy. The sample covers all Chapter 11 bankruptcies filed by US public companies from 1981 to 2012, resolved as of mid-2016, and is manually matched with Compustat. We remove cases of financial corporations. The patent-holding information of each firm from 1976 to 2006 is accessed using the NBER patent database; we extend that database to 2012 using Bhaven Sampat's USPTO patent and citation data. Patent transactions are obtained from the USPTO patent reassignment database from 1976 to 2015.

Panel A reports patent-level information. Panel B reports firm-level information collected from case petitions, Compustat/CRSP, CapitalIQ, and PACER. Detailed variable definitions can be found in Section 3 of the paper and the Appendix. The variable values are measured as of the year before bankruptcy filing. For each variable, we report the mean, standard deviation, and 25th, 50th, and 75th percentiles.

Panel A: Summary Statistics of Patents Owned by Bankrupt Firms

	Patents (N=62,720)				
	Mean	Std.Dev	p25	p50	p75
Core ($\iota = 0.66$)	0.444	0.274	0.213	0.377	0.673
I(Core)	0.245	0.430	0.000	0.000	0.000
Core ($\iota = 0.33$)	0.572	0.306	0.316	0.555	0.863
Scaled Citations	1.075	1.835	0.226	0.632	1.339
I(Young Patent)	0.254	0.435	0.000	0.000	1.000
MFT Liquidity	0.033	0.022	0.021	0.030	0.039
Redeployability	0.789	0.327	0.667	1.000	1.000
Sold	0.083	0.276	0.000	0.000	0.000

Panel B: Summary Statistics of Bankrupt Innovative Firms

	Number of Cases (N=518)				
	Mean	Std.Dev	p25	p50	p75
Prepack	0.197	0.398	0.000	0.000	0.000
DIP Financing	0.550	0.498	0.000	1.000	1.000
Duration (days)	511	538	203	369	641
Outcome (Acquired)	0.127	0.334	0.000	0.000	0.000
Outcome (Converted)	0.122	0.327	0.000	0.000	0.000
Outcome (Emerged)	0.512	0.500	0.000	1.000	1.000
Outcome (Liquidated)	0.239	0.427	0.000	0.000	0.000
Assets	972.825	5569.812	23.160	93.974	302.130
Leverage	0.589	0.502	0.232	0.507	0.806
Sales growth	0.275	1.612	-0.198	-0.025	0.159
ROA	-0.294	0.530	-0.412	-0.140	0.004
R&D/Assets	0.114	0.201	0.004	0.028	0.133
Patent Stock	175.145	1284.467	3.000	13.000	39.000
Distress (Stock Return)	0.288	0.453	0.000	0.000	1.000
Distress (Sales)	0.158	0.365	0.000	0.000	0.000

Table 4
The Determinants of Patent Sales in Bankruptcy

This table presents how innovation reallocation decisions in bankruptcy are affected by patent-level characteristics. The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing, using the following model:

$$Sold_{ip} = \beta \cdot Core_{ip} + \lambda \times Control_{ip} + \alpha_i + \varepsilon_{ip}.$$

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$ or 0.66. The *Core* is also discreted into within-firm quartiles and *Core*(*Quartile*) are dummy variables to indicate the quartiles. The dummy indicating the lowest quartile is omitted and serves as an effective benchmark. For patent age, *I(Young Patent)* equals one if the patent was granted up to six years before the bankruptcy filing. *Scaled Citations* is the number of citations received in the first three years of a patent's life, scaled by this three-year citation of patents from its own vintage and technology class. *Redeployability* captures the extent that the patent is utilized by firms other than the owning firm, and *MFT Liquidity* captures the liquidity of the market specific to the patent's technology class. More details regarding those variables are described in the Appendix. In columns (1) to (5), the sample includes patents owned by all bankrupt public firms between 1981 and 2012; in column (6), we include patents owned by the sample of bankrupt firms that eventually emerged from bankruptcy; in column (7), we exclude cases that are prepackaged. All specifications include firm fixed effects. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Core ($\iota = 0.66$)	0.022***			0.023***	0.028***	0.019***	0.029***
	(5.706)			(6.090)	(7.135)	(4.825)	(6.643)
Core (4th Quartile)		0.025***					
		(9.693)					
Core (3rd Quartile)		0.003					
		(1.311)					
Core (2nd Quartile)		0.003					
		(1.330)					
Core ($\iota = 0.33$)			0.018***				
			(5.586)				
I(Young Patent)				0.043***	0.042***	0.027***	0.055***
				(14.510)	(14.261)	(9.036)	(15.889)
Scaled Citation				0.004***	0.004***	0.004***	0.004***
				(6.373)	(6.304)	(6.048)	(6.559)
Redeployability					0.027***	0.024***	0.027***
					(9.225)	(8.553)	(8.593)
MFT Liquidity					0.212***	0.086**	0.244***
					(4.856)	(2.060)	(5.295)
Observations	62,720	62,720	62,720	62,720	62,720	53,582	54,263
R-squared	0.289	0.290	0.289	0.292	0.293	0.109	0.300
Firm FE	Y	Y	Y	Y	Y	Y	Y
All Firms	Y	Y	Y	Y	Y		
Emerged Only						Y	
Exclude Pre-packed							Y

Table 5
The Determinants of Patent Sales—In and Out of Bankruptcy

This table presents how innovation reallocation decisions in bankruptcy are affected by patent-level characteristics using a panel setting. The analysis is conducted on a sample that consists of repeated cross-sections of patent holdings p by firms i across years t, using the following model:

$$\begin{aligned} Sold_{ipt} = \beta \cdot Core_{ipt} \times I(InBankruptcy)_{it} \\ + \beta_C \cdot Core_{ipt} + \beta_B I(InBankruptcy)_{it} \\ + \lambda \times Control_{ipt} + \alpha_i + \varepsilon_{ip}. \end{aligned}$$

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$. $I(Core)$ is a dummy variable indicating whether the patent is at the within-firm top quartile. I(In Bankruptcy) is a dummy variable indicating whether a firm is undergoing a bankruptcy reorganization in that year. In columns (1) and (3) we control for both year and firm fixed effects; in columns (2) and (4) we control for firm-by-year fixed effects. All regressions include control variables *I(Young Patent)*, *Scaled Citations*, *Redeployability*, and *MFT Liquidity* as defined in the text. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1			
	(1)	(2)	(3)	(4)
Core x I(In Bankruptcy)	0.024***	0.003***		
	(23.774)	(3.159)		
Core	-0.001***	-0.001***		
	(-7.503)	(-15.478)		
I(Core) x I(In Bankruptcy)			0.021***	0.006***
			(26.077)	(6.442)
I(Core)			-0.003***	-0.003***
			(-46.758)	(-47.137)
I(In Bankruptcy)	0.001**		0.008***	
	(2.573)		(27.088)	
Observations	28,545,995	28,545,995	28,545,995	28,545,995
R-squared	0.074	0.251	0.074	0.251
Controls	Y	Y	Y	Y
Firm FE	Y		Y	
Year FE	Y		Y	
Firm x Year FE		Y		Y

Table 6
Heterogeneous Effects Across Industry Competition

This table how the phenomenon of selling core patents varies depending on the product market competition. Product market competition is defined using sales *HHI* at the 3-digit SIC level. The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing. In columns (1), (2), (4), and (5), the sample is split based on the *HHI*, and then run the main specification as in Table 4 separately. In columns (3) and (6), we present results in which we interact *Core* with the dummy indicating high HHI and the estimation is performed on the full sample. As a result, the coefficient on *Core* × High tests whether the pattern of selling core assets is significantly different in markets with high versus low competition levels.

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$. $I(Core)$ is a dummy variable indicating whether the patent is at the within-firm top quartile. All regressions include control variables *I(Young Patent)*, *Scaled Citations*, *Redeployability*, and *MFT Liquidity* as defined in the text. All specifications include firm fixed effects. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1					
	(1)	(2)	(3)	(4)	(5)	(6)
HHI =	High	Low	Interacted	High	Low	Interacted
Core	0.043***	0.017***	0.017***			
	(6.754)	(3.428)	(3.309)			
Core x High			0.025***			
			(3.233)			
I(Core)				0.047***	0.013***	0.012***
				(12.514)	(5.040)	(4.451)
I(Core) x High						0.036***
						(8.228)
Observations	22,503	40,217	62,720	22,503	40,217	62,720
R-squared	0.111	0.384	0.293	0.116	0.384	0.295
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

Table 7
Patent Litigation and the Reallocation of Innovation in Bankruptcy

This table how the phenomenon of selling core patents varies depending on the litigation risks of the different technology classes. Litigation risk is defined using the ratio of litigated patents in a technology class. The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing. In columns (1), (2), (4), and (5), the sample is split based on the *Litigation Risk*, and then run the main specification as in Table 4 separately. In columns (3) and (6), we present results in which we interact *Core* with the dummy indicating high litigation risk and the estimation is performed on the full sample. As a result, the coefficient on *Core* × High tests whether the pattern of selling core assets is significantly different for patents in higher litigation risks.

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$. $I(Core)$ is a dummy variable indicating whether the patent is at the within-firm top quartile. All regressions include control variables *I(Young Patent)*, *Scaled Citations*, *Redeployability*, and *MFT Liquidity* as defined in the text. All specifications include firm fixed effects. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1					
	(1)	(2)	(3)	(4)	(5)	(6)
Litigation Risk =	High	Low	Interacted	High	Low	Interacted
Core	0.049***	0.013**	0.010**			
	(8.553)	(2.466)	(2.255)			
Core x High			0.035***			
			(9.513)			
I(Core)				0.035***	0.013***	0.010***
				(11.126)	(4.742)	(3.426)
I(Core) x High						0.028***
						(7.504)
Observations	31,278	31,442	62,720	31,278	31,442	62,720
R-squared	0.297	0.309	0.294	0.298	0.309	0.295
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

Table 8
Heterogeneous Effects Across Asset Redeployability

This table how the phenomenon of selling core patents varies depending on the redeployability of a patent. *Redeployability* is a proxy for the degree to which the value of a patent is exploited by other firms—measured as the share of citations to that patent within three years that are made by other firms (i.e., non-self citations). The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing. In columns (1), (2), (4), and (5), the sample is split based on the *Redeployability*, and then run the main specification as in Table 4 separately. In columns (3) and (6), we present results in which we interact *Core* with the dummy indicating high *Redeployability* and the estimation is performed on the full sample. As a result, the coefficient on *Core* × High tests whether the pattern of selling core assets is significantly different for patents with high versus low redeployability.

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$. $I(Core)$ is a dummy variable indicating whether the patent is at the within-firm top quartile. All regressions include control variables *I(Young Patent)*, *Scaled Citations*, *Redeployability*, and *MFT Liquidity* as defined in the text. All specifications include firm fixed effects. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1					
	(1)	(2)	(3)	(4)	(5)	(6)
Patent Redeployability =	High	Low	Interacted	High	Low	Interacted
Core	0.039***	0.007	0.007			
	(7.917)	(1.149)	(1.251)			
Core x High			0.031***			
			(4.537)			
I(Core)				0.028***	0.021***	0.021***
				(10.199)	(6.271)	(6.271)
I(Core) x High						0.006
						(1.493)
Observations	36,683	26,037	62,720	36,683	26,037	62,720
R-squared	0.350	0.203	0.292	0.350	0.204	0.293
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

Table 9
Heterogeneous Effects Across Liquidity of Peripheral Assets

This table how the phenomenon of selling core patents varies depending on the peripheral (non-core) asset liquidity of the bankrupt firm. Non-core liquidity is defined using as the average market for technologies liquidity of patents within the bottom three quartiles of the core measure. The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing. In columns (1), (2), (4), and (5), the sample is split based on *Non-core Liquidity*, and then run the main specification as in Table 4 separately. In columns (3) and (6), we present results in which we interact *Core* with the dummy indicating high noncore liquidity and the estimation is performed on the full sample. As a result, the coefficient on *Core* × High tests whether the pattern of selling core assets is significantly different for firms with high versus low liquidity of their peripheral assets.

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$. $I(Core)$ is a dummy variable indicating whether the patent is at the within-firm top quartile. All regressions include control variables *I(Young Patent)*, *Scaled Citations*, *Redeployability*, and *MFT Liquidity* as defined in the text. All specifications include firm fixed effects. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1					
	(1)	(2)	(3)	(4)	(5)	(6)
Non-core Liquidity =	High	Low	Interacted	High	Low	Interacted
Core	0.021***	0.028***	0.030***			
	(3.893)	(5.004)	(5.670)			
Core x High			-0.009			
			(-1.107)			
I(Core)				0.019***	0.032***	0.033***
				(6.544)	(10.193)	(10.906)
I(Core) x High						-0.016***
						(-3.872)
Observations	32,064	30,656	62,720	32,064	30,656	62,720
R-squared	0.427	0.099	0.292	0.427	0.101	0.293
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

Table 10
Heterogeneous Effects Across External Access to Financing (DIP)

This table how the phenomenon of selling core patents varies depending on the whether the firm obtained DIP financing in Chapter 11. The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing. In columns (1), (2), (4), and (5), the sample is split based on whether the firm obtained DIP financing, and then run the main specification as in Table 4 separately. In columns (3) and (6), we present results in which we interact *Core* with the dummy indicating the DIP status. As a result, the coefficient on *Core* $\times$ with DIP tests whether the pattern of selling core assets is significantly different for firms with DIP financing.

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$. $I(Core)$ is a dummy variable indicating whether the patent is at the within-firm top quartile. All regressions include control variables *I(Young Patent)*, *Scaled Citations*, *Redeployability*, and *MFT Liquidity* as defined in the text. All specifications include firm fixed effects. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold					
	(1)	(2)	(3)	(4)	(5)	(6)
DIP =	With DIP	No DIP	Interacted	With DIP	No DIP	Interacted
Core	0.026***	0.028***	0.033***			
	(6.088)	(3.083)	(4.816)			
Core x with DIP			-0.007			
			(-0.970)			
I(Core)				0.015***	0.056***	0.058***
				(6.399)	(11.101)	(12.965)
I(Core) x with DIP						-0.043***
						(-8.518)
Observations	49,122	13,598	62,720	49,122	13,598	62,720
R-squared	0.134	0.509	0.293	0.134	0.513	0.295
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

Table 11
Heterogeneous Effects Across Fractions of Secured Debt Fraction

This table how the phenomenon of selling core patents varies depending on the senior creditor control. Secured debt ratio is defined as the fraction of secured debt in total debt of the bankrupt firm using information from Capital IQ and SEC filings. The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing. In columns (1), (2), (4), and (5), the sample is split based on *Secured Debt Ratio*, and then run the main specification as in Table 4 separately. In columns (3) and (6), we present results in which we interact *Core* with the dummy indicating high secured debt ratio and the estimation is performed on the full sample. As a result, the coefficient on *Core* × High tests whether the pattern of selling core assets is significantly different for firms with high versus low senior creditor control.

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Core* is the distance between the patent and the firm's core technological expertise as defined in Section 3.3, with parameters $\iota = 0.33$. $I(Core)$ is a dummy variable indicating whether the patent is at the within-firm top quartile. All regressions include control variables *I(Young Patent)*, *Scaled Citations*, *Redeployability*, and *MFT Liquidity* as defined in the text. All specifications include firm fixed effects. The t-statistics based on robust standard errors clustered at the firm level are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1					
	(1)	(2)	(3)	(4)	(5)	(6)
Secured Debt Ratio =	High	Low	Interacted	High	Low	Interacted
Core	0.047***	0.005	0.012**			
	(8.349)	(0.913)	(2.438)			
Core x High			0.025***			
			(3.849)			
I(Core)				0.065***	-0.017***	-0.017***
				(19.780)	(-6.226)	(-6.453)
I(Core) x High						0.081***
						(19.165)
Observations	22,050	33,465	55,515	22,050	33,465	55,515
R-squared	0.157	0.235	0.206	0.169	0.236	0.211
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

Table 12
Inventor Mobility and Innovation Reallocation around Bankruptcy

This table studies how inventor reallocation in a firm is affected by the reallocation of the inventor's patent and the bankruptcy status of the firm. We track inventor mobility using an inventor-firm-year-level data set, and each observation is an inventor l in a firm i for a particular year t. The sample includes inventors from all public firms between 1981 and 2010. We estimate the following specification:

$$\begin{aligned} InventorMobility_{lit} = {} & \beta_1 \cdot I(PatentBeingSold)_{lit} \times I(InBankruptcy)_{it} \\ & + \beta_2 \cdot I(PatentBeingSold)_{lit} + \beta_3 \cdot I(InBankruptcy)_{it} \\ & + \lambda \times Control_{lt} + \alpha_l + \varepsilon_{lit}. \end{aligned}$$

$InventorMobility_{lit}$ is a dummy variable indicating whether inventor l at year t moves to another firm in the next three to five years. $I(PatentBeingSold)$ equals one if the inventor has one or more patents sold to a firm at which the inventor is not currently working. $I(InBankruptcy)$ indicates whether year t is the year that firm i files for bankruptcy. In Panel A, we look at whether the inventor's patent being sold and the inventor's firm being in bankruptcy affect an inventor's reallocation decision. We control for inventor productivity by measuring new patents granted and the number of citations in the most recent three years. The t-statistics based on robust standard errors are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	I(Move within 3 Years)			I(Move within 5 Years)		
I(Patent Being Sold) × I(In Bankruptcy)			-0.035			-0.046*
			(-1.463)			(-1.807)
I(Patent Being Sold)	0.021***		0.021***	0.021***		0.021***
	(32.508)		(32.552)	(30.211)		(30.265)
I(In Bankruptcy)		0.047***	0.048***		0.050***	0.051***
		(12.717)	(12.830)		(12.424)	(12.592)
Inventor Productivity (Quantity)	0.002***	0.002***	0.002***	0.001***	0.001***	0.001***
	(54.604)	(55.444)	(54.605)	(35.572)	(36.350)	(35.571)
Inventor Productivity (Quality)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(50.364)	(50.479)	(50.406)	(48.127)	(48.237)	(48.168)
Observations	3,714,594	3,714,594	3,714,594	3,714,594	3,714,594	3,714,594
R-squared	0.019	0.019	0.019	0.018	0.017	0.018

Appendix (Not For Publication)

A1. Identifying Patent Reallocations from USPTO Documents

This appendix provides a detailed description of the method used to identify patent transactions. We first introduce the raw data set on patent assignments and then present the methodology used to identify patent transactions; that is, patent assignments other than transfers from an inventor to the firm at which she works or from a subsidiary to its corporate parent.

A1.1. Data Sources

We begin with the raw patent assignment database, downloaded from the USPTO patent assignment files, hosted by Google Patents. A patent assignment is the transfer of (part of) an owner's property rights in a given patent or patents, and any applications for such patents. The patent transfer may occur on its own or as part of a larger asset sale or purchase. These files contain all records of assignments made to US patents from the late 1970s. The original files are then parsed and combined to serve as the starting raw data set, including all patents assigned from an inventor to the firm, from a firm to an inventor, and from one inventor (firm) to another inventor (firm).

We make use of the following information for the purpose of identifying patent transactions. First, in regard to patent assignment information, we retrieve information on the assignment date, the participating parties, including the assignee—the "buyer" in a transaction—and the assignor—the "seller" in a transaction, and comments on the reason for the assignment. Some important reasons include assignment of assignor's interest, security agreement, merger, and change of names. Second, in regard to patent information, we retrieve information on patent application and grant dates, identification numbers (patent number and application number), and patent title. We then merge the raw assignment data with the USPTO patent databases to gather additional information on the original assignee and patent technology classes. We also combine the data set with the inventor-level data maintained at HBS, which allows us to identify the inventor(s) of any given patent. Since we focus on utility patents, we remove entries for design patents.

Next, we standardize the names of the assignee and assignor in the raw patent assignment data set, original assignee names reported in the USPTO databases, and inventor names in the HBS inventor database. Specifically, we employ the name standardization algorithm developed by the NBER Patent Data Project. This algorithm standardizes common company prefixes and suffixes, strips names of punctuation and capitalization, and it also isolates a company's stem name (the main body of the company name), excluding these prefixes and suffixes. We keep only assignment records for which the assignment brief is included under "assignment of assignor's interest" or "merger"—that is, we remove cases in which the reason for the assignment is clearly not a "change of names."

A1.2. Identifying Patent Transactions

In identifying patent transactions, we use several basic principles that predict predict how patent transactions appear in the data. First, the initial assignment in a patent's history is less likely to be a patent transaction; it is more likely to be an original assignment to the inventing firm. Note that this principle is more helpful with patents granted after 1980, when the raw data set began to be systematically updated. Second, if an assignment record regards only one patent with the brief reason "assignment of assignor's interest," it is less likely to be a transaction because it is rare that two parties transact only one patent in a deal (see Serrano (2010)). Third, if the assignor of an assignment is the inventor of the patent, it is less likely that this assignment is a transaction; instead it is more likely to be an employee inventor who assigns the patent to her employer. Fourth, if both the assignor and the assignee are corporations, it is likely that this assignment is a transaction, with the exception that the patent is transferred within a large corporation (from a subsidiary to the parent, or between subsidiaries). Based on these principles, the algorithm below is a process in which we remove cases that are unlikely to be patent transactions. The steps we take are as follows:

1. Check whether the assignment record date coincides with the original grant date of the patent (the date the patent was first issued). If it does, we label the assignment as a "non-transaction," and it is removed from the data set. Otherwise, we move to Step 2.

2. Check whether the patent assignment record contains only one patent, and is the first

record for this patent, with "assignment of assignor's interest" as the assignment reason. If the answer is affirmative, we move to Step 3. Otherwise, the record is labeled as a "potential transaction," and we move to Step 4.

3. Compare the assignee in the assignment record with the assignee in the original patent assignment in the USPTO. Similarly, compare the assignor in the assignment record with the inventor names in the HBS patent database. If the assignee names match, or if the assignor is the patent inventor(s) plus the assignee is a firm, we then categorize the assignment as a "non-transaction," and it is removed from the data set. This constraint covers cases in which either the assignee or the assignor has slightly different names in different databases. Otherwise, the record is labeled as a "potential transaction," and we move to Step 4.

4. Perform the analysis described in Step 3 on the "potential transactions," with one minor change: when comparing the assignee in the assignment record with the assignee in the original patent assignment in the USPTO patent database, and when comparing the assignor in the assignment record with the inventor names in the HBS patent database, we allow for spelling errors captured by Levenshtein: edit distance less than or equal to 10% of the average length of the two strings under comparison, and we denote these name as "roughly equal to each other." Then, if the assignee names roughly match, or the assignor is roughly the patent inventor(s) plus the assignee is a firm, then assignment is categorized as a "non-transaction" and is removed from the data set. Otherwise, the record is kept as a "potential transaction," and we move to Step 5.

5. Compare the standardized names and stem names of the assignee and assignor in records in the "potential transactions." If the names match, this is consistent with an internal transfer, and the record is labeled as a "non-transaction." If the names do not match, the record is labeled as a "transaction."

A2. Supplementary Tables and Results

Table A.1
Summary of Bankrupt Firms with No Innovation

This table reports summary statistics of bankrupt firms that do not own any patent at the time of bankruptcy filing. The sample covers all Chapter 11 bankruptcies filed by US public companies from 1981 to 2012, resolved as of mid-2016, and is manually matched with Compustat. We remove cases of financial corporations. This table reports firm-level information collected from case petitions, Compustat/CRSP, CapitalIQ, and PACER. Detailed variable definitions can be found in Section 3 of the paper and in the Appendix. The variable values are measured as of the year before the bankruptcy filing. For each variable, we report the mean, standard deviation, and 25th, 50th, and 75th percentiles. The last two columns report the differences between bankrupt firms with no patent and innovative bankrupt firms and T-test on their means.

	Number of Cases=1,105					Non-innovative − Innovative	
	Mean	Std.Dev	p25	p50	p75	Difference	T-test
Prepack	0.212	0.409	0.000	0.000	0.000	0.015	(0.681)
DIP Financing	0.471	0.499	0.000	0.000	1.000	-0.080	(-2.996)**
Duration (Days)	488.992	549.284	180.000	355.000	607.500	-21.780	(-0.749)
Outcome (Acquired)	0.109	0.311	0.000	0.000	0.000	-0.019	(-1.109)
Outcome (Converted)	0.162	0.369	0.000	0.000	0.000	0.040	(2.130)*
Outcome (Emerged)	0.500	0.500	0.000	0.000	1.000	-0.012	(-0.452)
Outcome (Liquidated)	0.230	0.421	0.000	0.000	0.000	-0.010	(-0.423)
Assets	591.160	4581.978	25.955	88.393	222.100	-381.665	(-1.252)
Leverage	0.629	0.461	0.306	0.566	0.834	0.044	(1.656)
Sales growth	0.349	1.516	-0.151	-0.007	0.249	0.077	(0.865)
ROA	-0.242	0.589	-0.285	-0.104	0.007	0.053	(1.630)
R&D/Assets	0.060	0.202	0.000	0.000	0.006	-0.055	(-3.883)***
Patent Stock	0	.	.	.	.		
Distress (Stock Return)	0.291	0.455	0.000	0.000	1.000	0.003	(0.131)
Distress (Sales)	0.108	0.311	0.000	0.000	0.000	-0.049	(-2.771)**

Table A.2
Innovation Redeployment in Bankruptcy—Logit Regression

This table presents how innovation reallocation decisions in bankruptcy are affected by patent-level characteristics using logit regressions (marginal effects reported). The analysis is conducted on a patent-level data set, and each observation is a patent p in a bankrupt firm i's patent portfolio in the year of bankruptcy filing, using the following model:

$$\begin{aligned} Sold_{ip} = \beta_1 \cdot Redeployability_{ip} + \beta_2 \cdot MFTLiquidity_{ip} \\ + \gamma_1 \cdot Utilization_{ip} + \gamma_2 \cdot TechCloseness_{ip} \\ + \lambda \times Control_{ip} + \alpha_i + \varepsilon_{ip}. \end{aligned}$$

The dependent variable $Sold_{ip}$ is a dummy variable indicating whether patent p is sold during the bankruptcy reorganization process (from bankruptcy filing to the confirmation of the reorganization plan) by its owning firm i. *Redeployability* captures the extent that the patent is utilized by firms other than the owning firm, and *MFT Liquidity* captures the liquidity of the market specific to the patent's technology class; *Utilization* is the number of total citations received by the patents in the most recent three years, and *Tech Closeness*, which is the distance between the patent and the firm's core technological expertise. For patent age, *Young Patent* equals one if the patent was granted up to six years before the bankruptcy filing. Scaled citations is the number of citations received in the first three years of a patent's life, scaled by this three-year citation of patents from its own vintage and technology class. More details regarding those variables are described in the Appendix. In columns (1) to (5), the sample includes patents owned by all bankrupt public firms between 1981 and 2012; in column (6), we include patents owned by the sample of bankrupt firms that eventually emerged from bankruptcy; in column (7), we exclude cases that are prepackaged. All specifications include firm fixed effects. The coefficients reported are marginal effects estimated at the sample mean. The t-statistics based on robust standard errors are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Patent Being Sold = 1						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Core ($\iota = 0.66$)	0.021***			0.021***	0.024***	0.022***	0.034***
	(5.961)			(6.127)	(7.144)	(4.986)	(6.584)
Core (4th Quartile)		0.003					
		(1.442)					
Core (3rd Quartile)		0.003					
		(1.405)					
Core (2nd Quartile)		0.020***					
		(9.293)					
Core ($\iota = 0.33$)			0.023***				
			(5.785)				
I(Young Patent)				0.038***	0.036***	0.032***	0.062***
				(14.900)	(14.288)	(9.489)	(16.165)
Scaled Citation				0.003***	0.003***	0.003***	0.004***
				(6.405)	(6.368)	(5.801)	(6.686)
Redeployability						0.026***	0.030***
						(7.800)	(7.906)
MFT Liquidity						0.074*	0.218***
						(1.773)	(4.806)
Observations	62,720	62,720	62,720	62,720	62,720	53,582	54,263
R-squared	0.289	0.290	0.289	0.292	0.293	0.109	0.300
Firm FE	Y	Y	Y	Y	Y	Y	Y
All Firms	Y	Y	Y	Y	Y		
Emerged Only						Y	
Exclude Pre-packed							Y

Table A.3
The Determinants of Patent Sales in Bankruptcy at the Firm Level

This table presents the propensity and intensity of selling innovation in bankruptcy correlates with firm-level characteristics at the filing. In Panel A, the dependent variable is a dummy variable indicating whether the bankrupt firm sold any patent during the reorganization process. In Panel B, the dependent variable is the ratio of patents sold in bankruptcy reorganization over the total number of patents owned by the firm at filing. The variables of interests include filing status, industry and financial distress, and bankruptcy outcome. The t-statistics based on robust standard errors are displayed in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Determinants on the decision to sell (any) patent

	Patent Being Sold					
	(1)	(2)	(3)	(4)	(5)	(6)
Prepack(dummy)	-0.248***					
	(-5.345)					
Debtor-in-Possession Financing (dummy)		-0.079*				
		(-1.817)				
Outcome (Emerged)			-0.280***			
			(-6.769)			
Outcome (Liquidated)				0.291***		
				(5.875)		
Observations	488	488	488	488	477	468
R-squared	0.111	0.078	0.149	0.136	0.074	0.083

Panel B: Determinants of the ratio of patents sold

	Ratio of Patents Sold					
	(1)	(2)	(3)	(4)	(5)	(6)
Prepack(dummy)	-0.139***					
	(-5.009)					
Debtor-in-Possession Financing (dummy)		-0.069**				
		(-2.328)				
Outcome (Emerged)			-0.210***			
			(-7.495)			
Outcome (Liquidated)				0.222***		
				(5.797)		
Industry Distress (Sales)					-0.004	
					(-0.087)	
Financial Distress						-0.057*
						(-1.912)
Observations	488	488	488	488	477	468
R-squared	0.044	0.027	0.116	0.102	0.015	0.023