

Online Appendix For  
**Bankrupt Innovative Firms**

Song Ma\*      Joy Tianjiao Tong<sup>†</sup>      Wei Wang<sup>‡</sup>

---

\*Ma: Yale University and NBER, [song.ma@yale.edu](mailto:song.ma@yale.edu), (203) 436-4687, corresponding author;

<sup>†</sup>Tong: Ivey Business School, Western University, Canada, [jtong@ivey.ca](mailto:jtong@ivey.ca), (519) 808-5059;

<sup>‡</sup>Wang: Queen's University, [wwang@queensu.ca](mailto:wwang@queensu.ca), (613) 533-3248.

## A1. 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).
I(Core)	Equals one if a patent is in the top quartile of <i>Core</i> .
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) Scaled Citations	Equals one if the patent is granted no earlier than six years prior. 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.
Collateral	An indicator variable that takes a value of one if a patent is used as collateral for financing.
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. 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.
Duration	Number of days in bankruptcy, from the date of filing to the date of plan confirmation.
Financial Distress	An indicator variable that takes a value of one if the bankrupt firm experiences financial (but not economic) distress, which is defined as firms in the top tercile in ROA and the top tercile in leverage in our sample firms.
Under-Collateralized	An indicator variable that takes a value of one if the ratio of secured debt to book assets is equal to or is larger than one.
Fulcrum (Loan-to-Own)	An indicator variable that takes a value of one if secured creditors received newly issued equity of reorganized firms.
Fulcrum (<100% Recovery)	An indicator variable that takes a value of one if the secure creditors' recovery rate is less than 100%.
c. Firm Characteristics	
Assets	Total book assets in millions, adjusted to 2007 US dollars.
Sales growth	The growth of net sales from $t$ to $t-1$ .

ROA	Earnings before interest, taxes, depreciation, and amortization scaled by total assets.
R&D/Assets	Research and development expenses scaled by total assets.
Secured Debt Ratio	The fraction of secured debt in total debt of the bankrupt firm. Secured Debt Ratio is defined as the sum of the outstanding amount of drawn bank revolvers, term loans, secured bonds and notes, capital leases, and other secured debt, scaled by the total debt amount.

---

## A2. Background: Asset Sales and Creditor Control in Chapter 11

This section provides a brief introduction to the institutional background on asset sales in Chapter 11 reorganization and how creditors can exert influence in this process.

Distressed and insolvent firms file for Chapter 11 to reorganize under bankruptcy court protection. In addition to setting up rules and guidelines to allow firms to restructure their debt claims, bankruptcy law provides firms the means to sell assets and pay creditors before court confirmation of a reorganization plan, most noticeably through §363 of the Bankruptcy Code. In our study, patent reallocations in bankruptcy are conducted through §363 sales.<sup>1</sup> This echos the trend of §363 becoming the main mechanism for firms to sell (innovation) assets in Chapter 11 reorganization (Baird and Rasmussen, 2002; Ayotte and Skeel, 2013; Gilson, Hotchkiss, and Osborn, 2016).

§363 has several unique features that facilitate asset sales in Chapter 11. Foremost, §363 offers a simplified procedure for asset sales. Selling assets through §363 requires a judge’s approval and often secured lenders’ consent, but not a formal vote of all creditors. This allows the debtor to conduct asset sales on an expedited basis.<sup>2</sup> This process typically takes a few weeks to complete and can occur shortly after bankruptcy filing. A detailed illustration of the process is outlined in Figure A.1. In contrast, asset sales through a reorganization plan must be voted on by each class of creditor and approved by a bankruptcy judge, and the process may take months or even years. Furthermore, §363 greatly improves the salability of assets by its provision of “free and clear of liens and encumbrances.” This provision allows the asset buyer to be exempted from the prepetition lenders’ security interest, improving the attractiveness of assets to potential buyers.

[Insert Figure A.1 Here.]

Even though §363 grants bankrupt firms opportunities to sell assets before plan confir-

---

<sup>1</sup>Anecdotally, well-known large-scale innovation sales in bankruptcy, such as those of Eastman Kodak and Nortel, were all conducted through §363. We also confirm in Appendix Table A.2 and Figure 2 that the great majority of innovation sales during the bankruptcy reorganization process are via §363.

<sup>2</sup>Specifically, §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 all creditors but require a “sound business purpose.”

mation, the nature of the assets sold and the selling procedure in restructuring are strongly influenced by senior secured lenders through three main mechanisms, through which patents can be sold quickly after bankruptcy filing

First, the debtor is required to ensure that the value of the secured creditors' claims is "adequately protected" in the bankruptcy process, if the secured creditors' claim is over-collateralized at the time of bankruptcy filing. Under §361 of the Bankruptcy Code, the debtor must make cash "adequate protection payments" or provide liens on existing unencumbered assets to offset any potential loss arising from diminution in the value of the secured lenders' collateral in Chapter 11. Since §363 sale removes lenders' liens on collateralized assets, sales of these assets are typically subject to the consent of the secured lenders.<sup>3</sup> Moreover, secured lenders are protected by the cash proceeds from the sale. Therefore, the secured lenders' consent is critical to the sale of collateralized assets through §363.

Second, secured lenders may request the judge to terminate the debtor's exclusivity of filing a plan as well as request grant relief from the automatic stay, especially if they are worried about the diminution of their collateral interest. This serves as an important mechanism for secured lenders to push for the sale of collateralized assets. Secured lenders may use the relief or even Chapter 7 conversion as a threat to exert pressure on the management to sell assets. Their incentives are stronger when the sale proceeds are sufficiently large to cover their claims, even if the assets are sold for too low a price. In contrast, it often takes time for the unsecured creditors to coordinate and exert influence. Specifically, the U.S. Trustee Office needs to organize the 341 meeting of unsecured creditors to form the official unsecured creditors' committee, which can take place a few weeks or months after the initial Chapter 11 filing.

Last, prepetition lenders often re-contract with the debtor firm through debtor-in-possession (DIP) financing. These new loan contracts contain many restrictions and strict covenants as well as milestones that the debtor firm must achieve during restructuring.

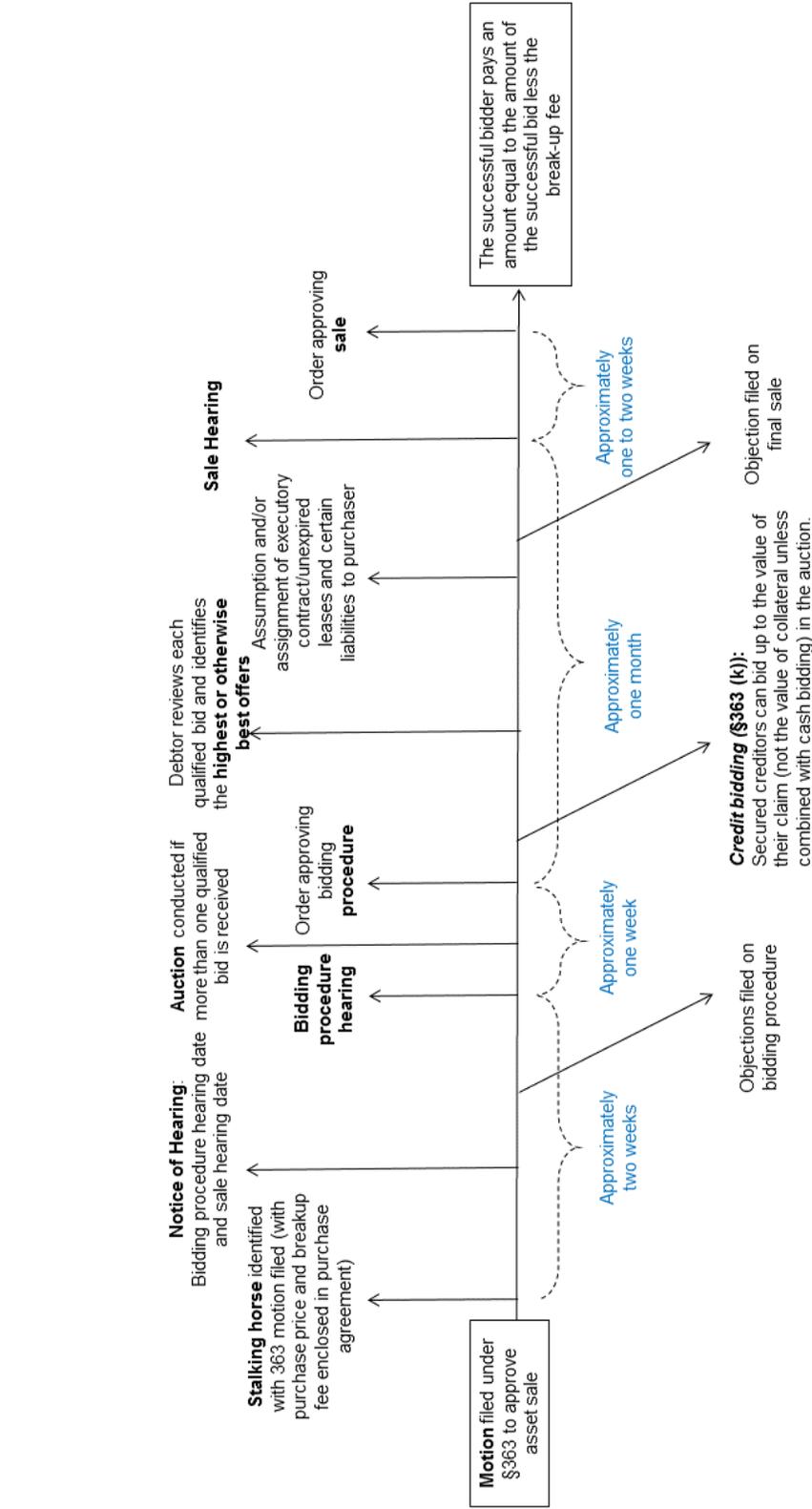
---

<sup>3</sup>The provision to use or sell collateralized assets free and clear of liens with the consent of lenders that have security interest is explicitly laid out in §363(f), which states: "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."

Specifically, the prepayment clauses that are tied to asset sale would prompt the debtor firm to pay DIP lenders upon the sale of assets. The DIP contracts, at times, afford lenders the ability to play an explicit role in asset sales through specific milestones requiring the debtor firm to set up a bidding procedure for §363 sale with the DIP lenders' approval. Moreover, creditors may re-contract with the management team to implement key employee incentive plans (Gilson and Vetsuypens, 1993; Goyal and Wang, 2017). Some of these plans request management to conduct asset sales and tie bonuses directly to proceeds from asset sales.

**Figure A.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.



### **A3. 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.

#### **A3.1. 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.”

### **A3.2. Identifying Patent Transactions**

In identifying patent transactions, we use several basic principles that 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.”

#### A4. Supplementary Tables and Results

**Table A.2.** The Dynamics of Innovation Sales in Bankruptcy

	(1) Patent Being Sold	(2)	(3) % of Patents Sold	(4)
I(In Bankruptcy)	0.039*** (10.828)		0.022*** (23.784)	
d[t-4]		0.019** (2.192)		0.002 (0.842)
d[t-3]		0.011 (1.219)		-0.001 (-0.245)
d[t-2]		0.013 (1.465)		0.002 (0.948)
d[t-1]		0.015* (1.695)		0.002 (0.969)
d[t]		0.037*** (4.274)		0.021*** (9.427)
d[t+1]		0.096*** (11.054)		0.055*** (24.207)
d[t+2]		0.043*** (4.984)		0.023*** (9.961)
d[t+3]		0.013 (1.521)		0.017*** (7.621)
d[t+4]		0.020** (2.273)		0.009*** (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***

*Notes.* 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 patents 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,  $d[t-4], \dots, d[t+4]$ , 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.

**Table A.3.** Summary of Bankrupt Firms with No Innovation

	Mean	Std.Dev	Number of Cases=1,105			p75	Non-innovative – Innovative Difference	T-test
			p25	p50	p75			
Prepack	0.212	0.409	0.000	0.000	0.000	0.015	(0.681)	
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 (Emergent)	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)	
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							
Secured Debt Ratio	0.529	0.358	0.200	0.519	0.888	-0.003	(-0.122)	

*Notes.* 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, Capital IQ, and PACER. Detailed variable definitions can be found in Section 2 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.

**Table A.4.** Innovation Redeployment in Bankruptcy—Logit Regression

	Patent Being Sold = 1				
	(1)	(2)	(3)	(4)	(5)
Core ( $\iota = 0.66$ )	0.021*** (5.961)		0.021*** (6.127)	0.024*** (7.144)	0.022*** (4.986)
Core ( $\iota = 0.33$ )		0.023*** (5.785)			
I(Young Patent)			0.038*** (14.900)	0.036*** (14.288)	0.032*** (9.489)
Scaled Citation			0.003*** (6.405)	0.003*** (6.368)	0.003*** (5.801)
Redeployability				0.022*** (8.525)	0.026*** (7.800)
MFT Liquidity				0.134*** (4.333)	0.074* (1.773)
Observations	62,770	62,770	62,770	62,770	53,603
R-squared	0.289	0.289	0.292	0.293	0.109
Firm FE	Y	Y	Y	Y	Y
All Firms	Y	Y	Y	Y	
Emerged Only					Y

*Notes.* 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:

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

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 2, with parameters  $\iota = 0.33$  or  $0.66$ . 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 (4), the sample includes patents owned by all bankrupt public firms between 1981 and 2012; in column (5), we include patents owned by the sample of bankrupt firms that eventually emerged from bankruptcy. 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.

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

	Patent Being Sold = 1			
	(1)	(2)	(3)	(4)
Core x I(In Bankruptcy)	0.024*** (23.774)	0.003*** (3.159)		
Core	-0.001*** (-7.503)	-0.001*** (-15.478)		
I(Core) x I(In Bankruptcy)			0.021*** (26.077)	0.006*** (6.442)
I(Core)			-0.003*** (-46.758)	-0.003*** (-47.137)
I(In Bankruptcy)	0.001** (2.573)		0.008*** (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

*Notes.* 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:

$$\begin{aligned}
Sold_{ipt} = & \beta \cdot Core_{ipt} \times I(InBankruptcy)_{it} \\
& + \beta_C \cdot Core_{ipt} + \beta_B I(InBankruptcy)_{it} \\
& + \lambda \times Control_{ipt} + \alpha_{i,t} + \varepsilon_{ipt}.
\end{aligned}$$

The dependent variable  $Sold_{ipt}$  is a dummy variable indicating whether patent  $p$  is sold in year  $t$  by its owning firm  $i$ .  $Core$  is the distance between the patent and the firm's core technological expertise as defined in Section 2, 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.

**Table A.6.** Firm-level Summary Statistics Across Creditor Control Variables

	<i>Secured Debt Ratio</i>		Low – High Creditor Control	
	<i>High</i> Mean	<i>Low</i> Mean	Difference	T-test
Assets	366.010	435.457	69.447	(0.645)
Sales Growth	0.077	0.070	-0.007	(-0.141)
ROA	-0.272	-0.244	0.028	(0.768)
Patent Stock	172.096	245.036	72.940	(0.495)

*Notes.* This table reports summary statistics of innovative bankrupt firms across secured debt ratio. This table reports firm-level information collected from case petitions, Compustat/CRSP, Capital IQ, and PACER. Detailed variable definitions can be found in Section 2 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. The last two columns report the differences between bankrupt firms with high vs. low creditor control variables and T-test on their means.

**Table A.7.** Robustness Based on Firms with More Patents

	Patent Being Sold = 1		
	(1) 5 Patents Or More	(2) 10 Patents Or More	(3) 20 Patents Or More
Core ( $\iota = 0.66$ )	0.027*** (7.108)	0.027*** (7.038)	0.028*** (7.240)
I(Young Patent)	0.042*** (14.307)	0.042*** (14.259)	0.041*** (14.001)
Scaled Citation	0.004*** (6.269)	0.004*** (6.196)	0.004*** (6.344)
Redeployability	0.027*** (9.230)	0.027*** (9.277)	0.027*** (9.270)
MFT Liquidity	0.212*** (4.855)	0.212*** (4.874)	0.211*** (4.851)
Observations	62,662	62,401	61,687
R-squared	0.292	0.289	0.275
Firm FE	Y	Y	Y
# Firms	349	281	204

*Notes.* This table presents how innovation reallocation in bankruptcy is affected by patent-level characteristics, excluding firms with fewer patents in their patent portfolio at the time of bankruptcy. It follows the identical design as Table 3 column (5), but only includes firms own five/ten/twenty or more patents at the time of bankruptcy, respectively. 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.

**Table A.8.** The Sale of Core Patents—Robustness Using Different Cutoff Years

<b>Panel A:</b> Heterogeneities across time-series, pre- and post-2001						
<i>Time period</i>	(1) Post 2001	(2) Pre 2001	(3) Interacted	(4) Post 2001	(5) Pre 2001	(6) Interacted
Core	0.034*** (7.840)	-0.007 (-1.046)	-0.007 (-0.737)			
Core x Post 2001			0.041*** (3.872)			
I(Core)				0.027*** (11.742)	0.004 (0.943)	0.004 (0.665)
I(Core) x Post 2001						0.023*** (3.670)
Observations	54,768	8,002	62,770	54,768	8,002	62,770
R-squared	0.276	0.475	0.294	0.277	0.475	0.295
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

<b>Panel B:</b> Heterogeneities across time-series, pre- and post-2002						
<i>Time period</i>	(1) Post 2002	(2) Pre 2002	(3) Interacted	(4) Post 2002	(5) Pre 2002	(6) Interacted
Core	0.032*** (7.192)	0.014* (1.786)	0.014* (1.818)			
Core x Post 2002			0.017* (1.921)			
I(Core)				0.032*** (13.654)	-0.003 (-0.643)	-0.003 (-0.656)
I(Core) x Post 2002						0.035*** (6.673)
Observations	49,787	12,983	62,770	49,787	12,983	62,770
R-squared	0.291	0.308	0.294	0.293	0.308	0.296
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

*Notes.* This table presents the robustness tests on how the phenomenon of selling core patents varies depending on the senior creditor control, measured by the time of bankruptcy filing. Panel A and B follows the identical design as Table 4 Panel B but use alternative subsample cuts. In Panel A, the sample is split based on whether the bankrupt firm filed before or after 2001. Panel B divides the subsamples by whether the bankruptcy filing was post-2002. 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.

**Table A.9.** Core Innovation and Patent Collateralization—All Firms

	Collateral = 1			
	(1)	(2)	(3)	(4)
Core	0.078*** (4.207)	0.087*** (4.109)		
I(Core)			0.063*** (5.739)	0.070*** (5.950)
Scaled Citation	0.005*** (4.350)	0.005*** (4.477)	0.004*** (4.212)	0.004*** (4.354)
Redeployability		0.025*** (4.861)		0.025*** (4.904)
Observations	1,335,442	1,335,442	1,335,442	1,335,442
R-squared	0.038	0.040	0.041	0.044
Grant Year FE	Y	Y	Y	Y
Technology Class FE	Y	Y	Y	Y

*Notes.* This table performs a cross-sectional regression to explore the determinants of whether a patent is required to be collateralized by a creditor using the full USPTO patent data set. Patent collateral dummy *Collateral* is coded using the USPTO patent assignment database. All other variables are defined in the Appendix. We control for grant year and technology class fixed effects, and standard errors are clustered at both the technology class and grant year level. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Table A.10.** The Presence of Strong Unsecured Creditors

	Patent Being Sold = 1					
	(1)	(2)	(3)	(4)	(5)	(6)
	HF on UCC	No HF on UCC	Interacted	HF on UCC	No HF on UCC	Interacted
Core	0.007 (0.707)	0.030*** (7.230)	0.030*** (7.361)			
Core x HF on UCC			-0.023* (-1.876)			
I(Core)				0.006 (1.145)	0.026*** (11.622)	0.026*** (11.831)
I(Core) x HF on UCC						-0.020*** (-2.792)
Observations	5,965	56,805	62,770	5,965	56,805	62,770
R-squared	0.304	0.292	0.294	0.304	0.293	0.295
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y

*Notes.* This table presents how the phenomenon of selling core patents varies depending on the influence by strong unsecured creditors. We use the presence of hedge fund (HF) and private equity (PE) fund investors on official unsecured creditors' committee (UCC). The presence of hedge fund and private equity fund investor is taken from [Jiang, Li, and Wang \(2012\)](#) and [Goyal and Wang \(2017\)](#). 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 there is a hedge fund or private equity fund investor on the UCC, and then we run the main specification as in Table 3 separately. In columns (3) and (6), we present results in which we interact *Core* with the dummy indicating the existence of a hedge fund or private equity fund investor, and the estimation is performed on the full sample. As a result, the coefficient on  $Core \times HF$  on UCC tests whether the pattern of selling core assets is significantly different for firms with and without a hedge fund investor.

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 2, 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.

**Table A.11.** Creditor Recovery

	Secured Debt Recovery		Unsecured Debt Recovery	
	(1)	(2)	(3)	(4)
I(Sell Innovation)	0.151*** (2.743)		0.010 (0.153)	
I(Sell Core Patent)		0.123* (1.764)		0.018 (0.236)
Observations	157	157	94	94
R-squared	0.046	0.020	0.000	0.001

*Notes.* This table presents the firm level analysis on the relation between innovation sales in bankruptcy and debt recovery rate of firms emerging from bankruptcy. Debt recovery is obtained from bankruptcy plans and disclosure statement for a subsample of our firms. The key explanatory variables are whether the firm sells any innovation, and whether the firm sells any core innovation. In column (1) and column (2), the dependent variables are the recovery rate of secured lenders. For columns (3) and (4), the dependent variables are the recovery rate of unsecured lenders, and the sample includes firms in which secured creditors' recovery rate is 100% or higher. When secured lenders' recovery rate is missing but unsecured lenders' recovery is non-missing, we assume secure lenders recover in full. The t-statistics based on robust standard errors are displayed in parentheses. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Table A.12.** Unsecured Creditor Objection in §363 Sale

	Full Sample (1)	363 Sample (2)
Core Sold/Core	0.124* (1.863)	0.185 (1.024)
Observations	518	149
R-squared	0.214	0.179
Year FE	Y	Y

*Notes.* This table presents the firm level analysis on the relation between innovation sales in bankruptcy and creditor objection inside bankruptcy §363 sale. The key explanatory variable is the fraction of sold core innovation in the pool of core innovation possessed by the bankrupt firm at Chapter 11 filing. The dependent variables is a dummy variable indicating whether the bankrupt firms' 363 sales receive any objection from unsecured creditors. We control for year fixed effects. The t-statistics based on robust standard errors are displayed in parentheses. \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Table A.13.** Inventor Mobility and Innovation Reallocation around Bankruptcy

	(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 (-1.463)			-0.046* (-1.807)
I(Patent Being Sold)	0.021*** (32.508)		0.021*** (32.552)	0.021*** (30.211)		0.021*** (30.265)
I(In Bankruptcy)		0.047*** (12.717)	0.048*** (12.830)		0.050*** (12.424)	0.051*** (12.592)
Inventor Level Controls	Y	Y	Y	Y	Y	Y
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

*Notes.* 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:

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

$InventorMobility_{lit}$  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.

## References

- Akcigit, U., M. A. Celik, and J. Greenwood. 2016. Buy, keep, or sell: Economic growth and the market for ideas. *Econometrica* 84:943–84. ISSN 1468-0262. doi:10.3982/ECTA12144.
- Ayotte, K., and D. A. Skeel. 2013. Bankruptcy law as a liquidity provider. *The University of Chicago Law Review* 1557–624.
- Baird, D. G., and B. Rasmussen. 2002. The end of bankruptcy. *Stanford Law Review* 55.
- Gilson, S. C., E. S. Hotchkiss, and M. G. Osborn. 2016. Cashing out: The rise of m&a in bankruptcy. Available at SSRN 2547168 .
- Goyal, V., and W. Wang. 2017. Provision of management incentives in bankrupt firms. *Journal of Law, Finance, and Accounting* 2.
- Jiang, W., K. Li, and W. Wang. 2012. Hedge funds and chapter 11. *Journal of Finance* 67:513–60.
- Serrano, C. J. 2010. The dynamics of the transfer and renewal of patents. *RAND Journal of Economics* 41:686–708.