BOSTON COLLEGE
Carroll School of Management

Why Do Innovative Firms Sell Patents? An Empirical Analysis of the Causes and Consequences of Patent Transactions

Jingxuan Zhang, Boston College

Abstract

In this paper, I analyze the secondary market transactions of patents from public assignor (i.e., seller) to assignee (i.e., buyer) firms. In particular, I study the causes and consequences of public assignor firms selling some of their patents. I document that firms with higher innovation productivity or innovation quality but with lower production efficiency are more likely to sell patents distant from their operations. Further, patents with lower economic value but higher scientific value are more likely to be sold. In terms of the consequences of patent transactions, I document that in the three years after patent transactions, assignor firms on average experience a positive and statistically significant improvement in their operating performance. In addition, their stocks enjoy a positive and significant long-run buy-and-hold abnormal return (BHAR) following these patent transactions. This pattern is robust to different holding periods and benchmark portfolios against which the long-run buy-and-hold return is calculated. I document one possible underlying mechanism driving these results, which is that assignor firms increase their focus after patent transactions.

Methods

1. Firm-level specification: Causes of patent transactions

$$I(Selling\ Patent_{i,t}) = \alpha_j + \alpha_t + \beta X_{i,t} + \boldsymbol{Z_{i,t-1}\gamma} + u_{i,t}$$

- $X_{i,t}$: innovation quantity, innovation quality, total factor productivity (TFP)
- Industry and year FEs

2. Patent-level specification

$$I(Patent_{i,j,t}\ is\ sold) = \alpha_j + \alpha_t + \beta X_{i,j,t} + \boldsymbol{Z_{i,t}\gamma} + u_{i,t}$$

- $X_{i,t}$: patent's technological distance, patent's scientific value (i.e., number of forward citations), patent's economic value (following Kogan et al. (2017))
- Firm and year FEs

3. Firm-level specification: Consequences of patent transactions

$$Y_{i,t} = \alpha_i + \alpha_t + \beta_1 Assignor\_After_{1-3} + \beta_2 Assignor\_After_{>3} + \boldsymbol{X_{i,t}\gamma} + u_{i,t}$$

- $Assignor\_After_{1-3}$: dummy variable equal to 1 if firm i is an assignor firm and the observation is in the first 3 years after a patent transaction in year t
- $Assignor\_After_{>3}$: dummy variable equal to 1 if firm i is an assignor firm and the observation is beyond the first 3 years after a patent transaction in year t
- Firm and year FEs

Results: Firm-level causes of patent transactions

At firm level, I document that firms with higher innovation productivity (as measured by the number of patents filed in the last 3 years) or innovation quality (as measured by the number of citations per patent for patents filed in the last 3 years) but with lower production efficiency (as measured by the TFP) are more likely to engage in a patent transaction.

	$I(Selling\ Patent_{i,t})$					
	(1)	(2)	(3)	(4)	(5)	(6)
Number of Patents in Last 3 Years (log)	0.063*** (0.002)	0.058*** (0.002)				0.106*** (0.005)
Number of Citations Per Patent in Last 3 Years (log)			1.651*** (0.491)	0.685** (0.278)		
Total Factor Productivity (TFP)					-0.051*** (0.003)	-0.011*** (0.001)
TFP × Number of Patents in Last 3 Years (log)						-0.016*** (0.001)
Total Assets (log)		0.012*** (0.001)		0.039*** (0.001)	0.042*** (0.001)	0.011*** (0.001)
R&D/Assets		-0.004 (0.003)		0.029*** (0.004)	0.044*** (0.005)	0.002 (0.003)
ROA		-0.008*** (0.001)		-0.015*** (0.001)	-0.000 (0.001)	-0.000 (0.001)
Leverage		0.004*** (0.001)		0.004*** (0.001)	0.001 (0.002)	0.005*** (0.002)
Current Ratio		-0.002*** (0.000)		-0.002*** (0.000)	-0.003*** (0.000)	-0.002*** (0.000)
Cash		-0.048*** (0.005)		-0.004 (0.005)	-0.015** (0.006)	-0.049*** (0.005)
Capital Expenditure		-0.139*** (0.013)		-0.084*** (0.015)	-0.116*** (0.017)	-0.161*** (0.015)
3-Digit SIC Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.193	0.216	0.037	0.134	0.157	0.233
Num. of Obs.	197,010	122,183	197,010	122,183	109,450	109,450

Results: Patent-level causes of patent transactions

At patent level, I document that patents technologically further away from assignor firms' operations are more likely to be sold in a patent transaction. In addition, patents with higher scientific value (as measured by the number of forward citations received by the patents) but with lower economic value (as measured by the announcement return upon the grant of patents) are more likely to be sold.

	$I(Patent_{i,j,t}\ is\ sold)$		
	(1)	(2)	(3)
Technological Distance	0.052*** (0.012)	0.080* (0.046)	
Total Number of Patents (log)		0.022*** (0.007)	
Technological Distance × Total Number of Patents (log)		0.018*** (0.006)	
I(Economic Value in bottom quartile)			-0.001 (0.003)
Number of Forward Citations (log) × I(Economic Value in bottom quartile)			0.214*** (0.073)
Number of Forward Citations (log)	0.027 (0.064)	0.084 (0.061)	0.059 (0.056)
Number of Claims (log)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
Patent Scope	-0.003* (0.002)	-0.003* (0.002)	-0.001 (0.001)
Number of Backward Citations (log)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Patent Litigation Dummy	0.128*** (0.015)	0.131*** (0.016)	0.127*** (0.015)
Firm FE	Yes	Yes	Yes
Filing-Year FE	Yes	Yes	Yes
R^2	0.348	0.349	0.347
Num. of Obs.	1,872,486	1,872,486	1,876,388

Results: Firm-level consequences of patent transactions

I document that in the three years after patent transactions, assignor firms on average experience a positive and statistically significant improvement in their operating performance. In addition, their stocks enjoy a positive and significant long-run buy-and-hold abnormal return (BHAR) following these patent transactions. This pattern is robust to different holding periods and benchmark portfolios against which the long-run buy-and-hold return is calculated.

Long-Run Buy-and-Hold Abnormal Returns (BHAR)

	1 Quarter BHAR [1, 63]	2 Quarter BHAR [1, 126]	3 Quarter BHAR [1, 189]	1 Year BHAR [1, 252]	2 Years BHAR [1, 504]	3 Years BHAR [1, 756]
Size-matched Firms	0.018** (0.009)	0.038*** (0.012)	0.052*** (0.015)	0.072*** (0.021)	0.068** (0.029)	0.261** (0.117)
CRSP Value-weighted Index	0.106* (0.061)	0.115** (0.05)	0.121** (0.043)	0.127*** (0.048)	0.13*** (0.05)	0.124** (0.06)
Standard & Poor's 500	0.112* (0.061)	0.128** (0.05)	0.139*** (0.043)	0.15*** (0.047)	0.176*** (0.05)	0.193*** (0.07)
Nasdaq Composite Index	0.103* (0.061)	0.112** (0.05)	0.115*** (0.043)	0.117** (0.048)	0.113** (0.05)	0.105* (0.06)

	$ROA_{i,t}$			
	(1)	(2)	(3)	(4)
$Assignor\_After_{1-3}$	0.23*** (0.069)	0.14** (0.06)		
$Assignor\_After_1$			0.138** (0.055)	0.08* (0.048)
$Assignor\_After_2$			0.142*** (0.04)	0.101*** (0.039)
$Assignor\_After_3$			0.138*** (0.04)	0.102*** (0.038)
$Assignor\_After_{>3}$	0.643*** (0.196)	0.291** (0.144)	0.623*** (0.192)	0.274* (0.143)
Total Assets (log)		-0.093 (0.211)		-0.093 (0.211)
R&D/Assets		-7.66*** (1.783)		-7.66*** (1.783)
Leverage		-4.303*** (1.077)		-4.303*** (1.077)
Current Ratio		-0.002 (0.047)		-0.002 (0.047)
Cash		-5.812** (2.528)		-5.813** (2.528)
Capital Expenditure		2.336 (1.677)		2.338 (1.678)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.136	0.239	0.137	0.239
Num. of Obs.	185,445	132,354	185,445	132,354

Conclusion

1. I show that firms with higher innovation productivity or innovation quality but with lower production efficiency are more likely to engage in a patent transaction. The effect of production efficiency on the probability of assignor firms selling their patents is greater for firms with higher innovation productivity.
2. I document that patents further away from assignor firms' operations are more likely to sold in a patent transaction. This effect is stronger for firms with higher innovation productivity. Further, patents with lower economic value but higher scientific value are more likely to be sold in a patent transaction.
3. In terms of the consequences of patent transactions, I document that in the three years after patent transactions, assignor firms on average experience a positive and statistically significant improvement in their operating performance. In addition, their stocks enjoy a positive and significant long-run buy-and-hold abnormal return (BHAR) following these patent transactions. This pattern is robust to different holding periods and benchmark portfolios against which the long-run buy-and-hold return is calculated. I document one possible underlying mechanism driving these results, which is that assignor firms increase their focus after the patent transactions.

References

1. Akcigit, U., Celik, M.A. and Greenwood, J., 2016. Buy, keep, or sell: Economic growth and the market for ideas. *Econometrica*, *84*(3), pp.943-984.
2. John, K. and Ofek, E., 1995. Asset sales and increase in focus. *Journal of Financial Economics*, *37*(1), pp.105-126.
3. Kogan, L., Papanikolaou, D., Seru, A. and Stoffman, N., 2017. Technological innovation, resource allocation, and growth. *The Quarterly Journal of Economics*, *132*(2), pp.665-712.
4. Marco, A.C., Myers, A., Graham, S.J., D'Agostino, P. and Apple, K., 2015. The USPTO patent assignment dataset: Descriptions and analysis. USPTO Economic Working Paper No. 2015-2, Available at SSRN: https://ssrn.com/abstract=2636461.
5. Serrano, C.J., 2010. The dynamics of the transfer and renewal of patents. *The RAND Journal of Economics*, *41*(4), pp.686-708.
6. Teece, D., 1986. Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy. *Research Policy*, *15*(6), pp.285-305.

PosterPosters.com