

Transfers of patent ownership in Japan: first look at their incidence and economic roles

Sadao NAGAOKA

Tokyo Keizai University, RIETI(Research Institute of
Economy, Trade and Industry), and an economic advisor to
the JPO*

Yoichiro NISHIMURA

Kanagawa University

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1. Backgrounds

- A transfer of an intellectual property right between organizations is a very important mechanism for both
 - promoting its commercialization and
 - strengthening the incentives for the creation of intellectual property
- It will promote the commercialization of an invention by realizing not only
 - a better match between the invention and the complementary asset
 - but also
 - a more efficient ownership structure (e.g. consolidation in case of too many owners).

Research questions

- How important are the transfers in Japan.
→we assess the incidence of the transfer of rights comprehensively: covering three types of transfers as well as transfers over the life cycle of patents.
- What types of patents are transferred, do the transfers result in more effective use of the patents and perhaps in more follow-on inventions ?

Three types of transactions

- “Specific succession” (“Tokutei Shoukei”) : transfer of IP rights unbundled with the other business assets
- “General succession” (“Ippan Shoukei”):transfer of IP rights bundled with the other business assets, accompanying an organizational change such as M&A
 - our investigation comparing the data on M&A transactions and the reports of the transfers to the JPO show that the reporting is fairly comprehensive for large Japanese firms.
- Transfer of the right to receive the patent before its registration for the purpose of consolidating the ownership

Prior literature

- Two recent studies on the patent transfers in the US and Europe
 - Marco, Graham, Myers, Agostino, and Apple (2015)
 - Ciaramella, Martinez, and Ménière (2015)
- According to the PATVAL surveys
 - 9.5% of the patents invented by the US inventors vs. 3.1% of those by the Japanese inventors and 3.8% of those by the German inventors were subject to transfers (Nagaoka, Tsukada, Onishi, Nishimura (2012))

Prior literature(2)

- Serrano (2010) on the characteristics of the transferred patents (quality, age) as well as the association between transfer and renewal.
- Galasso, Schankerman and Serrano (2013) on the effects of transfer on litigations
transfer for efficient enforcement

Figure. Number of transferred patents by specific transfers and transfer as a part of M&A

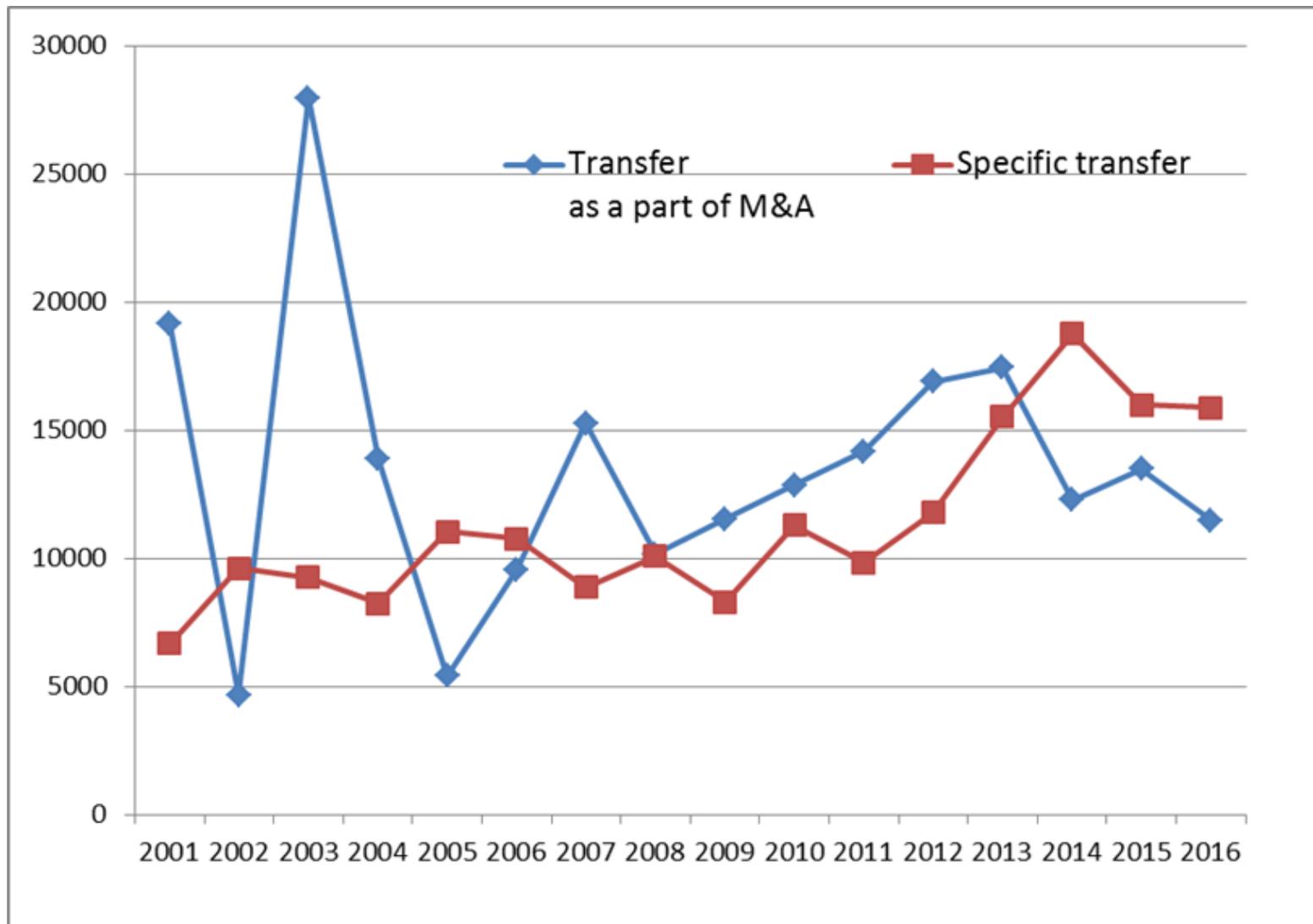
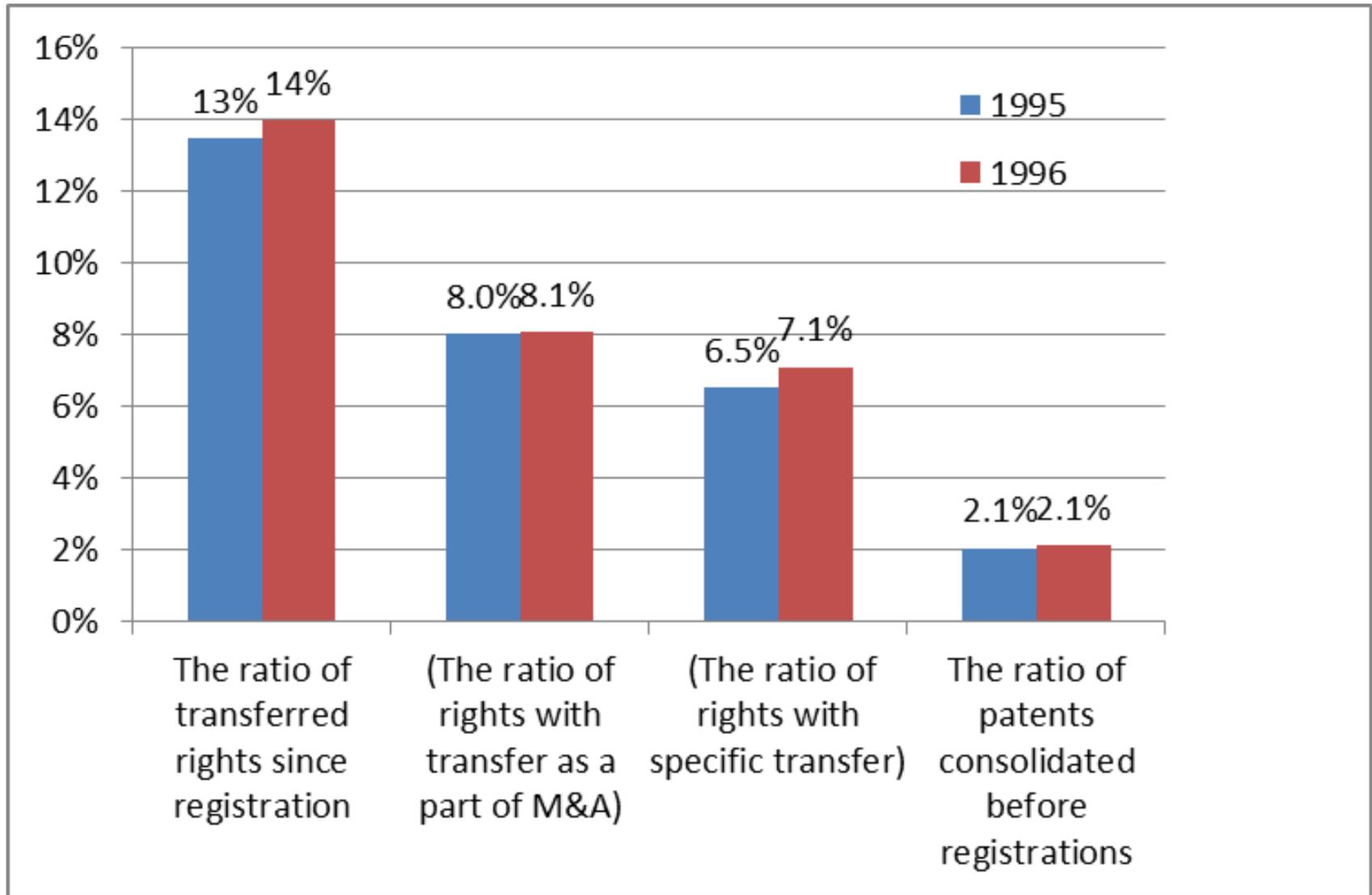


Figure. Shares of transferred patents over their life-cycle



Note. Only the transfer since 2001 are publicly available.

2. What types of patents are transferred -invention quality, complementary asset and ownership structure-

- Gains from transfer
 - a better match between the patent and the complementary asset in the case of specific transfer
 - a gain from concentrated ownership structure (if exists) in the case of a transfer for ownership consolidation
- The transfer will take place only if such gain is large enough to pay the cost of transfer, while invention quality enhances such gain.
 - Higher quality invention is more likely to be transferred.
- In the case of a specific transfer to a new owner, the threshold for the quality is higher when the current owner has a good appropriation capability.

Transfer as a part of M&A

- In the case of M&A, the M&A decision is made for the entire bundle of the IPR and complementary assets. Thus, we assume that the decision follows the following two stage:
 - (1) Determination of the target for M&A : The acquisitions may target underperforming firms with low quality invention stocks on the average.
 - (2) Determination of an individual patent for a transfer: The merging or acquiring firm will select a patent for a transfer to itself. The opportunity cost of not doing so is low, since the acquired or merged firm will disappear.
- Thus, there is likely to be a negative sample selection. Furthermore, the entire size of the complementary asset rather than the extent of its expansion is the determinant for the transfer. → Low quality patents can be more likely to be transferred as a part of M&A.

Ownership structure also matters for transfer

- Joint ownership reduces the reward for non-contractible effort for exploiting the patent , including the effort for finding a new owner of the patent
 - The transfer probability decreases with the number of owners, controlling for a number of applicants (which may affect the invention quality too).

Simple model for one-time transfer decision

- θ invention quality, G, F and H complementary assets, T^* the effective remaining patent life
- Transfer to a new owner: $\{(G - c_R)T^*(G, \theta) - (F - c_R)T^*(F, \theta)\}\theta \geq c_S$ (3)
- Consolidation: $\{(F_{single} - c_R)T^*(F_{single}, \theta) - (F_{joint} - c_R)T^*(F_{joint}, \theta)\}\theta \geq c_S$ (4)
- Transfer as a part of M&A: $(H - c_R)T^*(H, \theta)\theta \geq c_{M\&A}$ (5)

Estimation Model for transfer probability

- Linear probability model
 - Invention quality : the numbers of the first three year forward citations (examiners), claims and inventors
 - Ownership structure (the numbers of initial applicants and the owners at the registration)
- $$\text{Probability}(\text{patent } i \text{ is transferred}) = \alpha_0 + \beta_1(\text{forward citations}_i) + \beta_2(\text{claims}_i) + \beta_3(\text{inventors}_i) + \beta_4(\text{applicants}_i) + \beta_5(\text{owners}_i) + (\text{backward citations, age and other controls}_i) + \epsilon_i \quad (1)$$

the probability of the transfer

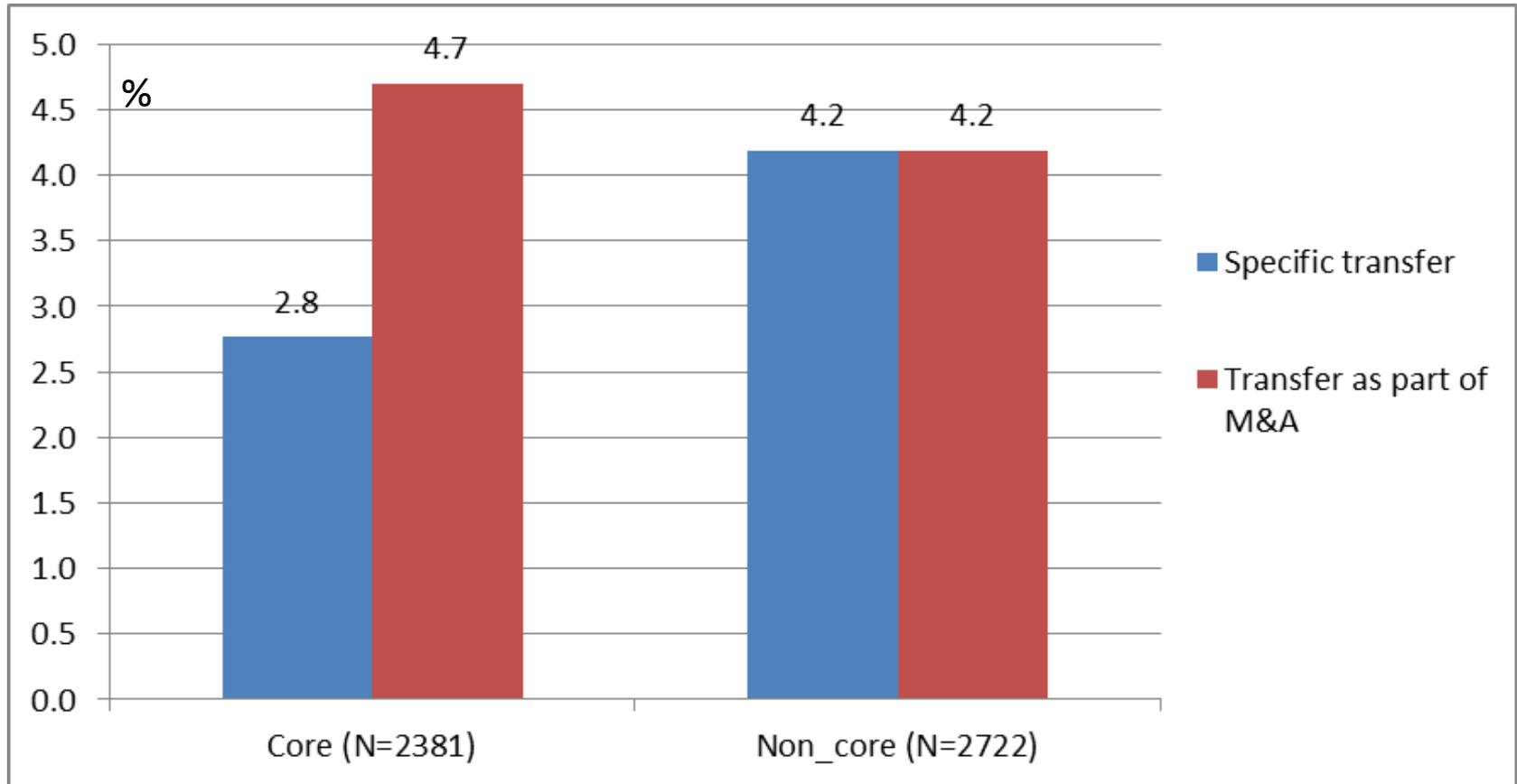
VARIABLES	(1) Specific transfer	(2) Ownership consolidation before registration	(3) Transfer as a part of M&A
ln(the number of forward citations within three years from application date (examiners)+1)	0.00420*** (11.58)		-0.00160*** (-4.14)
the number of claims at the time of registration	0.00046*** (14.60)		-0.00013*** (-3.74)
the number of claims at the time of application		0.00002** (2.13)	
the number of inventors	0.00035*** (2.98)	0.00029*** (4.76)	0.00190*** (15.29)
the number of applicants	0.18209*** (211.82)	0.14654*** (605.62)	0.07284*** (67.25)
the number of right holders at the time of registration	-0.10454*** (-113.47)		-0.01564*** (-13.87)
ln(the number of backward citations (examiners)+1)	-0.00423*** (-11.07)	0.00042** (2.15)	-0.00376*** (-9.28)
Foreign Priority	0.04107*** (67.21)	-0.00517*** (-16.66)	-0.04254*** (-63.51)
Constant	-0.15581 (-0.94)	-0.14521*** (-50.37)	-0.07687 (-0.43)
Observations	1,676,360	1,786,179	1,691,252
Adjusted R-squared	0.058	0.187	0.046

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

application year dummy variables, age dummy variables and technology field dummy variables are included in this estimation.

the probability of a transfer by complementary asset of the firm(based on the inventor survey)



the transfer probability for the inventor survey sample

	Dependent variable: transfer probability	
	Specific transfer	Transfer as a part of M&A
core	-0.0144*** (0.00545)	0.00673 (0.00608)
ln1cited_examiner	0.00721** (0.00328)	0.00140 (0.00349)
Computers & Communications	-0.00917 (0.00995)	0.00599 (0.00984)
Drugs & Medicals	-0.0191* (0.0108)	0.0238* (0.0136)
Electrical & Electronic	-0.00974 (0.00892)	0.0204** (0.00934)
Mechanical	-0.0167** (0.00852)	0.00110 (0.00869)
Others	-0.000243 (0.0104)	-0.00236 (0.00962)
Observations	4,871	4,914
R-squared	0.004	0.004
Adjusted R-squared	0.00156	0.00153
RMSE	0.189	0.208
Log Likelihood	1223	750.9
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.10		
application year dummies are also included		

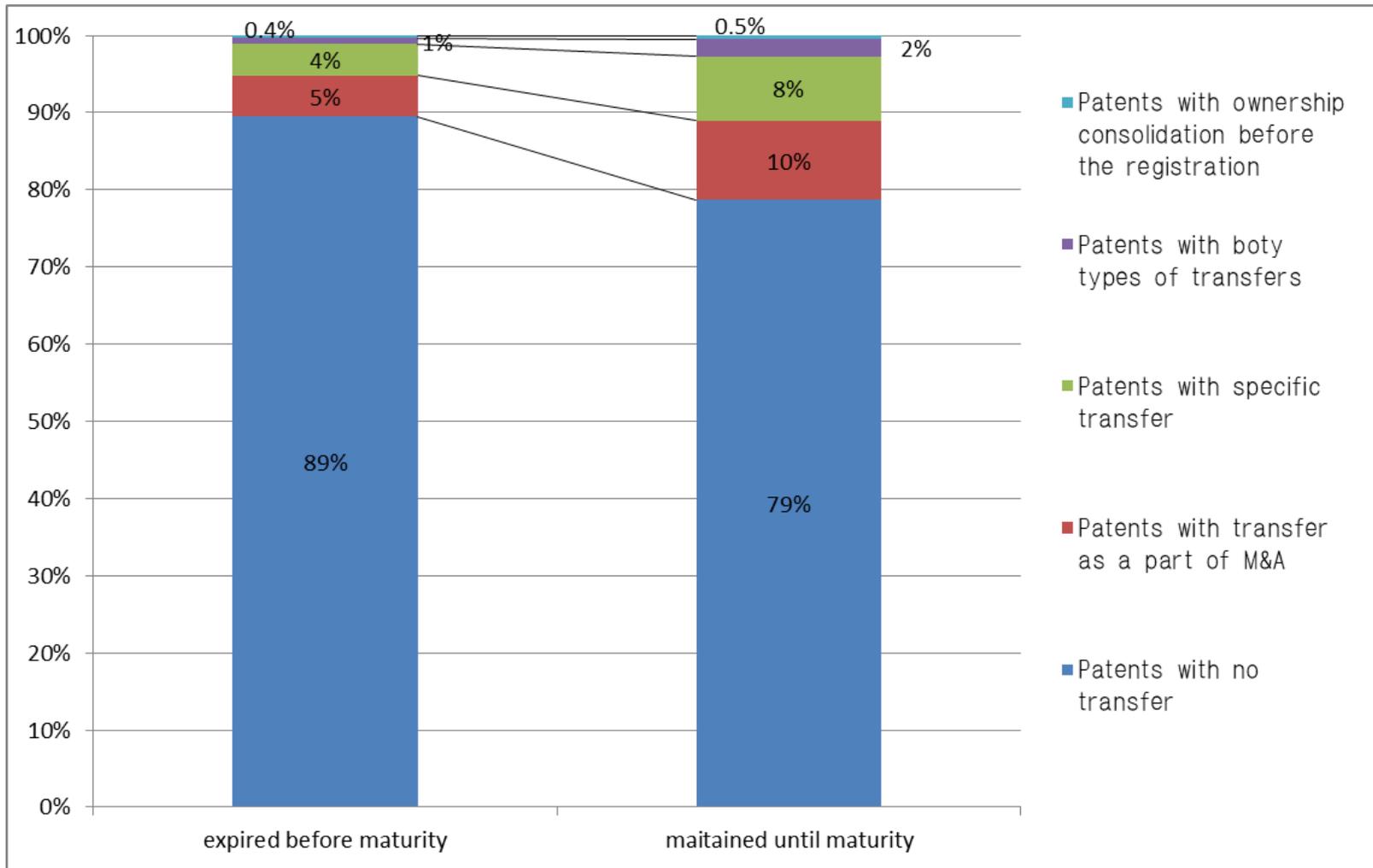
Major findings

- An invention with higher quality is more likely to be transferred to a new owner and to experience a before-the-registration transfer for consolidation, while the reverse is the case for the transfer as a part of M&A.
- A before-the-registration consolidation also facilitates specific transfer as well as a transfer as a part of M&A.
- The quality threshold for a specific transfer is higher for a patent with more complementary asset.

3. Transfer and renewal

- Three effects are at work for more renewal
 - Better match between the patent and complementary assets
 - Ownership consolidation due to before-the-registration transfer, but also
 - Positive selection for a transfer in terms of invention quality (expect of that through M&A)

Figure 2. Patents maintained until maturity vs those not maintained until maturity right by transfer status (patents filed from 1991 to 1993 and registered)



Linear probability model (survival) and OLS (survival days)

- Probability(patent_i is maintained) = $\alpha_0 + \beta_1(\text{specific transfer}_i) + \beta_2(\text{transfer in M\&A}_i) + \beta_3(\text{both}_i) + \beta_4(\text{Owners}_{registrations,i}) + (\text{patent quality and other controls } i) + \epsilon_i$
 - controls include technology class and application years
- Limitation: incomplete control for the patent quality tends to increase the effect of transfer

Table 3. Estimation results for survival and the survival duration

VARIABLES	(1) Maintained until maturity	(2) Maintained until March 06, 2014	(3) (1)+(2)	(4) Survival duration (days)
ln(the number of forward citations within three years from application	0.058*** (32.962)	0.049*** (77.739)	0.050*** (83.893)	132.729*** (106.318)
Number of claims at the time of registration	0.004*** (21.813)	0.001*** (22.436)	0.001*** (27.145)	1.708*** (18.325)
Number of inventors	0.007*** (14.030)	0.008*** (35.769)	0.007*** (38.034)	23.499*** (56.644)
Number of applicants	0.014*** (3.010)	0.007*** (4.331)	0.008*** (5.245)	28.092*** (9.417)
Number of right holders at the time of registration	0.005 (0.975)	-0.010*** (-5.944)	-0.007*** (-4.612)	-55.509*** (-16.546)
Patent rights with transfer as a part of M&A	0.127*** (35.614)	0.118*** (84.603)	0.119*** (91.203)	293.180*** (106.570)
Patent rights with specific transfer	0.140*** (32.873)	0.116*** (78.551)	0.119*** (84.482)	274.190*** (94.858)
Patent rights with both transfers	0.213*** (23.097)	0.191*** (57.389)	0.195*** (60.778)	478.964*** (80.824)
ln(Number of backward citations (examiners)+1)	0.022*** (13.113)	0.037*** (53.205)	0.035*** (54.422)	96.037*** (68.071)
Constant	0.073*** (21.388)	0.845*** (519.276)	0.090*** (51.026)	5,622.839*** (1,082.392)
Sample period				
Observations	272,526	1,507,748	1,780,274	1,780,274
Adjusted R-squared	0.037	0.196	0.288	0.503

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Technology, application year dummy variables are included in the estimation but not shown in the table

Findings

- Controlling for patent quality by the bibliographic variables
 - Transfers are significantly associated with more renewals (almost a year longer patent life): The probability of the full term patent protection is 14.1% higher for a patent with specific transfer and 12.8% higher for a patent with transfer as a part of M&A.
 - Ownership consolidation before the registration is also significantly associated with more renewals (around 50 days longer duration per a reduction of one owner. Note that the number of applicants itself has a positive coefficient).

4. Transfer and follow-on inventions

- Transfers enhance the use of the transferred patents.
- More follow-on inventions through the “demonstration effect” from the implementation of the new owner?

Or

- Less follow-on inventions through the “competition effect” from the investments by the new owner (strategic substitutes)?

DID Estimation Model

- Differences in differences (DID) estimator exploiting the examiner citation panel data (for 1991 to 2005)
 - Dependent variable $C_{i,t,a}$ is the number of citations received by patent i from the patents applied in year t in age a (the logarithmic formulation was also used).
 - the changes in the number of citations received by the patents accompanying the transfer (Treatment Group) vs. those for the non-transferred patents (Control Group), with controls over cohort effects, citing year effects and age effects + patent fixed effects

$$\begin{aligned}
 C_{i,t,a} = & \alpha_T^{transfer} \cdot D_{i,T}^{transfer} + \sum_{y \in \text{Application years}} \alpha_y \cdot D_y + 4\text{th order polynomials of } (t - 1991) \\
 & + \sum_{a \in \text{age}(=t-y)} \alpha_a \cdot D_a \\
 & + \sum_{c \in \text{Technology Fileds}} \alpha_c \cdot D_c + \alpha_Y^{Expiration} \cdot D_{i,Y}^{Expiration} + \alpha_0 + \alpha_i + \varepsilon_{i,t}
 \end{aligned}$$

Findings

- Both types of ownership transfers are associated with the reduction of the citation flows, while the expiration of the focal patent is associated with its increase.
- The results suggest that the competitive effect of transfer seems to be more important than its demonstration effect.

Table 4. Impact of transfers on forward citations flow

Dependent Variable : Count of forward citations	Fixed Effect Estimation		Pooled Estimation	
	(1)	(2)	(3)	(4)
VARIABLES	Patent rights with any type of transfers	Patent rights with transfer as a part of M&A or with specific transfer	Patent rights with any type of transfers	Patent rights with transfer as a part of M&A or with specific transfer
Transfer step function dummy	-0.01090*** (-18.72)		-0.02709*** (-47.52)	
Transfer fixed-effect dummy			0.01897*** (50.98)	
Specific transfer step function dummy		-0.01992*** (-24.04)		-0.03665*** (-45.41)
Specific transfer fixed-effect dummy				0.03073*** (59.31)
Transfer as a part of M&A step function dummy		-0.00302*** (-3.89)		-0.01874*** (-24.43)
Transfer as a part of M&A fixed-effect dummy				0.00801*** (15.99)
Expiration year dummy	0.05305*** (138.58)	0.05302*** (138.50)	-0.03139*** (-94.52)	-0.03138*** (-94.49)
Observations	38,199,349	38,199,349	38,199,349	38,199,349
Adjusted R-squared	-0.017	-0.017	0.056	0.056
Application Year Dummy	NO	NO	YES	YES
Citing Year Dummy	YES	YES	YES	YES
Technology Sector Dummy	NO	NO	YES	YES
Patent Fixed Effect	YES	YES	NO	NO
Number of patents	2,748,949	2,748,949		

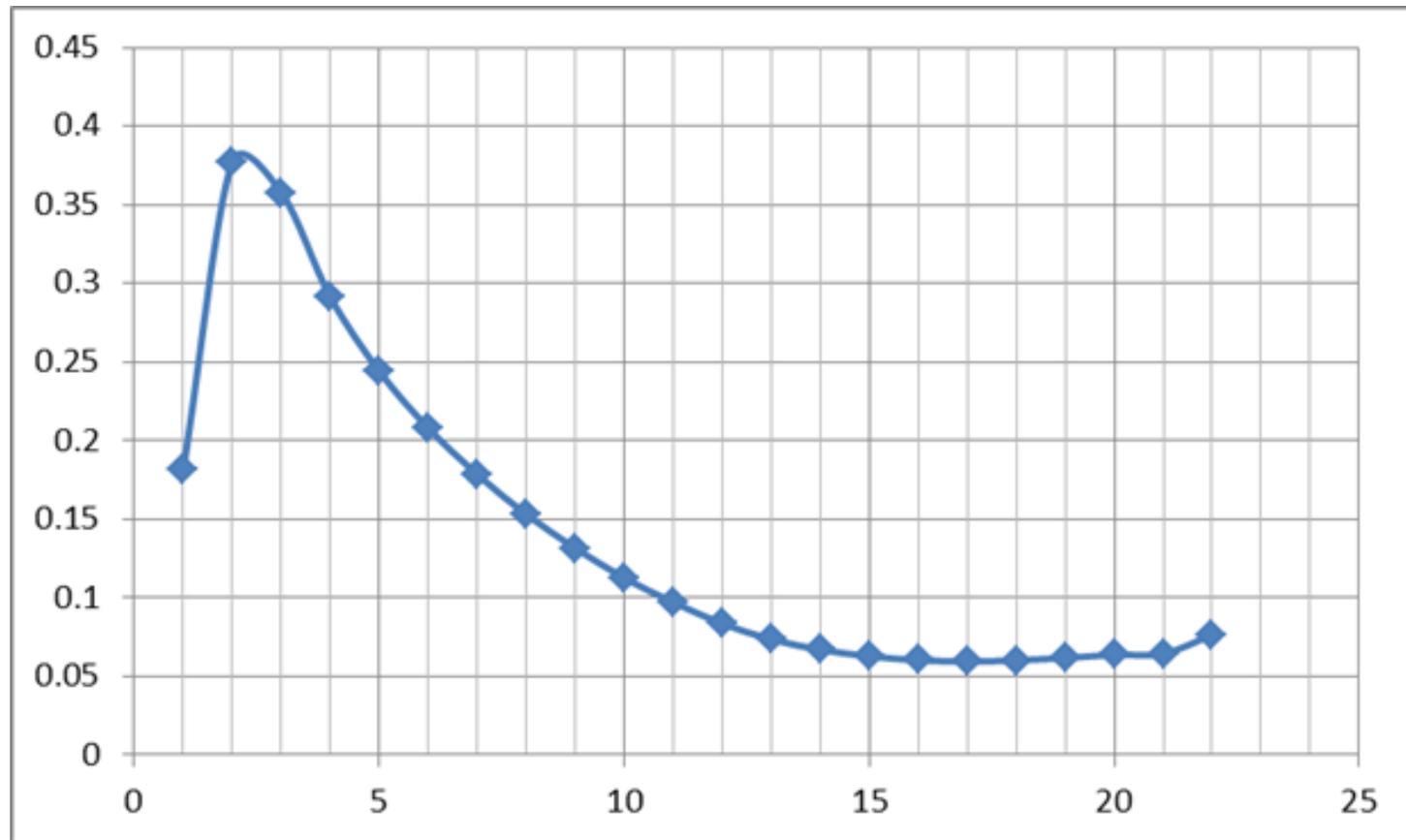
t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

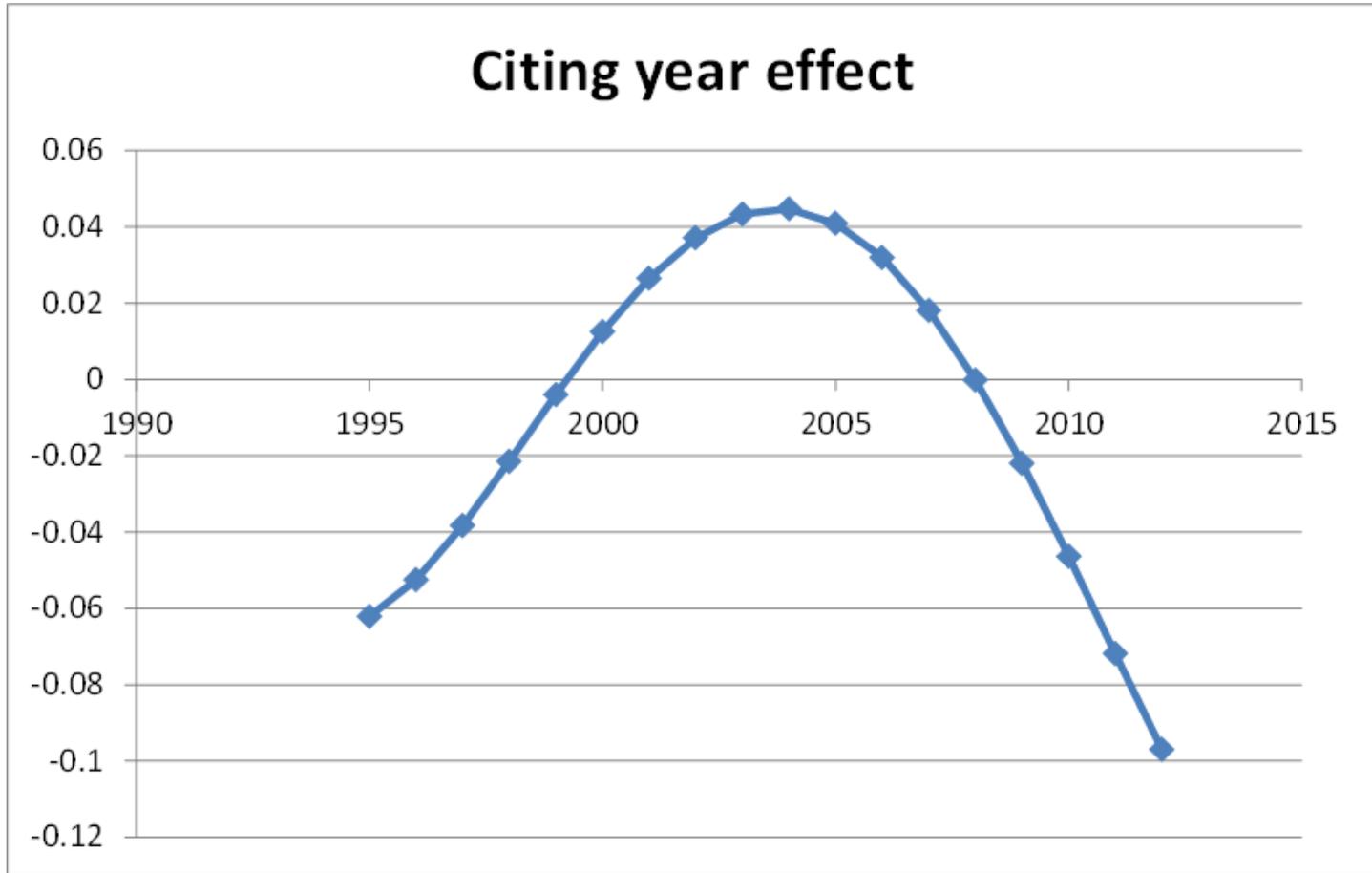
Age effect (age dummies) as well as citing year effect (the 4th order polynomials) introduced

Figure 3 Dynamics of the citations received (according to Model (1))

(A) Age effect



(B) Citing year effect



Conclusions

- Three types of transfers are significant in the life cycle of patents.

Around 14 % of the granted patents which were applied in the latter half of 1990s were transferred during their life time: 7 % through specific transfers, 8% through transfers as part of organizational change such as M&A and 2% through before-the-registration transfer.

- Higher quality invention is associated with more transfer (except for that as a part of M&A).
- Transfer is associated with a longer patent life through three effects: better match between the patent and complementary assets, ownership consolidation due to before-the-registration transfer, and positive selection for a transfer in terms of invention quality .

Conclusions (continued)

- On the other hand, we do not find evidence that the ownership transfer promotes follow-on inventions: the competitive effect of transfer seems to be more important than its demonstration effect.
- Ownership transfer helps improving innovation performance by promoting the effective use of a patented technology which is of relatively high quality.