Does Upfront Payment Reduce Running Royalty Rate?

Theoretical Perspectives And Empirical Analysis

By Jiaqing "Jack" Lu

1. Running Royalty Rate and Upfront Payment: Theory and Reality

This study continues the empirical approach of royalty rate study as set in a series of papers I authored or coauthored in recent years.[1] In these previous studies, the research efforts were concentrated on the fundamental story of royalty rate determination, investigating the economic role played by major factors such as profitability, industry performance, and market structure.

The focus of this paper is shifted to the structural side of licensing transaction and royalty payment, and devoted to one of the important structural issues, i.e., the interaction between upfront payment and running royalty rate. While the combination of upfront payment and running rate is one of the frequently-adopted payment methods, there is little research on the interaction between the two.

Theoretically, if the market is efficient, a licensor should be neutral to the payment methods such as a lump sum payment, a mixture of upfront payment and running royalty rate, or running rate only. In other words, if the market impounds all information, the prices determined by various payment methods shall converge with a licensor's share in the economic value of a technology, that is,

Licensor's share in technology value

- Lump sum payment
- Present value of payment stream from running royalty rate only
- Present value of payment stream from a lower running rate plus upfront payment

Simply put, the method of payment does not really matter. Borrowing the analogical interpretation of Modigliani-Miller Theorem, the size of the pie; in this case, a licensor's share in technology value; has nothing to do with how it is sliced. In this ideal world, a running rate is the future royalty payment expressed as percentage of sales, where future royalty payment is calculated by amortizing the lump sum payment over the license term. By contrast, lump sum payment is the present value of the entire stream of the periodic payments in the future.

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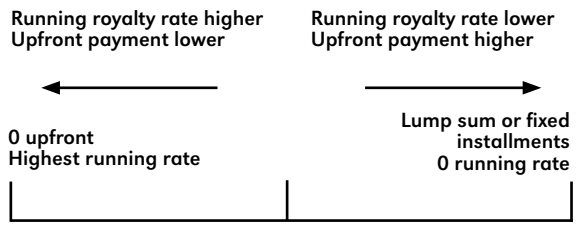
By the same token, an upfront payment is supposed to extract part of the downstream royalties generated from a running rate, and capture their prevent value as an advance. As a result, the presence of upfront payment would leave less amount of the license value in downstream payments, and hence lower running royalty rate; vice versa. In other words, if the parties have the same perfect information about the technology and transaction cost is omissible, *ceteris paribus*, running royalty rate is negatively associated with upfront payment. This hypothesis can be better illustrated by Chart 1.

Chart 1. Hypothetical Spectrum with Running Royalty Rate and Upfront Payment



However, the market is imperfect and may not be efficient. This is especially true for the licensing market where institution and system are severely underdeveloped compared to financial markets. First and foremost, incomplete information and uncertainty cloud the process, and shape the outcome, of all license negotiations. The search for licensee candidates may

1. Kemmerer, J. and J. Lu, "Profitability and Royalty Rates Across Industries: Some Preliminary Evidence," *Journal of the Academy of Business and Economics*, March, 2008, and presented at the Annual Conference of the International Academy of Business and Economics, Las Vegas, 2008; Becker, S. and Lu. J., 2009, "Royalty Rate and Industry Structure: Some Cross–industry Evidence," presented at the Annual Conference of the International Academy of Business and Economics, Las Vegas, 2009; Lu, J., 2010, "The 25% Rule Still Rules: New Evidences from Pro Forma Analysis," forthcoming in the *Licensing Economics Review*, 2010.

not be exhaustive; royalty determination may not be able to impound all available information; therefore, the concluded royalty may fail to reflect the true value of a license. Therefore, running royalty payment may not be equivalent to the amortized future value of a licensor's share in technology value. Instead, the method, in licensing practice, becomes a mechanism for the parties to mitigate the uncertainty and share the upside and downside risks.

Second, technology licensing is similar to corporate transactions such as capital raising or merger and acquisition, where information asymmetry exists and always exerts its impact. For example, if a licensor believes that a technology may not be as superior as she presents to a licensee; or if a licensee believes that a technology is much more profitable than a licensor had expected, a lump sum payment or a significantly large upfront payment may be preferred by the party with such a belief. In this occasion, the pricing may dramatically differ from the intrinsic value. Furthermore, large amount of initial payment could divert precious capital away from developing and implementing the technology, which, in turn, could delay or otherwise jeopardize the commercialization of the licensed technology. When this happens, the way to slice the pie actually changes the size of the pie.

Finally, the transaction cost can be a dominant factor in royalty determination and in choosing payment methods. From pre-engagement to negotiation, searching and scrutinizing for licensee candidates, advertising, expert consulting, and legal service all cost substantially. The capacity to afford such expenses certainly affects the outcome of negotiation and the selection of a payment method. For example, if a licensor is a small business or an individual, she may not be able to afford hiring auditors to monitor the sales revenue of a licensee. Therefore she may be willing to accept a drastic discount, and take a lump sum payment or an upfront payment that is significantly lower than fair market value.[2]

As a result, when market is not efficient and transaction cost not omissible, the prices as implied by various payment methods may differ, and may dramatically deviate from the intrinsic value of a license. Consequentially, the equation system above may not hold, and the parties in a license negotiation may not be neutral to payment methods. All of these render Chart 1 much less warranted.

With both theory and reality in mind, an interesting question is, will the inverse relationship between upfront payment and running royalty rate still hold in the presence of market imperfection? Or does upfront payment tend to reduce running royalty rate in licensing practice? The rest of this paper is set to answer such questions.

2. Research Design and Data Issues

The research topic of this paper was initially inspired by an interesting study in franchise contracting that investigated the relationship between royalty payment and upfront fixed fees.[3] Empirical research in the interaction of upfront payment and running royalty rate in technology licensing barely exists. A scholar from Japan published one of the few studies with substantial discussion on this issue.[4] Using the license transaction data from Japan's technology import contracts, the study tested several hypotheses on how the incidences of high royalty rate were determined, including the one on the substitutability between upfront payment and running royalty rate.

The findings from the regression analysis on the substitutability are basically inconclusive, according to this study. While the estimations from some specifications seemed to validate the hypothesis of substitutability, the results from others either indicated that the substitutability is statistically insignificant, or even pointed to a reinforceability, meaning that initial payment actually increases the odds of high royalty rate. Overall, dropping initial payment actually did not significantly affect the estimation of coefficients for all other variables in the regressions.

The inconclusiveness over the substitutability be-

2. Actually, transaction cost could be part of, or even the entire amount of, the upfront payment, as pointed out by Goldscheider. In other words, upfront payment could include the reimbursement of the expenses incurred during the process of engagement, negotiation, and execution. As a well-respected and experienced expert in this field, Mr. Goldschneider recommended that the initial payment "should, as a minimum, cover licensor's expenses leading up to the execution of the license agreement. It should be sufficiently large to provide an incentive to the licensee to work diligently so as to recover that sum with the least reasonable delay." See Goldscheider, R., 2009, "Licensing and the Art of Technology Management," Thomson Reuters/West, 11/2009.

3. Lafontaine, F. and Shaw, K., "The Dynamics of Franchise Contracting: Evidence from Panel Data," Journal of Political Economy, 1999, vol. 107, no.5. Using a panel data from 1,000 franchisors each year from 1980 to 1992, they studied the dynamics of franchise contracting. Most models of franchise contracting prior to this study imply that the franchise fee is inversely related to the royalty rate. However, based on the data, they found no negative relationship between royalty rates and the type of upfront fixed fees. They concluded that most likely, the franchise fee is not set to extract down-stream rents, but to cover costs of setting up franchises.

4. Nagaoka, S., "Determinants of high-royalty contracts and the impact of strong protection of intellectual property rights in Japan," Discussion Paper Series No. 60, Institute of Economic Research, Hitotsubashi University, December 2004.

tween upfront payment and royalty rate in this study specifically, and the lack of empirical study on the topic in general, are due mainly to the availability and quality of royalty data. In practice, terms especially the financial terms in license agreements are usually not disclosed. However, data availability has been improved gradually in recent years, and several data vendors including RoyaltySource, RoyaltyStat and ktMINE are offering data services.

Despite a choice of data sources, designing an empirical study can be very challenging for at least two data-related reasons. First, royalty pricing is an outcome of a usually sticky and prolonged negotiation; and each licensing agreement is essentially unique based on the following three categories of varieties and complications:

1) Licensor-licensee relationship. Technology licensing can happen in many different contexts, including product sales, product distribution, technology transfer, co-development, joint venture, and an outright technology sale, among many others, as detailed by Goldscheider;[5]

2) Major terms and provisions, such as exclusivity, duration, geographic restriction, volume limit, sublicensing, and grant-back, just to name a few;

3) Payment structure. Payment methods and forms can vary widely, including in-kind (as in cross-license), debt or equity instruments, lump sum, fixed periodic installments, running royalty rate, and payments contingent on milestones, among many others. Furthermore, each of the methods and forms can have further variants. For example, running rate can be fixed or variable; in percentage of sales or profit measures; in dollar amount per unit; or in cost-saving measures, depending on technology characteristics, industry normal, and the negotiation powers of the parties.

Obviously, controlling such a wide variety of factors and their even wilder combinations becomes a daunting challenge for econometric analysis.

Second, as pointed out by several previous studies, there are significant differences across industries.[6] While most industry characteristics can be controlled in regression analysis by introducing dummy variables, econometric analysis using cross-industry panel data faces certain practical challenges. For example, unlike the patent count data used by Professor Bronwyn Hall and her coauthors,[7] sufficiently large sample of royalty rate data for each of several industries is expensive to acquire, and even impossible to acquire due to the volume caps set by vendors. Also, some industries may have very limited data in running royalty rate due to the fact that transactions were usually conducted through cross-licensing, lump sum payment and other payment methods, adding further difficulty to cross-industry analysis.

In light of the challenges and difficulties in data collection and analysis, this study decided to use a sample of royalty rate data from medical device industry. The selection of medical device industry is not random. Three major criteria were used for industry screening. First, the industry has to produce relatively homogenous products; second, there should be significant number of samples left after controlling most of the varieties mentioned above; and third, each of the transactions left in the final sample shall have a pricing component in fixed running royalty rate expressed as the percentage of sales.

Medical device industry seems to meet the criteria above. Actually, the sample used in this study includes mainly vanilla or "pure" license transactions, not those embedded in certain "Master Agreements" designated for other corporate transactions such as joint venture, co-development, co-marketing, technology sale, and distribution etc.

The sample also includes only exclusive license transactions with a pricing element of fixed running royalty rate in percentage of sales. As of the first quarter of 2001, RoyaltySource database included 208 transactions from medical device industry that had such sales-based running royalty rate. The sample used in this study consists of 81 exclusive transactions, accounting for 39 percent of the population. The only reason to focus on exclusive transaction is the concern over the data quality. A substantial number of observations in royalty data as provided by the vendors, specifically by RoyaltySource, were retrieved from public sources without the access to actual license agreements. Public sources in some cases may not explicitly report the exclusivity of a transaction. Evidently, simply assum-

5. Goldscheider, R., 2009, "Licensing and the Art of Technology Management," Thomson Reuters/West, 11/2009.

6. Anand, B., and Khanna, T., "The Structure of Licensing Contracts," The Journal of Industrial Economics, Vol. XLVIII, No.1, March 2000; Benoit, B. et al., "Reasonable Royalties: Deal Structure and Risk Transfer," The Licensing Journal, November/December 2000, 7-14; Bessen, J. and Maskin, E., "Sequential Innovation, Patents, and Imitation," Working Paper, Department of Economics, No. 00-01, Massachusetts Institute of Technology, Boston, January 2000; Kim, Y., and Vonortas, N., "Determinants of Technology Licensing: The Case of Licensors," Managerial and Decision Economics, 27, 2006, 235-249; and my previous studies as cited in Footnote 1 of this paper.

7. For example, Hall, B. et al, 2005. "Market Value and Patent Citations." University of California Postprints, Year 2005, Paper 2454. For many other related papers published by Professor Hall and her coauthors and for detailed description of the NBER patent database, please visit Professor Hall's website at *http://elsa.berkeley.edu/~bhhall/.*

Table 1. Descriptive Statistics of Royalty Rates by Major Features of the Licensing Transactions

	Entire Sample	Upfront Payment		Academe as Licensor		Individual as Licensor		Payment in Equity and Funding Etc.		Strategic or Operational Relationship		Minimum Royalty Provision	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Sample Size Statistics	81	58	23	69	12	65	16	69	12	67	14	60	21
Average	5.34%	5.83%	4.10%	5.50%	4.44%	5.70%	3.88%	5.42%	4.88%	5.18%	6.11%	5.29%	5.47%
Median	5.00%	5.00%	5.00%	5.00%	4.00%	5.00%	3.75%	5.00%	4.50%	5.00%	5.50%	5.00%	5.00%
Maximum	20.00%	20.00%	10.00%	20.00%	10.00%	20.00%	8.00%	20.00%	10.00%	20.00%	12.00%	20.00%	12.00%
Minimum	0.10%	0.90%	0.10%	0.10%	2.50%	0.25%	0.10%	0.10%	2.00%	0.10%	2.00%	0.10%	0.90%

ing that all transactions are nonexclusive unless being explicitly mentioned otherwise will seriously distort the data and bias the analysis.

3. Data Analysis and Major Findings

The descriptive statistics of the data is summarized in Table 1. Of the total of 81 transactions, the average running royalty rate is 5.3 percent, and the median rate 5 percent. The rates vary widely, from the minimum of 0.1 percent to the maximum of 20 percent. As the table shows, 23 transactions have a component of cash upfront payments, and the average rate for such transactions is 4.1 percent. In contrast, 58 transactions do not involve upfront payments, and their average rate is 5.83 percent, 1.7 percentage points higher than the average rate of the transactions with upfront payments. Interestingly, the median rates coincide for both groups, while the maximum and minimum rates for the transactions with upfront payments are lower than those without upfront payments.

Although most of the varieties in provisions and terms discussed above are controlled through the data selection, the observations in the sample still have several significant features that need to be incorporated into the analysis. These features and the associated descriptive statistics are also reported in Table 1.

1) Academic institutions as licensors. Among the transactions studied, the licensors in 12 transactions are universities or government research institutions. The statistics shows that the average rate, median rate and maximum rate of such transactions are all lower than those of other transactions. Interestingly, however, the transactions with academic licensors enjoyed a significantly higher minimum rate of 2.5 percent, compared to 0.1 percent of the others.

2) Individual as licensors. 16 transactions have individuals as licensors. While some of the individuals are related parties such as company executives or major shareholders, most of them are individual inventors or patent owners. As shown in the table, the rates of this group are significantly lower than those of the other group by all of the four statistics. For example, the average rate for the group with individual licensors is 3.9 percent, while the average rate of other transactions is 5.7 percent.

3) Other compensations than upfront payments and running royalty rate. These additional payments include mainly financial instruments such as stocks, promissory notes, debt financing, and operation fees such as maintenance fees, testing fees, etc. 12 out of 81 transactions involve such compensations, and most of the rates for this group, except for the minimum rate, are lower than those of its counterpart.

4) Strategic or operational relationship. As mentioned above, the sample of transactions does not include any licensing agreements embedded in certain "Master Agreements" designated for other corporate transactions such as co-development and distribution. However, it does have the transactions with two types of strategic or operational relationship: i) Pre-existing relationships such as corporate ownership and research sponsorship; and ii) The relationships established by a licensing agreement, such as technical assistance, lessor-lessee, and manufacturing agreement etc. As shown in Table 1, most of the rates for such transactions are higher than those of the others, except for the maximum rate.

5) Minimum royalty payment. 21 transactions in the sample have minimum royalty requirements. Comparing this group of transactions with the others, the average and median rates are very close, but the maximum and minimum rates are quite different.

Table 2 presents the descriptive statistics for the upfront payments and the associated royalty rates. Among the 23 transactions with upfront payments, the amounts vary wildly from $5,000 to $5,000,000, with the average of about $600,000 and the median of $200,000. While the transaction with the maximum upfront payment has a royalty rate of 2 percent, the one with minimum upfront payment has an even lower rate, coinciding with the lowest royalty rate in the sample.

The second panel in Table 2 shows the upfront payments by bracket and the associated average royalty rates. Two important observations can be made. First,

Table 2. Descriptive Statistics of Licensing Transactions with Upfront Payments

1. Basic Statistics of Upfront Payments and the Associated Royalty Rates

	Upfront Payment	Royalty Rate
Maximum	$5,000,000	2.00%
Minimum	$5,000	0.10%
Average	$593,793	
Median	$200,000	

2. Upfront Payments by Bracket and the Associated Average Royalty Rates

	Count	Average Royalty Rate
Below $100K	7	3.80%
100K to 499K	10	4.03%
500K to 999K	3	5.83%
$1 million & above	3	3.33%
All	23	4.10%

the majority of the upfront payments in the sample are below $500,000, with only 6 transactions having upfront payments equal or higher than this amount. Second, it seems that the relationship between the amount of upfront payment and running royalty rate is not linear. As demonstrated in the table, the average royalty rate increases with the amount of upfront payment before upfront payment hits the $1 million mark, and declines afterwards.

The rest of this section is devoted to estimating the effects of upfront payment on royalty rate, controlling the influences from other features discussed above. The econometric model used for the study is a linear regression model, in which the dependent variable is royalty rate, and the independent variables include upfront payment, as dummy variable or in dollar amount, plus several dummy variables for each of the other features. Five different specifications were used for estimation, and the results are summarized in Table 3.

First of all, it is not surprising that R^2 is quite low across all of the specifications. As discussed in my previous studies,[8] the reported royalty rate was determined by a wide range of fundamental considerations such as profitability and market power; as well as by the context of the negotiation and the position of the parties, including numerous factors from technology innovativeness, to corporate financial situation, to the business cycles of the industry and economy. While the terms and payment structures do play a role in royalty determination, their roles are not supposed to be dominant.

The low R^2 could also be due to the nonlinearity between royalty rate on the left hand side of the model, and upfront payment and other features on the right hand side. Table 2 already indicates that the relationship between royalty rate and running royalty rate may not be linear. Obviously, market imperfection and distortion contribute to the nonlinearity, as discussed earlier in this paper. However, even if market is efficient, the nonlinearity may still exist. For example, the interaction among upfront payment and each of the other features could make their impacts on running royalty rate not linearly additive. Also, the present value is calculated by discounting the stream of future payments, and the discount factor dictates the relationship to be nonlinear.

In the model specification (1) and (2), upfront payment is represented by a dummy variable, which equals

8. Please see Footnote 1 of this paper.

Table 3. Regression Analysis of Royalty Rates with Upfront Payments and Other Relevant Features

	(1)		(2)		(3)		(4)		(5)	
R^2	0.0548		0.1483		0.1037		0.0474		0.1260	
	Coef.	P Value	Coef.	P Value	Coef.	P Value	Coef.	P Value	Coef.	P Value
Intercept	0.0583	0.0000	0.0633	0.0000	0.0598	0.0000	0.0590	0.0000	0.0624	0.0000
Upfront Payment										
Upfront Payment: Dummy	-0.0173	0.0350	-0.0190	0.0219						
Upfront Payment in $100K					-0.0007	0.2193				
Upfront Payment + Equity etc: Dummy							-0.0150	0.0509	-0.0141	0.0647
Other Relevant Features										
Academe as Licensor			-0.0182	0.0877	-0.0180	0.1008			-0.0155	0.1416
Individual as Licensor			-0.0237	0.0175	-0.0226	0.0271			-0.0199	0.0380
Payment in Equity and Funding Etc.			0.0044	0.6860	0.0006	0.9555				
Strategic/Operational Relationship			0.0048	0.6423	0.0072	0.4944			0.0088	0.3880
Minimum Royalty Provision			0.0053	0.5992	0.0023	0.8021			0.0036	0.6807

1 for transactions with upfront payments, 0 for those without. As shown in Table 3, the presence of upfront payment, on average, reduces running royalty rate by 1.7 to 1.9 percentage points. The estimate is statistically significant in both specifications. In other words, despite the imperfection and distortion, license market is efficient enough to reflect that upfront payment, on average, does extract royalties from the downstream and capture them in the advance.

The specification (3) uses the dollar amounts of the upfront payments to test if upfront payment is negatively associated with running royalty rate. The estimation has the expected negative sign, which indicates that an increase of upfront payment in $100,000 would lower running royalty rate by 0.07 percentage points. However, the estimation is not statistically significant.

In specification (4) and (5), cash upfront payment and the payments in other forms such as equity, promissory notes, and maintenance fees etc. are rounded into a new category called "total upfront compensation." According to the estimation, the presence of such compensation would lower running royalty rate by 1.4 to 1.5 percentage points. The estimates are statistically significant, although the significance levels are not as low as those in specification (1) and (2).

Other features are also included in the specification (2), (3) and (5) as dummy variables, and their coefficients exhibit several very interesting properties. First, when licensors are individuals, the average royalty rate is 2.0 to 2.4 percentage points lower than the average rate in this industry, and this gap is statistically significant. In other words, individual licensors are disadvantaged in the sense that they are more likely to take a markdown on royalty rate in licensing transaction, at least so in the medical device industry.

Academic institutions seem to behave similarly in license market, accepting a haircut of 1.8 percentage points compared to the average of the industry.[9] The result is statistically significant, although the significance levels are about 10 percent.[10] Notwithstanding the similarity, the causes of the royalty rate discounts may be different. Most likely, individual licensors are more constrained by resources, which weakens their negotiation power; while academic licensors are more motivated by their desires and initiatives in technology transfer and commercialization.[11]

The effects of three other features, including compensation in equity and funding etc., strategic or operational relationship, and minimum royalty payment, are not statistically significant.

4. Concluding Remarks

It is an intuitively plausible supposition that upfront payment reduces running royalty in a license agreement. While the supposition seems to be valid if license market is efficient, the imperfection and distortion in real license market render its validity much less warranted. Empirical test is deemed to be challenging due to the availability and quality of royalty data, as well as the wide variety of factors in royalty determination.

This study tries to test the hypothesis, using the data from exclusive license transactions in medical device industry. The dummy variable regression analysis shows that the presence of upfront payment reduces running royalty rate by 1.7 to 1.9 percentage points on average. Also, it appears that upfront payment is negatively associated with running royalty rate; such a relationship, however, is not statistically significant. The conclusions seem to vindicate that the license market, despite its imperfection, is sufficiently efficient in fathoming that upfront payment does draw downstream royalty toward the advance. The regression analysis also indicates that academic and individual licensors are more willing or likely to accept a haircut on royalty rate, in an amount of 2 percentage points lower than the average rates of other transactions in this industry.

There are at least three topics that deserve further research. First, data should be collected for more industries so that similar analysis can be done with these other industries. Also, when data availability permits, exclusivity should be brought back into analysis. Supposedly, exclusivity is one of the most important features in a license agreement that would have significant impact on royalty payment.

Second, cross-industry analysis needs to be conducted using panel data from multiple industries. Such panel data would allow us to control industry effects and reveal comparative characteristics across industries. Finally, when data is available, structural features and fundamental factors should be combined to estimate their joint effects on royalty determination. ■

9. The -1.55 percent in specification (5) is not statistically significant.

10. A culprit for the lower rates associated with individual or academic licensors could be the possibly disproportionately high incidences of other features in these two groups, as compared to their counterparts. For example, it is possible that academic licensors use more frequently strategic engagement such as sponsorship, or that individual licensors are more typically the equity owners of licensees. However, the statistics says the opposite. About 40 percent of the non-individual or non-academic licensors in the sample involved either strategic/operational relationship or compensation in equity and funding, or both; while the same percentage number for academic licensors is 33.3 percent, and for individual licensors, 37.5 percent.

11. The second part of the sentence was based on a brief conversation with Dan Pitkin of the National Institute of Standards and Technology. The author thanks Dan for his comments.