

Research on Key Elements of Technology Transfer in Colleges and Universities

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Abstract: The transfer of technology in colleges and universities is a key link between science and technology and economy. It is also an important way to transform industrial structure into a mode of economic development. Only when technological innovation and scientific research achievements of colleges and universities are transformed into actual productivity can they better realize their economy. Social value. But looking at the history of technology transfer, the technology transfer model of colleges and universities needs to be improved. In this paper, we discuss three key elements of technology transfer in universities based on vertical coordination technology transfer and technology transfer of contract transfer: technology transfer subject, technology transfer object and technology transfer behavior.

1. Introduction

Nowadays, more and more colleges and universities are beginning to realize their pivotal role in the national science and technology innovation system. The research on science and technology transfer in universities is also very important. Improving the efficiency and quality of technology transfer is an important topic in the field of technology transfer and transformation. However, traditionally, research in universities in China pays more attention to papers and results, and technology transfer has been weak. In most colleges and universities, there is no special department for technology transfer, technology transfer work is regarded as a marginal field, and there is a lack of compound talents that can deal with enterprises and markets. Therefore, technology transfer has formed a vicious circle, so the technology transfer mode of colleges and universities still needs to be improved. In this paper, we study the key elements of the university technology transfer chain through the vertical coordination of technology transfer and technology transfer of contract transfer. The university technology transfer chain is undergoing a rapid modernization process characterized by the emergence of private standards and different vertical transfer chain governance systems.

2. Key Elements of University Technology Transfer Chain

2.1 Vertically Coordinated Technology Transfer

Many of the technology transfer chains in universities face imperfections in technology and credit markets, making technology transfer behavior difficult and expensive. When the technology transfer object has less credit, less liquidity restrictions, the transaction cost is reduced due to economies of scale, or if the technology transfer object better understands consumer preferences, the information asymmetry is lower, and the technology transfer object may be consumed by the third party. It is easier to obtain modern technology. The technology transfer object can then provide a contract to a third party, including the conditions (time, amount, and price) of the technology transfer behavior. We consider the technology transfer opportunity cost of technology transfer behavior as $\tau < \tau^f$. This opportunity cost will depend on the transfer cost and the potential alternative investment return of the

technology transfer object (including the alternative purchase contract). This means that in the absence of a contract, the “differential payment” of the technology transfer object is equal to τ . For the sake of simplicity, we assume that the third party's “differential payment” is equal to $l = p_L q_L$, and then the technology transfer object and the third party participation constraints are defined as $\Pi^B \geq \tau$ and $\Pi^f \geq l$, and Π^B and Π^f represent the contractual payment of the technology transfer object and the third party, respectively. The total (net) surplus generated by technology transfer behavior and contract is $S = V - l - \tau$.

The division of contract surplus can be modeled as a Nash bargaining issue, in which each party receives a share of its disparity payments and contract surpluses. We represent the share of the third party as β , $0 \leq \beta \leq 1$. First, we assume that this sharing rule β is determined by prior bargaining. Later we explained how the distribution of surplus depends on contract execution and holding opportunities.

First consider the case where the contract is always fully implemented as a benchmark. In this case, in view of the differences between the two parties, the proceeds of the contract are

$$\Pi^{f*} = l + \beta S = l + \beta(V - l - \tau) \quad (1)$$

$$\begin{aligned} \Pi^{B*} &= \tau + (1 - \beta)S \\ &= \tau + (1 - \beta)(V - l - \tau) \end{aligned} \quad (2)$$

The asterisk (*) indicates the benefit of perfect execution. According to these assumptions, if the net surplus is positive, that is, technology transfer will occur

$$V \geq \tau + l \quad (3)$$

The value created (V) should be greater than the opportunity cost of labor (l) and transfer technology (τ). If the value of the technical product ($p_H - p_L$) or the impact on production efficiency ($p_H - p_L$) is higher, if the technology transfers the object, the technology transfer is more likely to transfer the technology τ the lower cost, if the labor opportunity cost Lower.

2.2 Technology Transfer of Contract Transfer

Transfer of technology through contracts depends on the execution of the contract. Contract execution is extraordinary. Contract and technology transfer may not occur due to imperfect contract execution.

Contract breaches can take many forms. In the context considered here, we can distinguish between three possible types of holds that may occur under imperfect contract execution. First, you can decide to transfer the technology provided by the technology transfer object by selling it or using it for different purposes. Second, after applying the transfer technology, you can default by selling the product to an alternate buyer. Such “side sales” may be profitable because the alternative technology transfer object does not have to consider the cost of the technology provided. Finally, if a product produced using advanced technology is more valuable to him than any other buyer, the technology transfer object can be blocked by renegotiating the contract at the time of delivery.

The technology transfer object may refuse to pay the agreed share of the value of the delivered goods, but instead provide the fee for paying only the best alternative V_s at the time (for example, the value of the product at the time of local sale). Doing so will result in a reputation cost for the technology transfer object being $\omega \geq 0$. In this case, the contract payment becomes $\omega \geq 0$ for the technology transfer object, for its $\Pi_r^f = V_s$. To make the self-execution contract feasible, it should satisfy the participation constraint ($\Pi^f \geq l$) and the incentive transfer constraint ($\Pi^B \geq \Pi_r^B = V - V_s - \omega$) of the technology transfer object. Combining these means the following conditions, under the threat of technology transfer objects, technology transfer behavior is still feasible:

$$l \leq V_s + \omega \quad (4)$$

Except for condition $V \geq l + \tau$, it was previously determined. This result means that the impact of the technology transfer object holding on the transfer feasibility does not necessarily depend on the value generated by the technology V : it depends on the reputation cost (ω) and the substitute (V_s) of the technology transfer object. The latter may be a function of value V , depending on the high value market structure and local needs.

Since the reputation cost ω of the technology transfer object is non-negative, $V_s \geq l$ is a sufficient condition for agreeing to the contract. This is the case when it is possible to sell “high-tech” products at a value such as “low technology” that is lower than the technology transfer object (for example, in the local spot market). In summary, when technology (V), the best value for technology transfer object quotation (V_s) and the value of reputation costs (ϕ and ω) are higher, and when the value is higher, the technology transfer behavior through the transfer chain contract More likely. The opportunity cost (l and τ) of the technology transfer object is lower.

3. Benefit Distribution and Contract Execution Analysis

3.1 Analysis of Benefit Distribution of Vertical Coordination Technology Transfer

So far, we have referred to β as a sharing rule that determines the distribution of earnings generated by technology adoption between technology transfer objects. We assume this is the result of a (non-simulated) bargaining game between technology transfer objects. However, β is only the correct indicator of how to distribute the surplus generated by technology transfer behavior between technology transfer objects and third parties under perfect contract execution. In the case of imperfect implementation, each party can obtain “bargaining power” (ie, requires a larger portion of the surplus) if it can create a legitimate threat to prevent the other party. In imperfect contract execution, we define β as “incomplete law enforcement sharing rules”, in which

$$\hat{\beta} = \frac{\pi^f - l}{S} \quad (5)$$

The π^f is a valid contract with a third party to pay off, as well as his opportunity cost.

Figure 1 illustrates how the technology value distribution varies with the value of the technology and the holding rate occurs at a relatively low value of the transfer technology V and the technology transfer object holding rate occurs at a relatively high V value. The upper graph of Figure 1 shows the actual distribution of earnings, S is the total surplus, βS is the surplus under the full contract execution, and $\hat{\beta} S$ is the surplus under imperfect enforcement. The technology transfer object surplus is the vertical distance between the line representing the total surplus and the third-party surplus. The panel below illustrates how constant β is for all V levels, while $\hat{\beta}$ varies with V .

If we move from left to right in the chart and increase the value V , we pass several “value areas”. In Domain A, the value of technology is too low to overcome the combined opportunity cost of technology transfer objects and third parties, and therefore, social inefficiency is adopted. In Domain B, the value V is sufficient to make the technology transfer socially efficient, but not sufficient to allow the contract to self-execute and avoid third party holdings. As shown in the previous section, if $V < l + 2\tau - \phi$, the technique transfer is not feasible. Beyond this level of V (Domain C), the efficiency gain of the transfer technique is sufficient to make the contract self-executing. In this case, the technology transfer object is willing to provide a so-called “efficiency premium” in addition to perfect law enforcement returns to avoid technology transfer.

At the point of $V = l + 2\tau - \phi$, the entire remaining S is required to compensate for the third-party non-transfer technique. Therefore, at this point, the entire surplus flows to a third party ($\pi^f - l = S$) to make the contract self-executing. The possibility of holding a third party raises his effective bargaining power to the highest level ($\hat{\beta} = 1$). This theoretical result can be explained by the

sometimes significant benefits of small household participation in these value chains, despite the focus on the object of technology transfer.

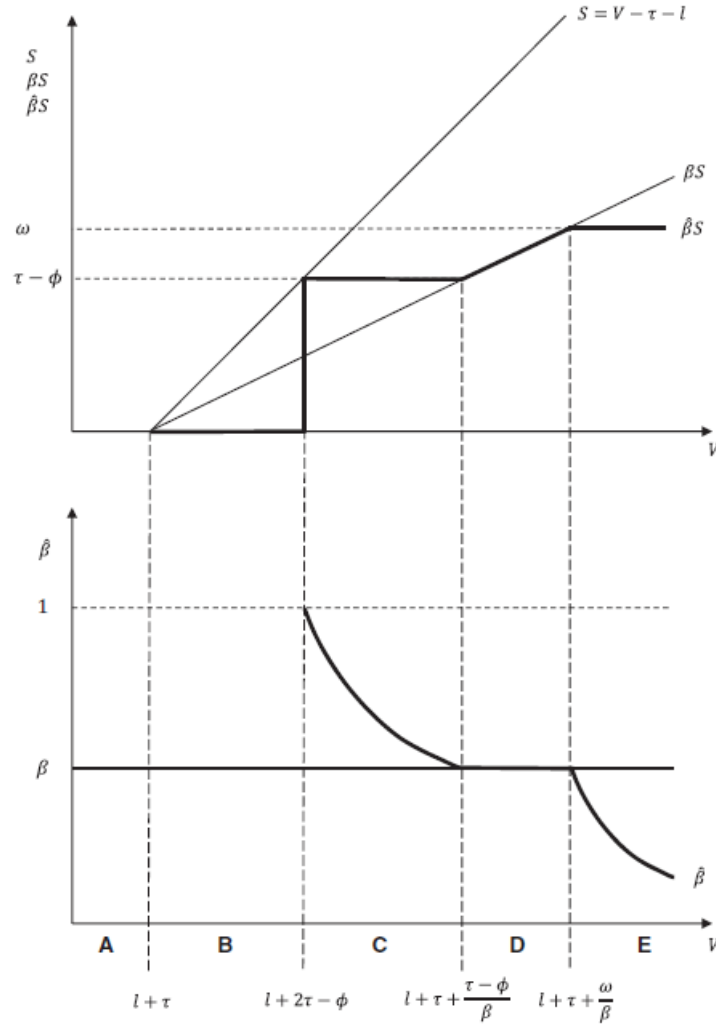


Fig.1 Distribution of Residual and Sharing Rules as a Function of the Value of Technology V and Holding Opportunities ($V_s=1$)

As V increases beyond this point, it generates more surplus and leaves more surplus for the technology transfer object. The remainder of the third party ($\hat{\beta}S$) remains the same because it is determined by the (fixed) holding opportunity level. Therefore, $\hat{\beta}$ decreases as V increases, but $\hat{\beta} > \beta$. More specifically, in domain C, the third-party holding rate is still binding, $\hat{\beta} = \frac{\tau - \phi}{V - l - \tau} > \beta$. $\hat{\beta}S$ is not suitable for domain D, whether it is a third party or a technology transfer object, so you can get the perfect law enforcement result and $\hat{\beta} = \beta$.

In domain E, technology is of the highest value, and unless the contract is sufficient to compensate for the technology transfer object, there will be technology transfer objects. As the technology transfer object holds binding, $\hat{\beta} = \frac{V_s + \omega - l}{V - l - \tau} < \beta$. The benefits of third-party technology adoption,

$\hat{\beta}S$, do not increase further with the increase of V in domain E, as shown in Figure 1. The technology transfer object holding potential brings the largest surplus to the technology transfer entity.

Figure 2 further illustrates when the technology transfer object holdings are binding on the case of $V_s = 1$. Combining the definitions of S and Π_r^B , we can derive the net income held by the technology transfer object.

$$\Pi_r^B - \tau = S - \omega \quad (6)$$

At the value V_r , the net gain held by the technology transfer object (represented by the $S - \omega$ line) is equal to the share of the technology transfer object in the surplus, $(1 - \beta)S$. This occurs at the remaining level S_r , where $S_r - \omega = (1 - \beta)S$, which means $S_r = \frac{\omega}{\beta}$ and $V_r = l + \tau + \frac{\omega}{\beta}$. This also means that the third party's maximum net surplus is equal to ω (and $\hat{\beta} = \frac{\omega}{S}$) on domain E. Therefore, the reputational cost of technology transfer objects not only affects when holdings will occur, but also affects technology transfer entities to benefit from self-implementation technology contracts.

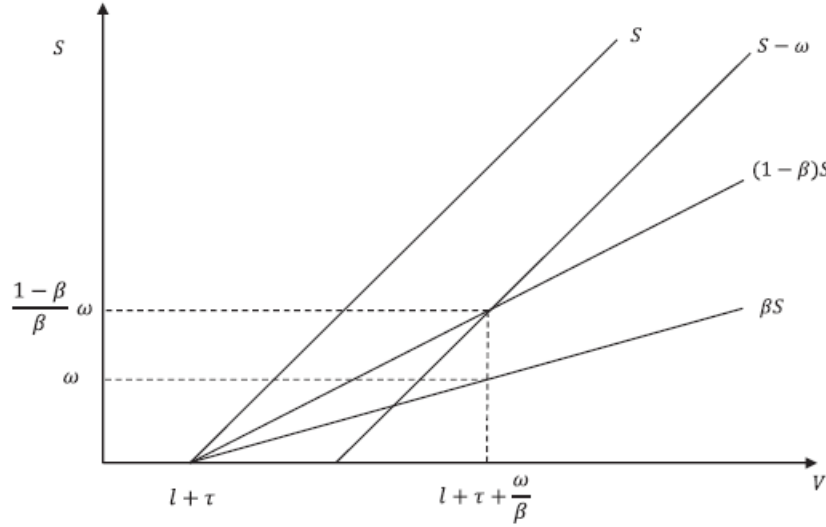


Fig.2 Technology Transfer Object Holdings and Surplus Allocation ($V_s = l$)

Finally, an important implication of this analysis is that simply looking at the market structure may bias the potential distribution of benefits from technology transfer through the transfer chain. Our results imply that in the context of imperfect contract execution, if the market power of the technology transfer subject is small (represented by low β), he or she may still be able to capture significant (represented by $\hat{\beta} > \beta$ in domain C) .

3.2 Incomplete Contract Execution Analysis

So far, our use of the term “technology” is not very specific. One aspect is the time dimension of technology transfer behavior. Some technology is required for each production period. They are repeated every year and their benefits are realized in the contract year. Other technologies affect production processes outside of the current period, such as knowledge or training, equipment or traceable system investments. These technologies provide long-term results beyond one production cycle. These differences will affect the time dynamics of the value created and may affect the execution and feasibility of the contract. Technology transfer behaviors with short-term value effects may be easier to transfer than technologies with long-term benefits because they are more likely to benefit during the contract period.

Another important aspect relates to the specific extent to which technology transfers transactions between technology transfer objects and third parties. “Technical specificity” has two components in our technology transfer chain and contractual framework. When transferring technology, one component is the technical (ex ante) value. So far, we assume that this value is τ . However, this value depends on the particularity of the technology and the imperfections of the local technology market.

Define τ^d as the value obtained by a third party when transferring technology. Then $\alpha = \frac{\tau^d}{\tau}$ is an indicator of the prior specificity of the technique. For a completely specific technique, $\alpha = 0$, there is

no value at the time of transfer.

The particularity of the technology affects the holding opportunities of third parties and buyers, thus affecting the feasibility of self-executing contracts for technology transfer behavior. First consider the amount of holdings. The benefit of transfer technology is $\alpha\tau$. Thus, in the case of technology transfer, the benefit is $\Pi_d^f = l + \alpha\tau - \varphi$ for the technology transfer subject and $\Pi_d^B = 0$ for the technology transfer object. As before, under the threat of a third party, the contract must be self-implemented and must meet the third party's incentive compatibility constraint ($\Pi^f \geq \Pi_d^f$) and the technology transfer object's participation constraint ($\Pi^B \geq \tau$). Combined with these, the conditions for technology transfer under the threat of third parties become $V \geq \Pi_d^f + \tau$ or

$$V \geq l + (1 + \alpha)\tau - \varphi \quad (7)$$

Therefore, with the higher pre-specificity of the technology (lower alpha), contracting is easier because it reduces the benefits of technology transfer.

Now consider the technology transfer object holdings. If the technology transfer object renegotiates the contract at the time of delivery, he must pay the third party the best alternative at the time, V_s . In the case of a technology transfer object, the third party's revenue is $\Pi_r^f = \gamma V$, and the technology transfer object's return is $\Pi_r^B = V - \gamma V - \omega = (1 - \gamma)V - \omega$. For self-executing contracts, the condition that technology transfer behavior is still feasible under the threat of technology transfer objects is

$$l \leq \omega + \gamma V \quad (8)$$

Contract feasibility is reducing the after-the-fact specificity of technology (γ reduction) because it reduces third-party alternatives, thus increasing the incentive for technology transfer objects to renegotiate contracts at product delivery.

In short, prior art specificity will increase contract feasibility by reducing the holding rate, while ex post specificity reduces contract feasibility by increasing technology transfer of object holding rate. In transaction costs, it is generally considered that increasing asset specificity leads to more holding opportunities and lower contract feasibility. Our results show that this relationship is more complicated in the context of interrelated technology transfer behavior. This is because transfer means that not a third party is required to invest in a particular relationship technology, but rather a technology transfer object that funds the transfer technology.

Empirical studies have shown that in some cases, technologies that are more difficult to transfer have been transferred through the technology transfer chain. This seems to require a specific technology transfer chain governance structure that enables it to govern the endogenous technology transfer chain of the nature of the technology type and contract execution issues.

4. Summary

In this paper, we analyze the key elements of the technology transfer chain. Technology transfer through the technology transfer chain may be a good way for buyers to source (high quality) products in an environment where credit and technology markets are imperfect. The feasibility of a transfer depends on a number of factors, including technology-generated surpluses, agency opportunity costs, and different forms of shareholding and contract enforcement agencies. Imperfect contract execution and holding opportunities in the chain have a negative impact on the feasibility of the transfer, but redistributing the surplus under a self-executing contract may make contract and technology transfer behavior feasible. Contract feasibility and technology transfer behavior also depend on the type of technology, including the dynamic allocation of the value it generates and the specificity of the technology to the technology transfer object - third party transactions. The type of technology and the opportunity to hold itself may affect the governance structure of the technology transfer chain, which is consistent with empirical observations of various contract designs and general institutional

organizations. Technology that is more problematic in contract execution (such as long-term investments with high ex post and low pre-specificity) may only occur (partial) in the technology transfer chain when the lowest level of external enforcement is available or as part of a complete vertical integration.

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