

INTERACTION OF TECHNOLOGICAL AND INSTITUTIONAL CHANGE IN THE DEVELOPMENT OF AN ELECTRONIC COMMERCE SYSTEM IN CHINA'S PHARMACEUTICAL DISTRIBUTION CHAIN

A Transaction Cost Perspective

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Keywords: Electronic commerce, pharmaceutical industry, transaction costs, institutional change.

Abstract: In this paper, we describe the introduction of electronic commerce into the drug distribution industry in China. This case is especially interesting because massive institutional changes coincide with the introduction of a new technology. For these reasons, it becomes possible to study the interaction of technological and institutional change in real time and in their real-life context. We use two alternative transaction cost-theoretic perspectives on the interaction between institutional and technological change as our theoretical framework. The case study suggests that the rationale which motivates introduction of a new technology in the context of institutional change may be different from the rationale which underlies the practices which develop on the basis on the newly introduced systems and institutions.

1 INTRODUCTION

Studying the interaction of institutional and technological change in real time is generally a difficult endeavour because of the slow speed at which institutions typically change. For this reason, scholars have focused on two empirical strategies, namely historical studies with respect to large-scale institutional changes, usually on the national level, and studies of institutional change on the level of individual companies (where institutions are changed more easily and thus more quickly). Prominent representatives of these two approaches are Alfred Chandler and Oliver Williamson respectively. Large-scale institutional changes become visible only after a substantial period of time has elapsed so that only historical analysis is feasible; studies on the level of individual organizations such as firms can only reveal small-scale institutional changes. While both approaches have yielded impressive results, studying the interactions between institutional and technological changes on an intermediate level

in real time would be desirable for the following reason. While institutions exist on multiple levels so that institutional change can also be studied on multiple levels, new technological systems are generally not developed on both the national scale and the level of individual firms but on intermediate levels. This is because development of new technological systems typically requires the cooperation among several organizations, not only because resources and capabilities of individual organizations are too limited but also because application of new systems, at least in the initial stages, requires close cooperation of users and suppliers who are thus actively involved in the design and development process (von Hippel, 1978).

However, institutional changes occurring on the intermediate level are seldom observable in real time because of the slow speed of institutional change on this level. One exception to this rule can be found in fast developing countries which actively experiment with medium-scale institutional changes. China may be the most interesting and relevant context in this regard and within China, the healthcare sector is the

Reimers K. and Li M. (2008).

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In *Proceedings of the First International Conference on Health Informatics*, pages 3-12

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one which currently receives the most attention by policy makers due to its economic as well as social and political importance.

Theoretically, the interaction between technical and institutional change has been addressed from a number of perspectives, including transaction cost theory. However, as North and Wallis (1994) have shown, existing institutional approaches -- including those by Chandler and Williamson -- only consider institutional change as a passive response to technical change. North and Wallis trace this traditional limitation back to an assumption that transaction costs cannot be observed or measured which has prevented scholars from appreciating an important mechanism through which technical change can also contribute to proactive institutional change. According to North and Wallis, in this tradition it is generally assumed that new technology requires institutional adaptation in order to be implemented which, however, will increase unit transaction costs even though the transaction cost minimizing institutional arrangement will be chosen. In contrast, if one accepts that transaction costs can be empirically observed, one will be naturally led to look for those parts of the economy which directly express the level of transaction costs existing in an economy at any given moment in time. North and Wallis have identified this sector as the 'transaction sector' and used it to measure the existing level of transaction costs in an economy (Wallis and North, 1986). By this approach they can show how institutions can be changed proactively as a result of a lowering of unit transaction costs through technical change. Thus, North and Wallis demonstrate two ways in which technical change can lead to institutional change: (1) in order to accommodate the requirements of a new technology, new institutions may have to be created which, however, increase unit transaction costs in an economy; since transformation costs are lowered simultaneously (through technical change), the overall effect can still be beneficial; (2) technical change can lower unit transaction costs and thus enable the creation of new institutional forms.

In this paper we want to explore this dual relationship using the case of a massive institutional reform of the distribution of drugs in China which coincided with the rise of e-commerce and led to a new way of selling and distributing drugs in which both elements of institutional and technological change are intertwined. We want to investigate to which extent emergence of this new structure follows the Williamson-Chandler pattern -- new technology needs new institutional forms which result in higher unit-transaction costs -- and to which extent it can be explained as a result of transaction-cost reducing technological change according to North's framework.

2 THEORETICAL FRAMEWORK

Transaction cost economics takes the transaction as its unit of analysis and therefore operates on an analytical level suitable for studying technological change affecting interaction among economic agents. Williamson (1993) has used a three-layer model to locate and motivate the analytic strategy of transaction cost economics. The focal layer concerns the governance of transactional relationships which is influenced by factors residing on a macro and a micro layer. On the macro layer, institutions such as contract law, property rights and norms and customs affect the comparative costs of governance. Changes on this layer may therefore lead to adjustments of governance structures as some forms of governance become relatively more cost advantageous while others become more costly. On the micro-level, behavioural traits of individuals influence governance forms. Prominent among them in Williamson's analysis are opportunism and bounded rationality. For example, governance forms need to prevent economic agents from exploiting one another should the possibility for such behaviour arise due to unanticipated changes in the economic environment.

While Williamson has not specifically developed his transaction cost-theoretic framework for the purpose of analysing its impact, technological change can be relatively easily incorporated into this framework through the notion of asset specificity. This notion refers to investments the value of which depends on the identity of one's business partners. As a consequence of such investments, one can become hostage to threats by that business partner to break up a business relationship. Specially designed governance forms need to anticipate and accommodate this situation. While creating these special governance forms is costly -- increasing unit transaction costs -- creating them can still be worthwhile since these governance forms allow for degrees of asset specificity which, in turn, may reduce transformation costs substantially. There are several types of asset specificity such as specificity of location, human skills and machinery. For example, locating one's production facilities close to one's customer's own production facilities may allow for superior logistical organization (such as Just-in-time delivery arrangements) which, however, creates a substantial degree of asset specificity since the value of that investment would be much reduced if the customer would sever the business relationship. Technological change can then be incorporated as investments in new machinery. Since initially such innovative machinery still follows proprietary or unproven designs, it may well be tailored to the specific needs of one business partner and therefore increase the de-

gree of asset specificity in a business relationship. These concepts are summarized in Figure 1 which extends and slightly modifies a figure presented in Williamson (1993).

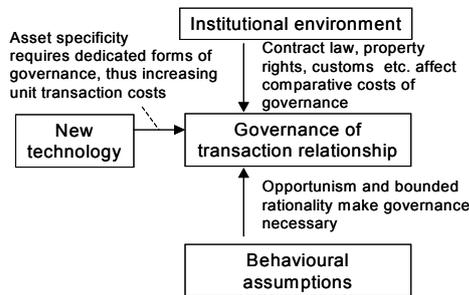


Figure 1: Technological change in a Williamsonian framework (modified from Williamson (1993) excluding feedback and indirect effects and adding the effect of new technology).

The Northian framework combines elements of neoclassical economic theory and transaction cost economics. North is not directly concerned with explaining or describing forms of governance but rather analyses development of macro entities such as whole economies/societies or sectors within one economy. In order to compare his approach to that of Williamson and to make it relevant for our analysis, it therefore needs to be ‘mapped’ onto the transactional level. In North’s (1990) framework forms of governance are treated as behaviour of organizations on economic markets which is influenced by formal and informal institutions through affecting levels of transaction costs (organizations are the players, institutions are the rules of the game). Some organizations engage in the production of new knowledge which, if incorporated into products, becomes technological change on economic markets. In addition, some organizations also engage in activity on political markets in order to affect institutions (and thus the rules of the game played on economic markets). Whether such political activity results in transaction cost reducing or increasing changes of the institutional framework largely depends on ideology (which thus becomes a major force in explaining rise and decline of whole societies). In analogy to the entrepreneur who drives technical progress on economic markets, North (1981) also introduces the political entrepreneur who drives change on political markets (which activity is in addition to the political activity of organizations). (North has incorporated some more elements in his framework such as markets for knowledge creation which we suppress here in order to keep complexity on a level allowing for comparing the two frameworks; for a more detailed

description and analysis, cf. Reimers (1995), pp. 11-18).

When mapped onto Williamson’s three layer model, the role of institutions is mostly identical to that assigned by Williamson to them. They act as “shift parameters” (Williamson, 1993) affecting the costs of doing business on the economic markets, i.e. transaction costs. However, changes on this level are incorporated into the analysis and are thus given a more active role while in Williamson’s framework institutional changes are treated as exogenous events. Thus, actions of organizations or entrepreneurs to affect institutions and thus indirectly behaviour on economic markets (including design of governance forms) is included in the framework. While such behaviour is affected by many factors, North assigns a prominent role to ideology which can be viewed as located on the micro-level in Williamson’s three layer model (cf. Figure 2 for a summary of those elements of North’s framework which are relevant from the perspective of Williamson’s three layer model).

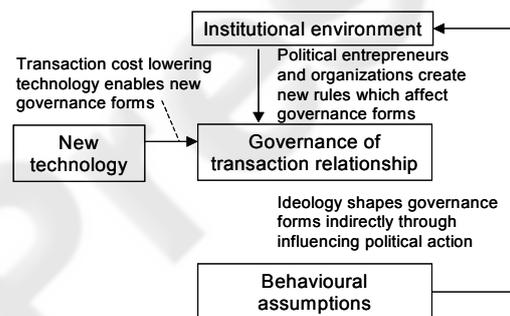


Figure 2: Technological change in a Northian framework (as mapped onto Williamson’s three layer model).

The main difference between the two frameworks -- apart from the different roles new technology plays in them -- consists in the effect ascribed to behavioural assumptions. In Williamson’s framework, behavioural assumptions necessitate creation of dedicated governance structures which thus take a prominent place in the framework and generally increase unit transaction costs. In North’s framework, behavioural assumptions affect behaviour on political markets (which take centre stage in the framework) which then affects transaction costs on economic markets. Technological change enters through different routes too, albeit in both cases indirectly. In Williamson’s framework, technology appears as a special form of asset specificity (thus, by necessity, increasing unit transaction costs); in North’s framework, technological change enters as ‘technical progress’ created on ‘knowledge markets’ (given the right ideology has emerged stimulating

the demand for 'productive' knowledge; in Figure 2, this relationship between new technology and knowledge markets is not expressly modelled).

The question arises how these two explanations can be empirically tested. While it would be tempting to approach the problem in a direct manner by estimating the effect of new technology on transaction costs (whether it lowers or increases unit transaction costs), such an approach would not be acceptable from a Williamsonian perspective since by assumption -- as pointed out and criticized by North -- transaction costs cannot be measured directly according to that perspective. However, it should be possible to observe for which purpose new technology is being used, taking use as an indication for its effect (on transaction and/or transformation costs). According to a Northian interpretation, new technology which coincides with the emergence of new governance structures should be used for purposes of preparing, negotiating, or monitoring contracts while, according to a Williamsonian perspective, new technology which coincides with the creation of new governance structures should be used for transformative purposes (making production and/or distribution/logistics more efficient).

In addition, certain characteristic differences should be observed. While institutional changes (i.e. changes in the institutional environment as defined by the three layer model) are not mandatory for new technology to have its predicted effects, they can co-exist with technological change. However, from a Williamsonian perspective, technological change and institutional change, should they both be observed simultaneously, would have independent effects on governance structures except for the case of institutionally mandated technological change. While institutional change may increase or decrease transaction cost levels technological change will always increase unit transaction costs. Thus, technological change will only occur if the resulting increase in unit transaction costs is accompanied by an even larger reduction in transformation costs or if changes in the institutional environment lead to the adoption of governance structures which are required to accommodate the technological change. In contrast, from a Northian perspective, one would expect political entrepreneurs or economic organizations to lobby for institutional change which would exploit the transaction cost lowering properties of new technology if such technology should become available. Thus, institutional change would have a different character in both cases. From a Williamsonian perspective, it would have the character of enforcing new governance structures (or be

completely independent of technological change) while, from a Northian perspective, it would have the character of being enabled by technological change.

Finally, behavioural assumptions would play different roles in the two theoretical frameworks and thus in any explanation of empirical phenomena. Specifically, from a Williamsonian perspective, they would underlie the design of governance structures; from a Northian perspective, they would shape political behaviour by political entrepreneurs and/or economic organizations.

The discussion can be summarized by the following two propositions:

Proposition 1 (Williamsonian interpretation): Technological change which coincides with institutional change and affects the governance of transactional relationships leads to systems which increase efficiency of logistical and/or production processes. In addition, institutional change takes on the character of enforcing the new governance structure which, in turn, will reflect behavioural traits of agents.

Proposition 2 (Northian interpretation): Technological change which coincides with institutional change and affects the governance of transaction relationships leads to systems which are used for lowering relevant transaction costs. In addition, institutional change takes on the character of being enabled by the technological change while behavioural traits of agents are reflected in the institutional change.

3 DESCRIPTION OF THE CASE

3.1 Description of Data Sources and Method

We used a single case study design for our research. Use of the case study research method is justified because our questions concern the 'how' and 'why' of an organizational phenomenon which cannot be studied outside its real-life context and which involves interaction of a large number of variables (Yin, 2003). Use of a single case design is justified because of the uniqueness of the case -- massive institutional change on an industry level coinciding with technological change -- and the difficulties of obtaining empirical data in that context (ibid.). Specifically, the healthcare industry in China is exposed to an intense public debate about its practices because of a widespread dissatisfaction with healthcare services and the difficult situation of central

government in this discussion. For these reasons, it is very difficult and time-consuming to gain access to key informants in the industry. We have therefore focused our research on the case of drug distribution in Beijing.

In total, 12 interviews were conducted with 15 informants between September 2004 and May 2007. Informants represent manufacturers, wholesalers, e-commerce intermediaries, a so-called bidding centre (a government agency), the Ministry of Health, and the key person driving the introduction of e-commerce into drug distribution in China. That person was interviewed four times over the research period, allowing us to follow the evolution of the technological and institutional change over three years. In addition, documented material -- mostly in the form of Chinese websites -- was used for supplementing our data.

All information presented in the case description below has been triangulated by at least two interview sources except in cases where informants represented the subjective view of their organizations; such instances are explicitly indicated in the following description when they occur.

3.2 The Problem which Triggered Institutional Action

The reform of economic structures in China started in the late 1970s has not only led to the emergence of business organizations and economic markets but also deteriorated existing economic organizational structures. One characteristic of these previously dominating structures was the tight integration of work organizations and social services such as housing, education and healthcare. These integrated units -- called *dan wei* -- were not only internally integrated but, to a large extent, externally insulated. Workers would seldom leave the compounds on which all facilities required for everyday life existed. The main connection with the economic environment consisted of flows of intermediate goods among these organizations (Walder, 2000). Thus, the functional separation that came with the emergence of dedicated business organizations -- as opposed to these integrated work organizations -- implied that social services would have to either be provided as a commercial service as well or by government. To some extent, both of these directions were pursued, especially with regard to healthcare. Specifically, while, through a reform of the health insurance system in 1998, all workers in cities are covered by a governmental insurance system, rural families receive practically no any health insurance coverage (cf. Dou, 2003, and IMS Health, 2004). Most medi-

cal expenses need to be paid out of pocket by rural families (ibid.). At the same time, governmental health insurance for urban workers covers only basic services so that a large number of privately-based insurance schemes has sprung to live covering additional health risks (ibid.).

While this situation was not satisfactory for most people and organizations involved in healthcare, it continued to function to the extent that healthcare costs could be kept low. The healthcare system started to be defunct, however, once the drug prices started to increase significantly. While one cause of the rise in drug prices was the entering of multinational pharmaceutical firms into the Chinese market and the accompanying rise of branded drugs -- alongside the much cheaper so-called ethnic drugs, i.e. drugs based on traditional Chinese medicine -- the root cause for this development was the chronic under-financing of hospitals. In order to survive in the new economic environment, hospitals took to earning most of their income (on average 80%) through the selling of drugs which naturally created incentives to sell expensive drugs with high margins.

Central government initiated several institutional measures to mitigate the situation. For example, it kept prodding provincial and local governments to improve healthcare provisioning and to develop insurance schemes for the rural population. It also instituted that all business organizations operating in the distribution of drugs had to be certified by the year 2004. The reason for this measure was an intention to cut down on the huge number of distributors, wholesalers and other intermediaries which, around the year 2002, was estimated to be between 16 and 17 thousand (Dou, 2003). This large number of intermediaries in the distribution of drugs was supposed to create inefficiencies through fragmentation (lack of economies of scale) and multiple mark-ups (each intermediary would add a mark-up to the price). Moreover, central government required hospitals to separate their internal pharmacy accounts from their other accounting processes in order to increase transparency regarding the extent to which hospitals financed themselves through the sale of drugs; a second institutional reform concerned the introduction of a centralized bidding process through which hospitals were expected to purchase drugs. There has also been some efforts to promote the development of an independent retail pharmacy sector because it was assumed that through this process the monopoly power hospitals traditionally held over the sale of drugs could be broken or at least diminished.

All these measures are very recent, beginning in the year 2000, and government is continuing to experiment with new approaches. However, government is severely restricted in enforcing its policies

for two reasons. First, it depends upon the services of hospitals, a fact which came to light during the SARS epidemic in 2003. Therefore, government cannot afford to let a large number of hospitals go out of business. Second, government is not a unified force but internally highly fragmented along vertical and horizontal lines. Specifically, regulatory and administrative powers regarding the healthcare sector were, in 2002, distributed across nine governmental agencies and ministries (Dou, 2003) some of which were later merged. Vertically, government power is spread across central and provincial governments, for example with respect to inspecting and certifying drug manufacturing.

In the following, we will focus on the introduction of the centralized purchasing process since this was the main force shaping the development of electronic commerce systems in drug distribution but also consider the effects of the other measures since they are all interdependent.

3.3 An Early Experiment

In order to curb corruption related to the problems outlined above, the provincial government in Henan province centralized all drug procurement related to hospital demand in 1993. Resistance by hospitals to this measure, however, led to the discontinuation of the practice two years later. The person in charge of implementing this measure, Mr. Li, then visited the US in order to study drug distribution there and became convinced that centralization of drug procurement was the “direction for the future of China” but that this was only possible by using e-commerce. After two years of preparation, an e-commerce system for procuring drugs commenced operations, initially with good results -- according to Mr. Li -- but which was closed down after just half a year of operations upon being declared illegal by central government under then premier minister Mr. Zhu Rongji because business operations had to be separated from their regulation. The system was then sold to a private company -- Haihong -- which would re-launch it in Henan and introduce it to several other provinces, among them Guangdong, Hainan, and Beijing.

3.4 How the System is used in Beijing

In Beijing, a centralized, e-commerce-based procurement system for drugs began operations in 2004. However, institutional reforms preparing for that system go back to the year 2000 when the ‘Beijing Bidding Centre’ was set up as a joint effort by nine government agencies involved in the regulation of

drug distribution to hospitals. These agencies include, for example, the Beijing Health Bureau (which has a role similar to a national Ministry of Health albeit on a provincial level), the Beijing Price Bureau and the Beijing Traditional Chinese Medicine Bureau. Based on experiences with similar systems in other provinces, most of them supported by Haihong’s software and services, a process for drug procurement was established; while the core elements of this process are similar across the whole country some elements show distinct characteristics distinguishing the process from those implemented in other provinces. In general, drug distribution is still a highly localized business; distributors who are fierce competitors in one province may therefore be business partners in another province. The following account focuses on the practices associated with the e-commerce system in Beijing.

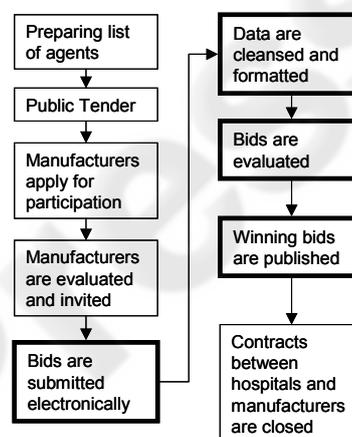


Figure 3: The bidding process (bold boxes indicate steps supported by the e-commerce system).

The bidding centre usually initiates a bidding process once per year. The process steps are depicted in Figure 3. The core step consists of evaluating competing bids by manufacturers on individual pharmaceutical agents (chemical substances) according to multiple criteria, including price and service quality of distributors (which must be assigned by manufacturers in advance and which often take over the paperwork associated with participation in the bidding process). The list of agents comprises about 15 thousand items on which manufacturers can bid. Evaluation is done by a group of experts for each of the province’s -- Beijing is a province as well as a city -- six hospital groups which have been set up according to certain differences in their demand for drugs. Once bids have been selected, hospitals are required to place purchase orders for drugs only among the winning bids. The main purpose of this process is to ensure that hospitals use high quality drugs while controlling drug prices.

The bidding process is facilitated by a number of intermediaries which have been certified for that purpose. While seven intermediaries have received such certificates, only three are active. Each hospital group selects one of them to help them with operating the bidding process. The largest among them -- serving four hospital groups -- is Haihong. The requirements according to the certification process also include ownership and operation of an e-commerce system. Regarding the bidding process itself, that system collects all documents which need to accompany a bid and which have to be submitted electronically. The intermediaries then pass these data -- after some data cleansing and format adjustments -- on to the bidding centre. Once winning bids have been selected, the results are published on the e-commerce systems.

The more important role which these e-commerce systems play, however, concerns the ordering process. Hospitals are required -- according to stipulations by the Beijing Health Bureau -- to submit orders through these systems. For that purpose, they log onto the system over a web interface and enter their orders directly into the system. Distributors then download order data from the system -- also by logging onto the system through a web interface -- and hospitals are automatically informed that distributors have downloaded order data. However, distributors cannot confirm or change purchase orders.

The express purpose of this use of e-commerce systems is to facilitate the monitoring of compliance with the rules of the bidding process. Specifically, the bidding centre is charged with the task of monitoring hospital purchasing activity in order to ensure that hospitals only buy 'from the list', i.e. do not circumvent the drugs which have been selected in the evaluation process.

The percentage of drugs sold/procured through these systems has increased continuously since their inception in 2004 and was estimated to be close to 100% in 2006. Use of the system is accredited with having caused a significant drop in the number of distributors in Beijing which fell from around 200 in 2004 to about 120 at the beginning of 2007.

The e-commerce system replaces a practice in which distributors took drug orders from hospitals by phone (orders by distributors to manufacturers continue to be placed over the telephone or by fax). The services of intermediaries complement the e-commerce system's functionality, mostly by offering a 'screening service'; if a distributor does not respond to an order, the intermediary will help the hospital to procure the drugs through other channels. The intermediaries also improve the efficiency of the

ordering process by harmonizing data. For example, hospitals often use internal codes to identify drugs. These codes are matched to standard drug identifiers defined by the China Food and Drug Administration (FDA) so that distributors can use the FDA codes for their internal processes rather than having to cope with multiple proprietary codes used by hospitals.

While some of the data used for the ordering and for the bidding processes are identical, the systems are separated (including separate databases) because they are regulated by different government agencies (as a side-effect of this separation, the ordering system could also be used by other organizations who do not have to participate in the bidding process such as independent pharmacies; because of capacity problems, however, use of the system is currently limited to hospitals). Operational efficiencies of using the e-commerce system for supporting the bidding process are minor as compared to the ordering process. The main benefits concern ease of selecting and evaluating drugs which facilitates the work of the expert group who selects bids. Again, this requires harmonization of data supplied by manufacturers (or distributors acting on behalf of manufacturers) which is done by the intermediaries.

The vision of Mr. Li, who continues to advise Haihong regarding further development of its e-commerce system, is to provide a comprehensive platform for managing the whole drug supply chain from manufacturers to hospitals. However, currently only the order process is supported by the system and even this support is rather limited (as evidenced by a lack of an order confirmation or change function). For example, it was intended to use the system for enabling zero-inventories in hospital pharmacies. However, hospitals were not interested in such a capability because they do not have to pay manufacturers for unsold inventories. While Haihong's system was the first to be developed, the systems of all three intermediaries are rather similar in terms of functionality and capacity and do not constitute a main competitive differentiator for them.

Thus, while the operational scope of the three e-commerce systems is rather narrow, they are indeed used for improving operational efficiency of the ordering process. For example, while, in 2004 the association of drug wholesalers and pharmacies received broad support by its constituency when submitting a petition to government objecting introduction of the e-commerce-based distribution system, that support is waning as large distributors (wholesalers) are discovering operational benefits of the system and because the system has led to a consolidation of the industry favouring the larger players.

Hospitals have to contract with the intermediary as well as with manufacturers. Each hospital group

selects one intermediary which, however, charges fees to manufacturers as stipulated by the Beijing Health Bureau. The licenses of intermediaries need to be renewed each year but the relationship between a hospital group and an intermediary tends to be stable and long-term. Upon conclusion of the bidding process, hospitals have to contract with manufacturers that have succeeded in the bidding process. Occasionally, hospitals also negotiate with manufacturers again before placing orders on the e-commerce system in order to receive discounts. In the evaluation process, it is also possible that the bidding centre negotiates with manufacturers who have participated in the bidding process. This occurs when for a specific agent (chemical substance) only one bid has been submitted. In addition, manufacturers use sales agents and other wholesalers to market and also sell their drugs to hospitals. However, these agents, who may receive the drugs at a discounted price, still have to use the licensed distributors for delivering the drugs to hospitals.

The specific governance structure used for operating e-commerce systems through intermediaries is justified by two rationales. First, the main benefit of the system is seen in the ease of monitoring compliance with the bidding rules. This is considered crucial since hospitals have very strong incentives to circumvent these rules in order to increase their income through the sale of branded and therefore high-margin drugs. Second, Mr. Li argues that e-commerce in China is only viable if facilitated by third parties. He points to an effort in Shanghai where wholesalers have tried to build e-commerce systems to directly connect with hospitals. These efforts have failed because of the fragmented market structure (hospitals typically deal with around 30 different distributors), fierce competition among distributors (forestalling cooperation among them) and low trust among all parties.

The e-commerce systems, however, are not used for the purpose of monitoring compliance with the bidding rules. Specifically, the bidding centre does not make any use of its ability to log onto the systems in order to check hospitals' compliance with the bidding rules (as reflected in their ordering behaviour). While the bidding centre claims that 50-60% of all purchasing transactions are reported to it by intermediaries, it turns out that this feedback is based on aggregated data which are provided by intermediaries to the bidding centre on paper and this only upon request which occurs infrequently and usually only once per year. The intermediaries suggest that the bidding centre lacks the technical skills

required for making sense of the data provided by the systems directly. The bidding centre itself indicates that its ability to sanction hospitals (through exposing non-compliance) is rather limited because it is difficult to tell violations of rules from "market behaviour", a view shared by Mr. Li. It was also frequently mentioned that hospitals often have sufficient "market power" to resist any sanctioning efforts. Mr. Li cited yet another reason for the failure of the bidding centre to directly use the e-commerce systems to monitor purchasing behaviour of hospitals. The data in the systems cannot be easily analysed because of a lack of data standards (apart from the use of proprietary product codes by hospitals mentioned above, other data such as names of manufacturers are not standardized either). Moreover, some hospitals ask intermediaries to provide them with so-called 'soft systems' for their data input which are tweaked so as to make it even more difficult to monitor their purchasing behaviour.

4 CASE ANALYSIS

Referring to the two propositions developed in the theory section, it becomes clear that the e-commerce systems described above have been developed with a Northian intention. The main idea of Mr. Li -- who can be viewed as the political entrepreneur described by North -- was that centralization of the procurement process -- i.e. a specific instance of institutional change -- was only possible if accompanied by an e-commerce system. He assumed that electronic commerce would facilitate the monitoring of hospital drug purchasing behaviour which was a central element in the introduction of the bidding process. These costs are an instance of transaction costs since they concern the monitoring of a contract, albeit one imposed on the participants in the market. Thus, the e-commerce system's ability to reduce transaction costs would be exploited for the purpose of institutional reform. Also, the organizations active on the economic market -- mostly distributors and hospitals -- tried to prevent the institutional reform through lobbying activity.

The bidding process centralized all negotiations between hospitals and manufacturers while the e-commerce system centralized ordering and delivery (for a small group of hospitals in Beijing, government has actually taken over all procurement activities, thus reversing the earlier decree by central government to separate regulation and business activity). Also, the very idea of solving the problems characterizing drug distribution through taking over

central control of the process seems to be in line with the overall ideology of economic policy in China. Thus, all elements suggested by a Northian interpretation of the interaction between institutional and technological change -- technology-enabled institutional change, activity on political markets to bring about or prevent the institutional change, a 'national' characteristic trait of the intended institutional reform -- seem to be in place.

However, the e-commerce system is not used for the intended purpose (facilitating institutional change through reducing the costs of monitoring compliance with the new rules); yet, the main actors in the industry continue to offer the rationale of facilitating monitoring of hospital drug purchasing behaviour as an explanation for continued use of the e-commerce systems. While there are several reasons for the factual avoidance of using the system for monitoring hospital transactions, including bargaining power of hospitals and lack of alternative funding schemes, the fact that the e-commerce systems are not used for their intended purpose allows us to reject the Northian interpretation of this case. The new institutional process -- the bidding process -- was not enabled by a reduction of transaction costs -- in this case monitoring costs -- through use of the e-commerce system; continued existence of the new institutional arrangement can only be explained by government's use of sanctions and administrative force. In addition, significant violation of the rules stipulated by the bidding process was tolerated by government agencies which may have reduced resistance to the new institutional order.

Regarding a Williamsonian interpretation, it seems reasonable to argue that the e-commerce systems did not reduce transaction costs but probably contributed to increased efficiency of the ordering process. For example, distributors do not have to handle multiple systems for identifying drugs through proprietary product codes while hospitals can place orders to distributors in one process rather than sending individual orders to each distributor separately. (Note that costs associated with placing orders are not transaction costs since they neither concern the costs of negotiating contracts -- this has been done through the bidding process resulting in bilateral contracts between hospitals and manufacturers -- nor do they constitute costs of monitoring contracts; if the supply chain would be controlled by one organization, it would still be necessary to create (internal) orders for replenishing inventories in hospital pharmacies.)

On the other hand, transaction costs associated with the new governance structure may well have

been increased because the bidding process introduced new costs into the distribution system; e.g., the expert groups have to evaluate bids on 15 thousand agents (chemical substances) by multiple suppliers. While the e-commerce systems provide some support for this process, the main work is manual. In addition, multiple other channels for negotiating between hospitals and manufacturers continue to be used. Finally, bilateral contracting between hospitals and manufacturers is still necessary, although these contracts are based on the prices quoted in the bidding process. In any case, hospitals would prefer to bilaterally negotiate with manufacturers even so they do not have to pay for the work of the bidding centre (which is completely funded by the Beijing government). Also, mandatory use of the new intermediaries did impose some new costs on the distribution system. Presently, these are carried by the manufacturers (who must -- by law -- be charged for the intermediaries' services -- although they serve the hospital groups). It was anticipated that hospitals would effectively oppose any efforts to make them pay for the services of intermediaries, e.g. by asking manufacturers to take over these fees).

The governance structure used for facilitating set-up and operation of e-commerce systems also seems to display typical 'Chinese characteristics' as these systems are developed and operated by third parties rather than within a bilateral governance structure typical for Western EDI-based models of e-commerce. Thus, all elements suggested by a Williamsonian interpretation can be identified in the way these systems are actually used. The governance structure underlying operation of the e-commerce systems is likely to have increased overall transaction costs in the distribution of drugs between distributors and hospitals. However, operational efficiencies in the ordering process could (partly) compensate for these increased transaction costs. As the operational efficiencies become clearer, resistance towards using the e-commerce systems wanes (this fading resistance seems also to be related to recognition among the main players that the systems are not used for monitoring their market behaviour).

However, because of a lack of hard data, a Williamsonian interpretation cannot be proven. Moreover, this lack of hard data could well be implied in the approach itself, a problem which motivated the critique of North and Wallis in the first place. Yet, we find that the Northian interpretation explains the motives behind the political initiative to create a centralized, e-commerce-based drug procurement process while actual use of the system contradicts such an interpretation.

5 CONCLUSIONS

In exploring two alternative transaction cost-based explanations of the interaction of institutional and technological change in the case of China's drug distribution system, we have found evidence that a Northian interpretation -- which suggests that transaction cost reducing technological change enables institutional change -- does not apply to the actual practice of distributing drugs based on new institutional rules and an e-commerce system but does accurately describe intentions and political behaviour which has resulted in these new arrangements. Actual use of the e-commerce system and its governance structure seems to be more in line with a Williamsonian interpretation which suggests that institutions and governance structures need to be adapted to enable implementation of new technology in organizational systems, resulting in increased operational efficiency, albeit at the expense of increased transaction costs.

We therefore conclude that development and use of new technology as well as intentions associated with an institutional change and the practices based on these changes may well follow different rationales. More generally, while a certain *perceived* interaction between technological and institutional change may motivate these changes, the practices which result from these changes could follow a different logic of interaction. This result is reminiscent of early formulations of neo-institutional theory (Meyer and Rowan, 1977). These formulations suggested that organizations maintain a 'gap' between their internal operational processes and their external, symbolic justification of these processes. While these early propositions have been strongly criticized by institutional theorists themselves (Powell, 1991), our results suggest that such a gap could be the result of an implementation process in which the rationales that motivated technological and institutional change continue to exist as a 'distant echo' in actual practices. However, actual practices have adapted to a different rationale.

While our results are not sufficient to accept or reject one transaction cost-theoretic interpretation over the other, they suggest that further exploration of these two explanations in settings which study the interaction of technological and institutional change on an intermediate level between that of individual organizations and whole economies is a worthwhile effort. Moreover, our study shows that the two explanations could account for different phases in the evolution of that interaction, a result which was not expected at the outset of this study.

ACKNOWLEDGEMENTS

The first author would like to acknowledge support by the Deutsche Forschungsgemeinschaft (grant number 1328/2-2); the second author would like to acknowledge support by the China Natural National Science Foundation (grant numbers 70621061 and 70672007) and the China MOE Project of the Key Research Institute of Humanity and Social Sciences at Universities (number #06JJD630014).

REFERENCES

- Dou, W. (2003). *The Chinese Pharmaceutical and Biotechnology Market Guide 2003*. SCRIP Report No. BS1210, 28 March 2003, Richmond/Surrey: PJB Publications.
- IMS Health (2004). *IMS Market Prognosis Australasia 2004-2008 – China*. IMS Health, London, March 2004.
- Meyer, J. W., & Rowan, B. (1977). Institutionalized Organizations: Formal Structure as Myth and Ceremony. *American Journal of Sociology*, 83, 440-463.
- North, D. C. (1981). *Structure and Change in Economic History*. N.Y., London: W. W. Norton.
- North, D. C. (1990). *Institutions, Institutional Change, and Economic Performance*. Cambridge: Cambridge University Press.
- North, D. C., & Wallis, J. J. (1994). Integrating Institutional Change and Technical Change in Economic History -- A Transaction Cost Approach. *Journal of Institutional and Theoretical Economics*, 150, 609-624.
- Powell, W. W. (1991). Expanding the Scope of Institutional Analysis. In: W.W. Powell & P.J. DiMaggio (eds.), *The New Institutionalism in Organizational Analysis* (pp. 183-203). Chicago et al.: University of Chicago Press.
- Reimers, K. (1995). *Normungsprozesse – Eine Transaktionskostentheoretische Analyse*. Wiesbaden: Gabler Verlag (Neue betriebswirtschaftliche Forschung Bd. 146).
- Von Hippel, E. (1978). A Customer-active Paradigm for Industrial Product Idea Generation. *Research Policy*, 7, 240-266.
- Walder, A. G. (2000). China's Transitional Economy. In: J.T. Li et al. (eds.), *Management and Organizations in the Chinese Context* (pp. 63-83). Houndsmills et al.: Macmillan.
- Wallis, J. J., & Douglass C. N. (1986). Measuring the Transaction Sector in the American Economy 1870 - 1970. In: S.L. Engerman & R.E. Gallman (eds.), *Long Term Factors in American Economic Growth*, Chicago: University of Chicago Press.
- Williamson, O. E. (1993). Transaction Cost Economics and Organization Theory. *Industrial and Corporate Change*, 2, 107-156.