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Path Dependence in B2B-Relationships

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„Wege entstehen dadurch, dass man sie geht.“
Franz Kafka

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1. Abstract

This study asks the question if sources of relational rents lead to path dependence in b2b-relationships. Additionally the question will be asked if there are any differences in b2b relationships between b2b relationships of German companies with Chinese firms and with US firms regarding the issue of path dependence caused by the sources of relational rents. The presumed contribution lies in the combination and empirical analysis of the relational view and path dependence. The combination of these theories offers a broader view which adds the down side of potential inefficiency to the (transaction) costs reducing and benefits enhancing (e.g. by relation-specific governance mechanisms) bright side of relational rents. The empirical analysis will consist of semi-structured interviews and a simultaneous equation model. The explorative qualitative research design offers first insights and establishes the base for the simultaneous equation model, which draws on the theoretical discussion and the qualitative empirical findings.

2. Introduction

In order to examine the first research questions and address “the lack of a theory of the firm in David’s and Arthur’s leading papers“ (Stack/Gartland 2003: 487) in the field of path dependence and to further sharpen the understanding of how inefficient processes and lock-ins emerge, the theoretical lens of path dependence in the reading of Sydow et al. (2009) and the relational view by Dyer and Singh (1998) were selected. To fully address the relational view one also has to take into account transaction cost economics and the concept of absorptive capacity.

The relevance of the first research question in general becomes clear against the background of the overall decreasing intraorganizational real net output ratio and the hereby increasing importance of interorganizational cooperation (Mellewigt 2003: 1). The relevance in particular reveals itself in the current discussion in the strategic management literature on the dynamization of the resource-based approaches (Schreyögg/Kliesch 2005: 2), especially the dynamic capabilities (Teece et al. 1997), and the core rigidities (Leonard-Barton 1992). Beyond that the study could make a theoretical contribution by combining the relational view and the concept of path dependence. Within the framework of the resource-based approaches the relational view is appropriate to elucidate resources that are located between organizations and therefore within interorganizational - or more precisely - b2b relationships. Up to now resources in most cases are still regarded as solely positively, even though Leonard-Barton (1992) has laid the foundation for a more differentiated understanding. At this point the theory of path dependence seems to offer the missing link.

B2b-relationships may not only lead to the development of relational rents but also prohibit the development of alternative advantages in alternative relationships. Resources that are located between organizations and therefore can only be developed cooperatively can lead not only to relational rents, meaning rents that are generated solely within a specific relationship and not by any organization in isolation (Dyer/Singh 1998: 662), but also hinder the development of new alternative relationships and thus may lead to a decreased flexibility and as a result at least to potential inefficiency and thus to path dependence.

The second question, whether b2b relationships between b2b relationships of German companies with Chinese firms and with US firms differ in terms of path dependence through relational resources, derives its relevance from the current global issue of the increasing importance of China in the world's economy in general, the different ways of successfully doing business (Tsang 2002: 844) in both countries and the „underdeveloped legal framework“ (Xin/Pearce 1996) in particular. The different underlying conditions in those countries call for different relationship governance mechanisms. In China for example Guanxi serves as an important self enforcing agreement. „Guanxi means good connections“ (Tsang 1993: 64) and relates basically to commitment, trust and reputation (Ibid.: 66 et seq.). Those governance mechanisms (e.g. trust) only evolve over time and are characterized by comparatively low transactions costs (Dyer/Singh 1998: 670). “These safeguards presumably have high initial ‘set-up’ costs but once in place they have relatively low maintenance costs” (Dyer 1997: 547 et seq.)¹. Furthermore those safeguard have relation specific elements and thus may lead to quasi rents. In most western countries in contrast organizations depend more heavily on formal agreements (Jansson et al. 2007) which in comparison are more unspecific but, accordingly to Dyer (1997: 547 et seq.), more costly in the long run.

As a result one can assume that b2b relationships in China and in western countries may lead to different transaction costs over time. For that reasons one can further suppose that the transaction costs and the sources of relational rents concerning the effective governance in b2b relationships in China and western countries are not the same over time and may differ in their absolute amount. Consequently the question emerges if b2b relationships between German companies and Chinese firms and between German companies with US firms are differently exposed to path dependence through relational rents. This calls for a multicultural management and understanding which helps to build relationships across cultures and boundaries.

¹According to Dyer (1997: 537) set-up costs can be seen as part of the overall transaction costs that elapse in an interorganizational relationship over time.

3. Theoretical Framework

3.1. B2B-Relationships

Bilateral quality uncertainty is a central feature of transactions in business-to-business-markets (Press, 1997: 1). The process of performance generation is mostly characterized by a high amount of integration. The Performance cannot be foreseen and the highly complex goods contain more trust and experience qualities than search qualities. These transaction risks can be reduced by making a b2b-Relationship (Kleinaltenkamp, 1994: 21). A b2b-relationship is the result of a series of buyer-supplier market transactions that are not random. Not random either means, that there exist reasons on the supplier and/or buyer side, which would make a systematic connection of market transactions appear reasonable or necessary, or that lead to a de facto connection (Plinke 1997: 25). A b2b-relationship can be regarded as outcome of market transactions with an inner connection (Ibid.). B2b-relationships can be planned, which leads to specific investments, or they can emerge “de facto”, for instance by learning processes that generated value. These originated values and investments can be considered to be the mentioned inner connection between market transactions (Plinke 1997: 25). Several studies demonstrated that the probability of future transactions with a transaction partner rises by previously engagement with the same transaction partner (Li/Rowley, 2002; Gulati, 1995; Gulati/Gargiulo, 1999). A routinely instead of a recursive re-selection of transaction partners can be regarded as an expression of path dependence (Sydow, 2007: 323 et seq.).

3.2. Path Dependence

The origin of a economic theory of path dependence can be seen in the articles of Arthur (1989) and David (1985), whereat Arthur (1989, 1994) was the first to establish a formal theory on this matter and to identify increasing returns as the major drivers of the path-shaping process. Subsequently the theory was transferred to an organizational context in which North (1990) uses the theory to describe institutional change and by this means puts it in a socio-scientific context. In order to address the persistence of organizations and to explore the logic and dynamics of internal organizational processes leading to a lock-in, Sydow et al (2009) developed a theoretical framework of organizational path dependence. According to this theoretical framework organizational path dependence (see figure 1) is defined as “a process which (1) is triggered by a critical event leading to a critical juncture, (2) is governed by a regime of positive, self-reinforcing feedback, constituting a specific pattern of social practices, which gains more and more predominance against alternatives, and (3) leads, at least potentially, into an organizational lock-in, understood as a corridor of limited scope of action that is strategically inefficient” or at least poten-

tially inefficient (Ibid.: 14). The idea of a lock-in, as a (potentially) inefficient and non reversible market disequilibrium contradicts the basic neoclassical principles (Schreyögg et al. 2003: 260) of market balance, rationality and efficiency. Not only for this has the theory of path dependence been criticized (Liebowitz/Margolis 1990, 1995). Garud and Karnøe (2001) for example point out that the role of agents is underdeveloped within the framework of path dependence.

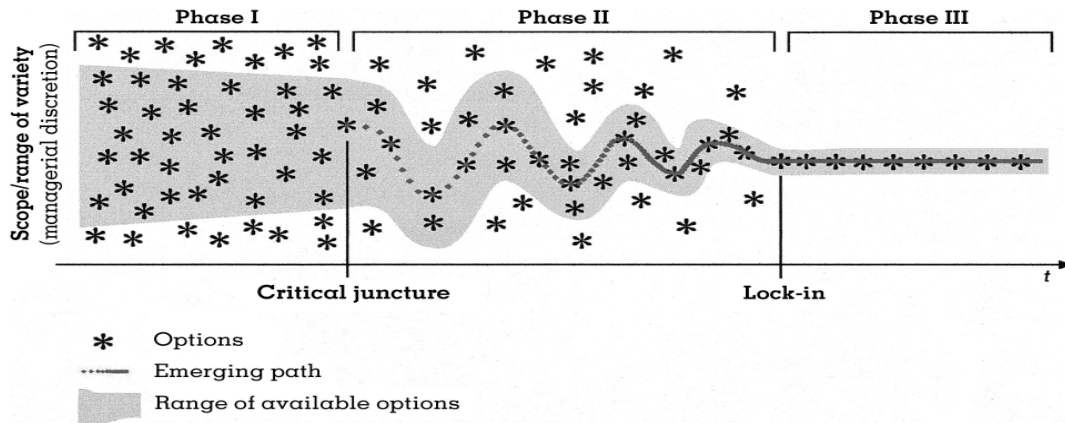


Figure 1: The Constitution of an Organizational Path (Sydow et al. 2009: 692)

Path dependence can be differentiated in three development phases (see figure 1). The preformation phase is characterized by a broad set of choices, which have unpredictable outcomes, or least one can not foresee the whole range of consequences. Once a choice is made, “this choice may, however, amount to a small event which unintentionally sets off a self-reinforcing process” (Ibid.: 691). As stated elsewhere in the article of Sydow et al. (2009: 693) small events are not always “so innocent, random and ‘small’”, they might be intentionally set. As soon as self-reinforcing processes occur the “critical juncture”, marking the end of the first phase and the beginning of the second phase, is reached (Ibid.). The formation phase is characterized by self-reinforcing processes. “By implication, the range of options narrows and it becomes progressively difficult to reverse the initial choice” (Ibid.). The lock-in phase is characterized by a further restriction of scope that in the end leads into a lock-in (Ibid.: 696).

Acting on the assumption of path dependence referring to a time period rather as to a certain point in time, “rigidity therefore always means potential inefficiency” (Sydow et al. 2009: 695), which becomes manifest when an organization loses its flexibility due to a constraint of the existing path (Ibid.: 699).

At the core of the theory of organizational path dependence are self-reinforcing mechanisms because they are likely to lead to a specific path of action (Sydow et al. 2009: 689). Amongst others this constitutive characteristic of path dependence distinguishes path dependence from related conceptions, such as escalating commitment, imprinting, sunk costs, reactive sequences or structural inertia (Sydow et al. 2009: 696 et seq.). According to Sydow et al. (Ibid.: 674) four self-reinforcing social mechanisms in an organizational context “in particular are likely to contribute to an explanation of the development of organizational path dependence: coordination effects, complementarity effects, learning effects, and adaptive expectations”. Coordination effects, as for instance the right-hand traffic, result in reduced coordination costs. The more individuals follow the rules, the more attractive becomes an adoption of these rules. Complementary effects, such as economies of scope, are synergies, resulting from an interaction of separate but interrelated resources, rules or practices (Sydow et al. 2009: 699). Learning effects describe an efficiency gain caused by increasing repetition of a process/task, which results in decreasing average costs per unit of output. March (1991, 2006) describes that learning effects lead to a focus on this exploitative learning in disfavor of explorative learning. Adaptive expectation effects refer to an interactive building of preferences, like the herd behavior of individuals operating in the stock market, entailing a dominant solution. This idea contradicts the neoclassical assumption of fixed preferences, which as well exemplifies the rise of a theory of path dependence from the critique of the neoclassic (Sydow et al. 2005: 700). Nevertheless self-reinforcing processes may not be endless. Accordingly increasing returns might not increase forever, but remain static or even decrease after they reached a certain point (e.g. paradox of trust, transaction costs cannot fall below zero, etc.).

3.3. The Relational View

If one talks about b2b-relationships and the relational rents that may stem from them, the relational view by Dyer and Singh (1998) seems to be the appropriate theory. This approach can enlighten interorganizational resources that are located within certain relationships. According to the relational view, unlike the resource-based view, resources are located within interorganizational relationships and not within the boundaries of organizations only. That is what makes the relational view, besides the fact that the resource orientated theories belongs to the dominant paradigms in strategic management science, the theory of choice to investigate b2b relationships.

The transaction cost economics come into play as the underlying concept of one of the four sources of relational rents, namely effective governance, described by the relational view. An effective relationship government is crucial to obtain relational rents, “because it influences

transaction costs, as well as the willingness of alliance partners to engage in value creation initiatives” (Dyer/Singh 1998: 669). Effective governance mechanisms are mediated by coordination effects that according to Sydow et al. (2009: 698) are likely to lead to the development of organizational paths. According to Dyer (1997) “different safeguards [...] result in different transaction costs over different time horizons”². Furthermore some governance mechanism (e.g. specific contracts) are characterized by decreasing transaction costs with increasing transactions (Dyer/Singh 1998: 670) and by thus ceteris paribus by increasing returns.

Dyer and Singh (1998: 669) categorize governance mechanisms into third-party enforcement and self-enforcing of agreements. The first are mainly contracts, which is the domain of transaction cost economics. The second mechanisms are further distinguished in formal and informal self-enforcing agreements. “Formal self-enforcing safeguards are economic hostages created intentionally to control opportunism (...)” (Ibid.). In general self-enforcing mechanisms are more effective and more efficient in the long run (Ibid.). Although they may have higher set-up costs and might be partner-specific (e.g. trust).

Governance mechanisms can be linked to the self reinforcing mechanisms of coordination effects that according to Sydow et al. (2009: 698) are likely to lead to the development of organizational paths. Coordination effects “build on the benefits of rule-guided behavior: the more actors adopt and apply a specific institution (i.e. an organizational rule or routine), the more efficient is the interaction among these actors” (Ibid.: 699). That thought might also be applicable to an increasing number of transactions between the same actors, because it serves as an uncertainty and by thus as a transaction costs (Williamson 1981: 1546) reducing mechanism. In terms of transaction cost economics self reinforcing mechanisms can be described as decreasing transactions costs with any further (similar) transaction performed with the same partner. According to Williamson (1985: 60) transaction costs are „easier to recover for large transactions of a recurring kind”. Therefore with an increasing frequency of transactions the following transactions of the same kind become more and more attractive, because the transaction costs, depending on the chosen governance mechanism and the perceived opportunism, can be divided among a greater number of transactions. The effectiveness and the costs of relationship governance mechanisms do not solely depend on the mechanism itself but also on the characteristics of the organization and the transaction (Dyer 1997: 538).

² Dyer and Singh (1998: 669) distinguish between three different kinds of relational governance mechanisms as source of relational rents: Third-party enforcement, formal self enforcing agreements and informal self enforcing agreements.

Besides effective relationship governance Dyer and Singh (1998: 661 et seq.) define three additional sources of relational rents. The second source are knowledge-sharing routines, which are a “regular pattern of interfirm interactions that permits the transfer, recombination, or creation of specialized knowledge” and therefore as „institutionalized interfirm processes that are purposefully designed to facilitate knowledge exchanges between alliance partners” (Ibid.). Various authors have showed that, besides the mere access to knowledge, interorganizational knowledge-sharing routines have the potential to lower costs and strengthen quality and by thus enhance overall performance and may lead to competitive advantages (Duschek 2004: 63; Dyer/Hatch 2006: 709 et seq.; Mursitama 2006: 552). The “ability to exploit outside sources of knowledge is largely a function of prior related knowledge or the ‘absorptive capacity’ of the recipient of knowledge” (Dyer/Singh 1998: 665).

The third source of relational rents presented by Dyer and Singh (1998: 666 et seq.) are complementary resources and capabilities. Those resources are defined “as distinctive resources of alliance partners that collectively generate greater rents than the sum of those obtained from the individual endowments of each partner” (Ibid.) and therefore generating relational rents. They furthermore act as a determining motivation factor to conduct interorganizational relationships (Aiken/Hage 1968: 915; Bönnte/Keilbach 2005: 286; Das/Teng 2000: 37; Gulati 1995: 621 ff; Meeus et al. 2001: 150). To generate relational rents by complementary resources and capabilities Dyer and Singh (1998: 667) propose that none of the partners can purchase the relevant resources elsewhere. Consequently complementary resources and capabilities are indivisible and thus building an imitation barrier. First interviews and pre-tests revealed that complementary resources and capabilities are rather a prerequisite for engaging in b2b-relationships in the first place, than self-reinforcing mechanisms. Sydow et al. (2009) characterize this as “pure complementaries without any self reinforcing processes”.

Dyer and Singh (1998: 660) consider relational specific assets as the fourth source of relational rents. Various authors have showed that the performance of an organization is linked to specific assets (Dyer 1996a: 272; Schoemaker/Amit 1994: 28; Parkhe 1993: 806). Those assets „will often permit cost savings to be realized. But investments are also risky, in that specialized assets cannot be redeployed without sacrifice of productive value“ (Williamson 1985: 54). Accordingly the value of relation specific investments is by definition lower in any other alternative usage than the original one (Williamson 1981: 1546; Dyer 1996a: 272). Consequently the organizations are “locked-into” the relationship to a “significant degree” (Williamson 1981: 1546), because

leaving the relationship is coupled with negative economic consequences (Wathne/Heide 2000: 42).

All three preceding sources of relational rents can be considered at least as partially relation-specific assets. They also imply self reinforcing mechanisms of different kinds (e.g. relation-specific absorptive capacity, coordination effects, decreasing average transaction costs due to increasing frequency, etc.). Beyond that, transaction- or relation-specific assets are often understood as the effort that enables transactions in the first place (Sydow 1992: 132). Without specific assets there is no need for any safeguards and consequently no possibility to create any rents by effective governance. Therefore relation-specific assets are prerequisite to realize any relational rents by an effective governance, because specific assets are, under the assumption of bounded rationality, opportunistic behavior, complexity and uncertainty, the drivers of transaction costs (Williamson 1991: 282; Dyer 1996b: 651; Dyer 1997: 535 et seq.) and therefore „the big locomotive to which transaction cost economics owes much of its predictive content“ (Williamson 1985: 56).

Furthermore some governance mechanisms need substantial time to develop (Dyer/Singh 1998: 671) and are for itself relation-specific assets (e.g. trust). Relational rents too are itself by definition (Dyer/Singh 1998: 662) relation-specific. Dyer and Singh (1998: 662) “define a relational rent as a supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners”. Therefore they represent quasi-rents of relational-specific assets. For that reason relational rents are quasi rents or opportunity costs in case of ending the concerned relationship and consequently may lead to path dependence. This very study is solely concerned with those sources of relational rents and self reinforcing effects that are relation-specific, because everything else can be redeployed in any alternative relationship and therefore cannot lead to relational rents and by thus potentially to path dependence.

3.4. Absorptive Capacity

The concept of absorptive capacity has received broad attention in the literature and has been employed to study various units of analyses (Lane et al. 2006: 833 et seq.). In the following the evolving concept in the different streams of the literature will outlined in the style of Schreyögg and Schmidt (2009). Hereby providing an overview on the most relevant literature according to Lane et al (2006: 2006), but laying the focus on an interorganizational context. The concept was first coined by Cohen and Levinthal in the year 1990 and refers in the initial reading to “the

ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen/Levinthal 1990: 128). Moreover the authors point out that absorptive capacity “is largely a function of the firm's level of prior related knowledge” (Ibid.: 128) and by thus “the cumulateness of absorptive capacity and its effect on expectation formation suggest an extreme case of path dependence” (Ibid.: 136).

Lane and Lubatkin (1998) were the first who studied the absorptive capacity in an interorganizational setting. They shift the unit of analysis to a partner-specific absorptive capacity in a student-teacher learning dyad (Ibid.: 462). The authors conclude that the “ability to value, assimilate, and apply new knowledge from a learning alliance partner” depends on a common knowledge base, similar organizational practices and a shared organizational problem set (Ibid.: 474). Similar Dyer and Singh (1998: 665) state that “partner-specific absorptive capacity refers to the idea that a firm has developed the ability to recognize and assimilate valuable knowledge from a particular alliance partner” and “is a function of (1) the extent to which partners have developed overlapping knowledge bases and (2) the extent to which partners have developed interaction routines that maximize the frequency and intensity of sociotechnical interactions”.

Zahra and George (2002: 185) reconceptualised the construct of Cohen and Levinthal (1990) under a dynamic capability view. They distinguished between potential and realized absorptive capacity and adding the fourth dimension of transformation. This refers to the ability to “a firm's capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge” (Ibid.: 190). The potential absorptive capacity consists of the ability to acquire and assimilate new relevant external knowledge and the realized absorptive capacity is composed of the ability to transform and exploit this knowledge (Ibid.: 189 et seq.). Also potential and realized absorptive capacity can evolve separately, but only together they unfold their full effect (Schreyögg/Schmidt 2009). This idea has been criticised by Todorova and Durisin (2007: 780) for not probably reflecting the concept of absorptive capacity as a “set of organizational routines and processes” (Zahra/George 2002: 186) and being characterized by an unclear definition of absorptive capacity. Hence they doubt the need for a new concept of potential and realized absorptive capacity. Accordingly Jansen et al (2005: 1009) found evidence for distinct effects of organizational antecedents on the four components of absorptive capacity. The authors studied the effects of organizational antecedents on both components of the absorptive capacity. They found out that “coordination capabilities (cross-functional interfaces, participation, and job rotation) primarily enhance potential absorptive capacity, while organizational mechanisms associated with socialization capabilities (connectedness and socialization

tactics) primarily strengthen realized absorptive capacity” (Ibid.: 1009). But the results also reveal that those organizational mechanisms have different impacts on each one of the four components (Ibid.: 1009).

In consequence of their criticism Todorova and Durisin (2007: 774) “make a call back to the Cohen and Levinthal roots, and propose a refined model”. They reintroduce the recognition of the value and frame the process of transformation as an alternative and linked process to assimilation. In their understanding knowledge will be assimilated, if the “existing cognitive structure does not change” (Ibid.: 778). The knowledge will be transformed, if the cognitive structures are altered to adapt the new knowledge (Ibid.). Assimilation and transformation are likely to be linked together and knowledge moves forth and back to be absorbed (Ibid.: 779).

Lane et al. (2006) choose a different perspective by differentiate the absorptive capacity into three process. They define absorptive capacity as the „firm’s ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning, and (3) using the assimilated knowledge to create new knowledge and commercial outputs through exploitative learning.“ The classification into exploratory, transformative and exploitive learning is also addressed and operationalized by Lichtenthaler (2009: 822) who “identifies technological and market knowledge as two critical components of prior knowledge” and found evidence “that exploratory, transformative, and exploitative learning have complementary effects on innovation and performance”.

Most studies about absorptive capacity have one thing in common: Starting with Cohen and Levinthal (1990: 135 et seq.) many authors (Mowery et al. 1996: 80; Lane/Lubatkin 1998: 463; Dyer/Singh 1998: 665; Van den Bosch et al. 1999: 554; Zahra/George 2002: 195; Jansen et al. 2005: 1000; Lavie/Rosenkopf 2006: 803; Todorova/Durisin 2007: 778 et seq.; Lichtenthaler 2009: 823 et seq.) point out that path dependence play a crucial role in the development of absorptive capacity. According to Cohen and Levinthal (1990: 128) absorptive capacity “is largely a function of the firm’s level of prior related knowledge”. Dyer and Singh (1998: 665) argue that a partner-specific absorptive depends on overlapping knowledge-bases of the two partners. Similar Van den Bosch et al. (1999: 566) speak of feedback loops between prior related knowledge and the absorptive capacity. The absorptive capacity of the organization is characterized by self reinforcing mechanisms, because every investment in absorptive capacity strengthens the organizations ability to value, acquire and exploit new knowledge in that particular area in which the

organization has already build its absorptive capacity. To put it another way: “Accumulating absorptive capacity in one period will permit its more efficient accumulation in the next” (Cohen/Levinthal 1990: 136). “The learning effect theory holds that the more often an operation is performed, the more efficiency will be gained with subsequent iterations” Sydow et al. (2009: 700). Furthermore “in an uncertain environment, absorptive capacity affects expectation formation, permitting the firm to predict more accurately the nature and commercial potential of technological advances” (Ibid.). Speaking of self reinforcing processes that underlie the (relation-specific) absorptive capacity one should not forget the potential inefficiency that may stream from that very processes. Sydow et al. (2009: 700) draw attention to the fact that increasingly exploitative learning may drive out explorative learning and that legitimacy from the organization may suppress the search for “fresh alternatives”. Congruent Cohen and Levinthal (1990: 128) argue that a lack of investment in a certain area may foreclose the development of future capabilities in that very area. This self reinforcing process may lead to a lock-in in certain knowledge domains and to a lock-out of other domains in which no absorptive capacity has been build (Cohen/Levinthal 1990: 135 et seq.).

4. Theoretical Model

Organizations can be locked in certain relationships if this relationship is characterized by relational rents and by thus by opportunity costs in case of ending that very relationship. Consequently it may lead to potential inefficiency, if the organization has jointly generated relational rents in an established relationship and cannot foresee all alternatives and cannot fully predict the relational rents that could be realized over time. Additionally this can be seen as strategic inefficiency, because the organization might loss some of its flexibility. As a result the organization might be lock-in a certain relationship and thus path dependent. The (potential) inefficiency, which is according to Sydow et al. (2009: 696) a decisive feature of path dependence, comes into play if a new path (e.g. a new market entrance that can offer lower prices or pays higher prices etc.) emerges. Incidentally it does not matter whether the new path is actually new or just new to the considered organization due to bounded rationality. However if a new more efficient path emerges (i.e. lower transactions costs or higher transaction value) the organization might be locked-in, because the relational rents generated in the established relationship serve as opportunity costs³ that reduce the alternative rents that can be created by following the alternative path. It might be impossible at a certain point (i.e. lock-in) to switch from the established path to an alternative path once the opportunity costs of the established path are high enough. It is however

³ What matters for this line of argumentation are not sunk costs, but opportunity costs only, although sunk costs are not irrelevant in imperfect capital markets and under the assumption of bounded rationality.

important to note that the costs associated with the established or any alternative path can change over time. This could be caused by internal (e.g. lost of confidence) or external shocks (e.g. new technologies).

To show the down-side of the sources of relational rents, the sources of relational rents will be linked to an organizational lock-in in the following (see figure 2). As already discussed knowledge-sharing routines induce relational rents by lowering the costs of knowledge transfer and enhancing the possibility of gaining new ideas and innovations (Dyer/Singh 1998: 665). They are a function of prior related knowledge and the firm's partner-specific absorptive capacity (Ib-id.) and therefore subject to self reinforcing learning effects. The self reinforcing mechanisms are operationalized as a reciprocal causation between knowledge exchange and partner-specific absorptive capacity defined as a set of interorganizational routines and processes that foster the acquisition, assimilation, transformation and exploitation of partner-specific knowledge and by thus building a source of relational rents. As a result the more absorptive capacity has been build the higher the costs in terms of time and money to find an alternative relationship. Mooi and Gosh (2010: 107) define a "lock-in as the difficulty a buyer faces in switching or replacing products or suppliers". Additionally the construct while be applied to the difficulty a supplier faces in finding a new buyer.

H1a: The more knowledge will be exchanged, the higher the partner-specific absorptive capacity.

H1b: The higher the partner-specific absorptive capacity, the more knowledge will be exchanged.

H1c: The higher the partner-specific absorptive capacity the greater the lock-in.

Effective governance mechanisms lead to relational rents by motivating b2b-relationship partners to engage in value creating initiatives and reducing transaction costs. The more often certain governance mechanisms are used, the higher the coordination effects which are reducing uncertainty and therefore transaction costs. Therefore some performance might be lost by terminating the established relationship.

Following Dyer and Nobeoka (2000: 348) there are three dilemmas to solve in interorganizational knowledge transfer: First the partner has to be motivated to share his knowledge, secondly opportunistic behavior has to be minimized and thirdly the efficiency of the knowledge transfer has to be maximized. All three dilemmas can be solved by effective governance mechanisms.

According to Dyer and Singh (1998: 670 et seq.) trust is one of the most effective and efficient governance mechanisms. Similar Yli-Renko et al (2001) found out that trust has a positive influence on the ability to acquire knowledge. In sum trust not only has a positive effect on a lock-in situation, but also enhances the partner-specific absorptive capacity.

H2a: The more trust has been developed, the higher the partner-specific absorptive capacity.

H2b: The more trust has been developed, the greater the lock-in.

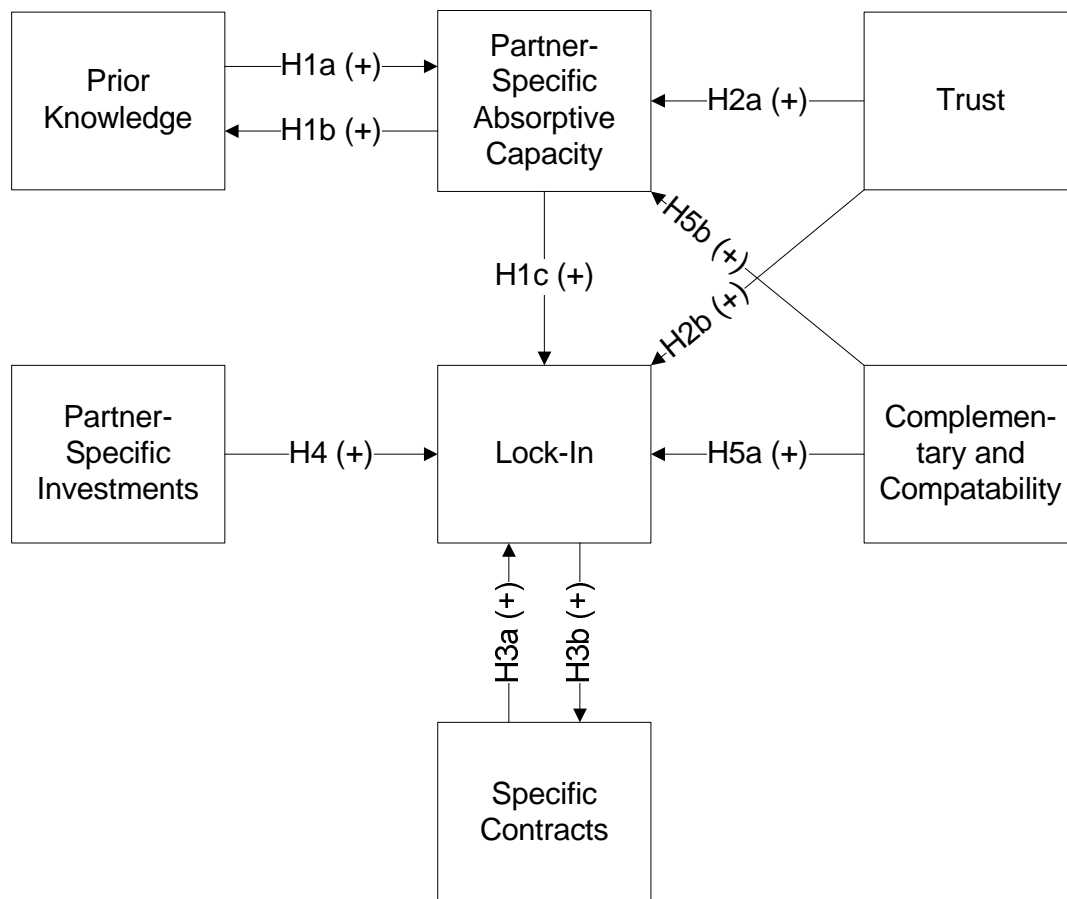


Figure 2: Path Dependence in B2B-Relationships

The second governance mechanism financial hostages were left out of the model because the exploratory study suggests that those mechanisms are neither self-reinforcing nor a commonly used governance mechanism to motivate partners to make partner-specific investments or reduce transaction costs. Nevertheless a corresponding variable was included in the questionnaire for further investigation. The third governance mechanism according to Dyer and Singh (1998: 669) are contracts. As already discussed only partner-specific sources of relational rents may lead to a

situation where partners are locked into their relationship. Therefore specific contracts may be used to control for opportunism and by thus created relational rents, but may also increase the danger of being locked-in the relationship. Mooi and Gosh (2010: 107) “use ‘contract specificity’ to indicate the extent to which contract terms with respect to (1) technical specifications of the product, (2) implementation procedures, (3) financial and legal considerations, and (4) overall contractual features are specified in detail ex ante”. They further found evidence for a positive effect of a lock-in situation on the degree of contract specificity because a lock-in “implies higher switching costs and increases the hazards of opportunistic behavior” (Ibid.) and therefore the need for governance mechanisms which serve as safeguards of specific investments against opportunism. Accordingly the relationship between lock-in and contract specificity is operationalized as a feedback loop.

H3a: The higher the degree of contract specificity, the greater the lock-in.

H3b: The greater the lock-in, the higher the degree of contract specificity.

Different, however, from lost performance costs, which are caused by lost benefits and cost reductions from established knowledge-sharing routines and effective governance mechanisms, sunk costs are caused by lost quasi-rents of relation-specific assets. Sunk costs only occur if relation-specific investments have been made. Relation-specific assets only pay off as long as the relationship exists. Jones et al. (2002) together with Whitten and Wakefield (2006) noted that “sunk costs are economically irrelevant but psychologically important” (Jones et al. 2002: 443). In this study the focus is not on psychological effects, but rather on specificity that, as soon as the relationship will be ended, transform into sunk costs.

H4: The more partner-specific investments made, the greater the lock-in.

According to Dyer and Singh (1998) complementary resources and capabilities are also one of the sources of relational rents. In the line of the previous argumentation it will hypothesized, that complementary and compatability between partners in a b2b-relationship will have a positive influence on a relationship lock-in. Although Kale et al. (2000), whose scale will be employed, could not show a positive relationship between complementary capabilities and learning, a positive effect on absorptive capacity was added to the model because various authors found evidence for that relationship (Cohen/Levinthal 1990: 135; Mowery et al 1996: 80; Dyer/Nobeoka 2000: 353; Nobeoka et al. 2002: 732; Zahra/George 2002: 193).

H3a: The higher the degree of complementary and compatability between partners, the greater the lock-in.

H3b: The higher the degree of complementary and compatability between partners, the higher the partner-specific absorptive capacity.

5. Methodology

5.1. Exploratory Qualitative Study

To gain first insights and to prepare the questionnaire interviews with executives of German companies in China were employed. Semi-structured interview templates, concerning what characterizes the most important German and Chinese b2b-relationship the company has, were used. Data were collected from open-ended interviews⁴. Of a total of 19 interviews 17 were in-depth, 30-minutes to one and a half hour in-person interviews with executives at a regional manager level. Additionally, two 30-minutes telephone interviews were used. The unit of analysis are German companies that are doing business and that are represented in Shanghai, China.

Relational knowledge-sharing routines and relational governance mechanisms have a positive effect on the lock-in and reported by interviewees. “For example, I got a supplier ... in which I invested one or two years work until he understands the standard and is capable of producing [set-up costs A/N]. And now you can reap the fruits. [...]. If I would switch now and get a new one [supplier A/N], I would have to invest one or two years again. That is easily ... 30, 40, 50.000 Euros ...“

“That is a benefit. If you have a good relationship to you customers, and if you know what is coming up to you [reduced uncertainty A/N]...”

Self reinforcing mechanisms are a matter of frequency (Sydow et al. 2009: 698). Likewise coordination and learning effects, as confirmed by various interviewees, are strengthens by transaction frequency, for example: „There is always a learning effect. If you have consistently the same partner, the same business partner, and you deal with them more often there will be a learning effect on both sides”. The same holds true for coordination effects and the relation-specific absorptive capacity as reported by one interviewee in the following statement: „The negotiations will be always easier, if you work together with the same [partner A/N], ... because, if you work

⁴ The quotations of those interviews conducted in German were translated into English. 16 out 19 interviews were conducted in German.

together with somebody over a longer timeframe, you will be able to pull the contract right out of your pocket, practically finished, because you know what the other wants to be considered.” Furthermore the interviews indicated that companies that generate high relational rents, in absolute amounts and relative to any general rents, within one or few b2b-relationships have fewer alternatives. Accordingly one interviewee stated: “The whole thing [b2b-relationships in China compared to Germany A/N] is more emotionally loaded and it just takes some time to build up a relationship. Therefore you cannot make business en masse with thousands of customers, but rather due to time restrictions it is limited to a few customers with them you have to do more, that is the typical Cross-Selling what we are doing here.” Hence the strategic flexibility is more and more limited with increasing switching costs. Likewise other Interviewees reported that a limited flexibility enhances the likelihood of carrying further that particular b2b-relationship.

Regarding the second research question the interviews showed that contracts are important governance mechanisms in both Germany and China. However interviewees reported in unison that they either never tried to or failed to enforce any contract at court in China. Contracts in China were rather seen as a roadmap than as binding agreement. As reported in the following statements: “The contract itself, especially in China, is rather a scrap of paper, which is actually not relevant; therefore no one will make a payment here just based on a contract”. “As a basic principle there will always be contracts concluded. But one has to take into consideration that here in China contracts are seen differently than in Europe. Even if a contract is signed it will not remain forever. Even after the signing of the contract one is rather set and willing to discuss and change that agreement if that will make sense for both sides.”

As the data further revealed b2b-relationships in China are more costly and time consuming and require more relation-specific investments, as reflected in the following statements: “It is just a different culture. Relationships in Europe can be handled a bit more superficial. Here in China, if one wants to build and cherish a relationship, one will have to cement ties.” “In China the b2b-relationship requires that you have to be more responsive, more emotionally responsive, to your counterpart.” “Until the contract is signed, one has fewer costs in Germany [compared to China A/N].” Accordingly German companies tend to have higher relational rents and therefore switching costs generated within and specifically tailored to a particular relationship, in China than in Germany where those companies tend to have more b2b-relationships with a relatively smaller stake of the overall profits.

5.2. Simultaneous Equation Modeling

In order to test the first theoretically derived hypotheses a quantitative research design, in form of a simultaneous equation model, will be applied. Furthermore to test the second hypothesis a multi group analysis will be employed. A quantitative research design enables the validation of the conflation of the underlying theoretical concepts. Beyond that this design allows a (limited) generalization of the findings about if and how path dependence develops in the light of the previously mentioned theories.

Subsequent to the conceptual framework and the theoretical model I will describe the empirical design by following the different phases of the research process described by Schnell et al. (2005: 8) and the approach of Mellewigt (2003: 149 et seq.). According to this I will lay out the research design, the unit of analysis, the data source and the operationalization. According to De Vaus (2003: 10) one can distinguish between the following research designs: experiments, case studies, longitudinal design and cross-sectional design. The classical experimental design includes the field and the lab experiment (Schnell et al. 2005: 224 et seq.). Both can be excluded from this study, because it is (nearly) impossible to replicate the complex organizational structures of interorganizational relationships in a laboratory or to convince any organization to change its b2b relationships and to take the attended risk just for the good of science (Kubicek 1975: 67 et seq.; Mellewigt 1995: 138). Among quasi-experimental designs Schnell et al. (2005: 229 et seq.) rate natural and quasi-experimental designs. Both experimental designs are ruled out, because it can neither be assumed that the independent variable will “naturally” change nor can the independent variable, because of the reasons mentioned above, be changed by the researcher. A case study design is also excluded, because this design does not allow any conclusions whether the same measures lead to the same outcomes in different contexts or organizations, (Kubicek 1975: 59), whereas the research question is concerned with a (limited) generalization. The longitudinal design is theoretically suitable, but in consideration of its high personnel, financial and temporal effort compared to a cross-sectional design it is not practical (De Vaus 2003: 176; Kubicek 1975: 63; Mellewigt 1995: 139). Beyond that cross-sectional designs allow statements about the conditionality of organizations and about the effect of organizational measures and consequently one can capture regularities in organizational behavior and test corresponding hypotheses (Kubicek 1975: 63).

In order to test the developed hypothesis it is in principal possible to either analyze secondary data or to collect primary data (Mellewigt 2003: 152). Due to a lack of available secondary data the collection of primary data is mandatory (Ibid.). According to Schnell et al. (2005: 319) there

are three different procedures to collect data: surveys, observations and content analysis. Following the reasoning of Mellewigt (1995: 143 et seq.), I have chosen the survey design to collect the data. I will conduct the survey using a structured self-administering questionnaire (see appendix) which is received and returned by mail. I chose this method of questionnaire administration after having weighted the advantages and disadvantages of this method accordingly to de Vaus (2003: 188), Mellewigt (2003: 162 et seq.) and Schnell et al. (2005: 321 et seq.).

The development of the questionnaire requires an elaborated pre-testing (Schnell et al. 2005: 448). Furthermore a pre-test ensures the validity and reliability of the measuring instruments (Ibid. 11). Within the scope of the development of the questionnaire the pre-test aims to clarify whether the questions are intelligible and unambiguous (Ibid.). Following Schnell et al. (Ibid. 448) a pre-test has been carried out by conducting qualitative interviews with the target population. To further ensure validity, this study relies primarily on items used in prior research and was pre-tested. The Pre-test was conducted by holding a focus group with fellow academics from the Freie Universität Berlin and a discussion with 30 executives from sale departments after they filled in questionnaire.

The unit of analysis and therefore the statistical population are German companies that are doing business and are represented in China or the USA with at least an own representative office. The data will be collected from a contact database provided by the German Chamber of Commerce in China and the USA. The database contains the address of approximately 3500 German companies in each country.

In the appendix I will lay out the operationalization according to the theoretical background discussed above. All variables, besides some control variables, will be measured on a seven-point-scale and asked for most important business relationship with a local buyer and a local supplier. Therefore the questionnaire will be two-parted. Furthermore the reduced form equations to show that the model is just identified will be provided.

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Appendix

List of Variables

Variable / Indicator	Question	Reverence
Prior Knowledge	To what extent have you learned from your customer new technological expertise? new marketing expertise? new product development expertise? managerial techniques? new manufacturing process expertise?	Lane et al. (2001)
Absorptive Capacity	Regarding your specific customer relationship, please let us now know if you agree with the following statements: Our company has frequent interactions with our customer to acquire new knowledge. Employees of our company regularly visit our customer. We collect information from our customer through informal means (e.g. lunch). Our company periodically organizes special meetings with our customers to acquire new knowledge. We are slow to recognize shifts in our customers demand. We quickly understand new opportunities to serve our customer. We quickly analyze and interpret changing needs of our customer. Our company regularly considers the consequences of changing needs of our customer in terms of new products and services. Employees record and store newly acquired knowledge regarding our customer for future reference. Our company quickly recognizes the usefulness of new external knowledge compared to existing knowledge regarding our customer. Employees hardly share their practical experiences among each other about our customer. We laboriously grasp the opportunities for our company from new knowledge from our customer. Our company periodically meets to discuss consequences of changing needs of our customer. We clearly know how activities within our company regarding our customer should be performed. Complaints of our customer fall on deaf ears in our company. Our company has a clear division of roles and responsibilities regarding our customer. We constantly consider how to better exploit knowledge regarding our customer. Our unit has difficulty implementing new products and services regarding our customer. Our company and our customer have a common language regarding our products and services. Due to the relationship of our company with that customer, we could increase the profits above industry average.	Jansen et al. (2005)
Trust	Our Customer has always been even handed in its negotiation with your company. This Customer may use opportunities that arise to profit at your expense. Based on past experience, your company cannot with complete confidence rely on this customer to keep promises made to your company. Your company are hesitant to transact with this customer when specifications are vague. Your company trust this customer to treat your company fairly. Your company trust that confidential/proprietary information shared with this customer will be kept strictly confidential.	Gulati/Sytch (2007)

	Your company engages in ongoing discussion with the supplier to jointly improve both their operations and yours.	
	Both parties expect to be able to make adjustments in the ongoing relationship to be able to deal with changing circumstances. Problems that arise in the course of the relationship are treated by parties as joint rather than individual responsibilities.	
Partner-Specific Investments	We have made significant investments in tooling and equipment dedicated to our relationship with this customer. This customer has some unusual technological norms and standards, which have required adaptation on our part. Training and qualifying this customer has involved substantial commitments of time and money Our production system has been tailored to using the particular items bought from this customer Our production system has been tailored to meet the requirements of dealing with this customer Gearing up to deal with this customer requires highly specialized tools and equipment	Heide/John (1992)
Lock-in	If the relationship with our customer failed and had to be replaced, what would be the loss in terms of time and money, associated with finding a new customer? training your personnel? data and information entry? stoppage at production departments?	Mooi/Ghosh (2010)
Complementarity and compatibility	There is high Complementarity between the resources/capabilities of the two partners There is high similarity/overlap between the core capabilities of each partner The organizational cultures of the two partners are compatible with each other The management and operating styles of the partners are compatible with each other	Kale et al. (2000)
Specific Contracts	How specifically tailored to your customer were the contractual features with respect to the following Implementation procedures Financial and legal conditions Technical specifications Agreement as a whole Regarding your specific customer relationship, please let us now how much you are involved in the following operations of your customer Initial product/ service design Quality improvement Cost control Product modification Production process Sub-sourcing Forecasting commodity requirements	Mooi/Ghosh (2010)
Financial Hostages	Has your company made any equity investments (e.g. equity stake, venture capital) in your customer's company? If yes, how many percent of the total equity of your customer does your company own? _____ percent Has your customer made any equity investments (e.g. equity stake, venture capital) in your company? If yes, how many percent of the total equity of your company does your customer own? _____ percent	Deeds/Hill (1998)

Table 1: List of Variables (using the example of the sales department questionnaire)

Model Identification

$$Y_1 = \beta_{12}Y_2 + \mu_1$$

$$Y_2 = \gamma_{21}X_1 + \gamma_{23}X_3 + \beta_{21}Y_1 + \mu_2$$

$$Y_3 = \gamma_{31}X_1 + \gamma_{32}X_2 + \gamma_{33}X_3 + \beta_{32}Y_2 + \beta_{34}Y_4 + \mu_3$$

$$Y_4 = \beta_{43}Y_3 + \mu_4$$

$$Y_1 = \beta_{12}Y_2 + \mu_1$$

$$Y_1 = \beta_{12} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} X_1 + \beta_{12} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} X_3 + \beta_{12} \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1 + \beta_{12} \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2 + \mu_1$$

$$\Pi_{11} = \beta_{12} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}}$$

$$\Pi_{13} = \beta_{12} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}}$$

$$M_1 = \beta_{12} \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1 + \beta_{12} \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2 + \mu_1$$

$$Y_2 = \gamma_{21}X_1 + \gamma_{23}X_3 + \beta_{21}Y_1 + \mu_2$$

$$Y_2 = \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} X_1 + \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} X_3 + \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1 + \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2$$

$$\Pi_{21} = \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}}$$

$$\Pi_{23} = \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}}$$

$$M_2 = \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1 + \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2$$

$$Y_3 = \gamma_{31}X_1 + \gamma_{32}X_2 + \gamma_{33}X_3 + \beta_{32}Y_2 + \beta_{34}Y_4 + \mu_3$$

$$Y_3 = \left(\frac{\gamma_{31}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} \right) X_1 + \frac{\gamma_{32}}{1 - \beta_{34}\beta_{43}} X_2$$

$$+ \left(\frac{\gamma_{33}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} \right) X_3 + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1$$

$$+ \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2 + \frac{1}{1 - \beta_{34}\beta_{43}} \mu_3 + \frac{\beta_{34}}{1 - \beta_{34}\beta_{43}} \mu_4$$

$$\Pi_{31} = \left(\frac{\gamma_{31}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} \right)$$

$$\Pi_{32} = \frac{\gamma_{32}}{1 - \beta_{34}\beta_{43}}$$

$$\Pi_{33} = \left(\frac{\gamma_{33}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} \right)$$

$$M_3 = \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1 + \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2$$

$$Y_4 = \beta_{43} Y_3 + \mu_4$$

$$\begin{aligned} Y_4 = & \beta_{43} \left(\frac{\gamma_{31}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} \right) X_1 + \beta_{43} \frac{\gamma_{32}}{1 - \beta_{34}\beta_{43}} X_2 \\ & + \beta_{43} \left(\frac{\gamma_{33}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} \right) X_3 + \beta_{43} \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1 \\ & + \beta_{43} \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2 + \beta_{43} \frac{1}{1 - \beta_{34}\beta_{43}} \mu_3 + \left(1 + \beta_{43} \frac{\beta_{34}}{1 - \beta_{34}\beta_{43}} \right) \mu_4 \end{aligned}$$

$$\Pi_{41} = \beta_{43} \left(\frac{\gamma_{31}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} \right)$$

$$\Pi_{42} = \beta_{43} \frac{\gamma_{32}}{1 - \beta_{34}\beta_{43}}$$

$$\Pi_{43} = \beta_{43} \left(\frac{\gamma_{33}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} \right)$$

$$\begin{aligned} M_4 = & \beta_{43} \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\beta_{21}}{1 - \beta_{21}\beta_{12}} \mu_1 + \beta_{43} \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{1}{1 - \beta_{21}\beta_{12}} \mu_2 + \beta_{43} \frac{1}{1 - \beta_{34}\beta_{43}} \mu_3 \\ & + \left(1 + \beta_{43} \frac{\beta_{34}}{1 - \beta_{34}\beta_{43}} \right) \mu_4 \end{aligned}$$

$$\Pi_{11} = \beta_{12} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}}$$

$$\Pi_{13} = \beta_{12} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}}$$

$$\Pi_{21} = \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}}$$

$$\Pi_{23} = \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}}$$

$$\Pi_{31} = \left(\frac{\gamma_{31}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} \right)$$

$$\Pi_{32} = \frac{\gamma_{32}}{1 - \beta_{34}\beta_{43}}$$

$$\Pi_{33} = \left(\frac{\gamma_{33}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} \right)$$

$$\Pi_{41} = \beta_{43} \left(\frac{\gamma_{31}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{21}}{1 - \beta_{21}\beta_{12}} \right)$$

$$\Pi_{42} = \beta_{43} \frac{\gamma_{32}}{1 - \beta_{34}\beta_{43}}$$

$$\Pi_{43} = \beta_{43} \left(\frac{\gamma_{33}}{1 - \beta_{34}\beta_{43}} + \frac{\beta_{32}}{1 - \beta_{34}\beta_{43}} \frac{\gamma_{23}}{1 - \beta_{21}\beta_{12}} \right)$$

Ten (reduced form) equations and ten unknowns à just identified.