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Managing Asymmetric Resource Dependence and Environmental Risk in Relationships by Real Options[**]

Asymmetric dependence in buyer-seller relationship is probably among the most widely studied phenomena in relationship research. However, the focus on asymmetric resource dependence has mainly addressed risks within the buyer-seller dyad and has largely disregarded external types of risk affecting relationships. This paper examines how to balance resources in relationships when there is inter-organizational dependence *and* when there is environmental risk. The author uses a formal real options model to analyze the effects of different types of risk having an impact on relationships and to determine an optimal management of relationships when there is asymmetric dependence and environmental risk.

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1. Introduction

The management of industrial buyer-seller relationships has become one of the key issues in management research over the last two decades. Several frameworks have been applied to explain the existence of close buyer-seller relationships and to deduct appropriate implications for the management of relationships. Economic theories as well as behavioral approaches serve as foundations for the analysis of buyer-seller relationships such as the Resource-Based View (e.g. Prahalad/Hamel 1990; Morgan/Hunt 1999), the Resource Dependence Perspective (e.g. Emerson 1962; Pfeffer/Salancik 1978), Transaction Cost Economics (e.g. Williamson 1985, Williamson 1991), as well as Social-Exchange Theory (e.g. Thibaut/Kelley 1959; Homans 1974).

A particular challenge for partners is the management of the resources in a relationship and the related resource dependence. Therefore, dependence and (a)symmetry of dependence in buyer-seller relationships are probably among the most widely studied constructs in relationship research (e.g. Heide/John 1988; Anderson/Narus 1990; Buchanan 1992; Frazier/Antia 1995; Soellner 1999). Dependence arises when external parties provide important resources for which there are only few alternatives (Emerson 1962, Pfeffer/Salancik 1978).[1] In buyer-seller relationships, the main focus is on the resources provided by relationship partners. Relationship partners offer external resources, which ensure the firm's survival in the long run.[2]

Relative dependence indicates whether a relationship is symmetric or asymmetric. To determine relative dependence, the levels of dependence are compared between the parties to the relationship. If the dependence of both parties is assessed equally, the partnership is symmetric. If the dependence of both parties has different levels, the partnership is asymmetric (e.g. Buchanan 1992). Especially when levels of dependencies diverge, i.e. where the one or the other party is more dependent than the other, management problems are likely to occur in exchange. In this case of asymmetry, the risk of opportunism arises.[3] The party being less dependent compared to the other party thus having a dependence advantage will manifest tendencies to exploit the partner (McAlister et al. 1986; Gundlach/Cadotte 1994; similar Williamson 1985).

The analysis of buyer-seller relationships on the basis of the Resource Based View and Resource Dependence Theory has added precious insights into the management of relationships. However, there are two problems related to Resource Dependence analysis applied to buyer-seller relationships. (1) The focal interest is frequently directed towards risk *within* the buyer-seller dyad. Opportunistic behavior as a type of behavioral risk has been analyzed in depth in the relationship literature. In contrast, the role of external risks affecting buyer-seller relationships has been disregarded in a large number of contributions even though Pfeffer/Salancik (1978) have

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[1]   Dependence is often viewed as the obverse of power (Emerson 1962).

[2]   In this paper, we consider mainly measureable resources such as cash flows delivered from relationship partners.

[3]   Williamson (1985: 47) defines opportunism as "self-interest seeking with guile".

explicitly included environmental risk into their framework.[4] Left unexplored is a differentiation between various types of risk in connection with resource dependencies. (2) The Resource Based View and Resource Dependence Theory are based on a qualitative frameworks using theoretical reasoning. A formal mathematical modeling of relationships including both aspects, i.e. aspects of dependencies and environmental risks, has been rarely applied. Formal mathematical modeling is especially valuable to investigate causal links between variables. Theoretically clear and consistent results can be achieved by a formal study of dependence and environmental risk.

The aim of this paper therefore is to jointly analyze dependencies and environmental risks by a real options modeling. It can be shown that balancing asymmetric relationships protects resource from the partners against expropriation. The effect of demand fluctuations on resource in relationship is ambiguous. However, it may be favorable to leave asymmetric relationships imbalanced when there is technological change in order to keep options open to profit from alternative resources, which may be available in the future. Interaction or trade-off effects occur when partners are exposed to behavioral risk *and* technological risk.

The next section briefly summarizes the core elements of the Resource Dependence Perspective. It discusses relative dependence along with (a)symmetries in relationships, gives real world examples, and links Resource Dependence Theory to Social Exchange Theory and Transaction Cost Economics. Section 3 briefly introduces the Real Options Analysis in order to lay a foundation for further discussion of a real options approach towards dependencies and environmental risks in relationships. The paper concludes with a discussion of the results and offers suggestions for future research.

2.   (A)symmetric Resource Dependence in Relationships

Pfeffer/Salancik (1978) argue that resource dependence consists of three different elements. First of all, dependence comprises the *importance* of a resource. Transferred to the issue of buyer-seller relationships, a resource is important when it is of high value to a partner. This is the case when a supplier sells a large fraction of her products to one particular customer; or, vice versa, when a customer buys a large fraction of his purchases from one particular supplier (Heide/John 1988). Dependence in relationships rises with the importance or magnitude of the resource provided the partner.

Second, dependence comprises the extent to which the external party has discretion over the resource (Pfeffer/Salancik 1978). In buyer-seller relationships discretion over a resource relates to the extent that the partner has control over the resource. This is the case when a partner has the possibility to withdraw his/her resources from the relationship. For example, when a partner is able to cancel the relationship prior to maturity he/she has high discretion on the decision whether to stay or whether to exit a relationship. Dependence in relationship increases with the extent of the partner's discretion over the resource.

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4   Authors such as Buchanan (1992) or Frazier/Antia (1995) have studied environmental risk in connection with dependence in relationships. Nevertheless, the environmental risk construct traditionally used in resource dependence has been studied on a fairly abstract level.

Third, resource dependence rises when there are few alternatives instantly available (Pfeffer/Salancik 1978). When the resources provided by a partner in a buyer-seller relationship are difficult to replace due to a lack of alternatives, dependence increases. For example, when a customer is in a relationship with one supplier who holds a patent on a specific technology, he will be dependent on the supplier since no other supplier is capable of providing the same technology. Vice versa, a supplier may be dependent on a customer when she produces a highly specialized product tailored to the needs of a particular customer. Such a product is unlikely to be sold elsewhere. Dependence increases with declining numbers of alternative trading partners available.

The third element 'number of alternatives' relates to arguments that have been equally discussed within other theoretical frameworks applied to the analysis of buyer-seller relationships. Social-Exchange Theory as well as Transaction Cost Economics use constructs which are similar to the 'number of alternatives' and which help to analyze dependence in relationships in more detail. Thibaut/Kelley (1959), as supporters of the Social-Exchange Theory, argue that the parties to a relationship judge the outcomes of a relationship (rewards received minus costs incurred) against a comparison level (CL) and a comparison level for alternatives (CL_{alt}).[5] The comparison level for alternatives CL_{alt} is defined as "the lowest level of outcomes a member will accept in the light of available alternative opportunities" (Thibaut/Kelley 1959: 21). Its level is determined by the quality of the best alternative available to a partner. Consequently, dependence in relationships arises when the outcomes received from a relationship are higher than outcomes from alternative partners (CL_{alt}) (Thibaut/Kelley 1959; Anderson/Narus 1984; Heide/John 1988; Anderson/Narus 1990).

According to Transaction Cost Economics, the specificity of assets determines the dependence of partners in relationships (e.g. Williamson 1985; Williamson 1991). Frequently, specific assets have to be dedicated to a relationship to start-up and to maintain the relationship. Since a party's resources are limited, the dedication of specific resources to a relationship needs careful consideration. These specific resources – in turn – provide access to external resources such as customers or suppliers. Specificity of assets or resources dedicated to relationships relate to physical and human assets that cannot be redeployed without valuable sacrifice if relationships are prematurely terminated (Williamson 1985). To measure the degree of specificity, quasi-rents serve as indicators. Klein et al. (1978, 298) forward a basic definition: "The quasi-rent value of the asset is the excess of its value over its salvage value, that is, its value in its next best *use* to another renter". Consequently, the degree of specificity varies to the extent of the existence and the level of a salvage value. As soon as one party has dedicated specific assets or resources to an exchange alternative uses or user becomes comparatively worthless.[6] Dependence on a parnter arises because a specific asset has relatively little or no value outside the exchange. The lower the value of second best alternatives of using an asset dedicated to a relationship, the higher the

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5   The comparison level CL is usually defined as the expected standard of outcomes against which the partners measure the attractiveness of a relationship (Thibaut/Kelley 1959).

6   Williamson (1985) calls this process fundamental transformation. He suggest that an ex ante competitive situation turns into a bilateral monopoly ex post.

of using an asset dedicated to a relationship, the higher the quasi-rent and the higher the specificity of assets, and finally the higher the dependence on the partner.

In sum, besides the 'number of alternatives' in buyer seller relationships it is *the value of second best alternatives* as reflected by Thibaut/Kelley's CL_{alt} and by Williamson's asset specificity concept that may cause dependence on partners. This equally relates to the scarcity of resources as proposed by Pfeffer/Salancik (1978). If a party to a relationship has just *one* alternative trading partner apart from the existing partner and if this alternative partner provides a comparatively high value (which means that the second best alternative user can provide similar outcomes compared to the incumbent partner), dependence in relationship will decline. In this case, dependence is low although the number of alternatives is small.

In addition to the dependence construct, relationship research has added the criterion of relative or reciprocal dependence in relationships determining when dependence becomes disadvantageous in relationships (e.g. Anderson/Weitz 1989; Anderson/Narus 1990; Buchanan 1992; Gundlach/Cadotte 1994). Relative dependence can be measured by comparing a party's dependence to the partner's dependence on the relationship (Anderson/Narus 1990; Buchanan 1992). It is "the difference in the dependence levels, taken from the perspective of the focal organization" (Gundlach/Cadotte 1994: 518).

By comparing the supplier's dependence with the customer's dependence or vice versa, relative dependence can have four different outcomes according to whether dependence is high or low on each side of the relationship (Table 1).

Table 1:   Relative rependence in buyer-seller relationships

		Customer's Dependence	
		low	high
Supplier's Dependence	low	(1) Symmetry	(2) Asymmetry
Supplier's Dependence	high	(3) Asymmetry	(4) Symmetry

When dependence is balanced between a supplier and a customer, i.e. when dependence is either low or high on both sides of the relationship, cases of symmetry prevail (Case 1 and 4). Case 1 is unproblematic since neither party is dependent on the other. Conflicts and management problems are unlikely to occur. In Case 4, dependence of both parties is high because resources are important to both parties, the opposite parties have discretion over the resource and valuable outside opportunities do not exist. In this situation, which is equivalent to a bilateral monopoly, conflicts are unlikely to occur since the partner's demands can be resisted due to the partner's dependence (Thibaut/Kelley 1959).

The management of relationships becomes problematic when dependence diverges. These are cases of asymmetry (Case 2 and Case 3). In Case 2, the supplier is less dependent than the customer so that the supplier dominates the relationship. The supplier is then likely to show opportunistic tendencies since the resource provided by customer are not important, the customer has no discretion over the resource, and the supplier has alternative, valuable outside options. As an example, consider technologies developed in the automobile industry. *Bosch* for example developed ESP (Electronic Stability Program) and is therefore the only supplier in the relationship with *Mercedes Benz* that is able to deliver the product. *Bosch* as the supplier of the technology is important to *Mercedes Benz*, it has discretion over its resources, and there is a lack of alternatives to *Mercedes Benz*. *Bosch* in turn sells its technology to other carmakers (such as *Volkswagen*) so that it has alternative trading partners, which makes *Bosch* less dependent on *Mercedes Benz*.

In the opposite case, the customer is less dependent than the supplier (Case 3). The customer dominates the relationship. In this situation, the customer can try to exploit the supplier since the customer's resources are important to the supplier, the supplier has no discretion over the resources, and she lacks alternative trading partners outside the relationship. Automobile suppliers, for example, frequently have to make specific investments into production facilities, specific production tools and/or specific production sites. Since automobile suppliers are assembling increasingly complex modules for the car manufacturers, they have even started to buy out the manufacturer's production sites. A recent example is *Siemens VDO* that purchased an automotive electronics production site from *Chrysler* in Huntsville, USA. In this case, the resources provided by *Chrysler* is important to *Siemens VDO*, Siemens will fairly have discretion over the resource, and we can expect a lack of valuable, alternative uses of the production site. Similarly, the pistons producer *Mahle* acquired a camshaft production site from *BMW* in Berlin. For the relationship between *Mahle* and *BMW* the same holds as for the relationship between *Siemens VDO* and *Chrysler*. These examples demonstrate situations where suppliers are more dependent compared to their customers.

In asymmetric relationships, it can be expected that the less dependent party will show exploitative tendencies (McAlister et al. 1986; Gundlach/Cadotte 1994; Kumar et al. 1995; similar Williamson 1985). The less dependent party will try to redistribute profit shares in favor of its own advantage (e.g. by renegotiating on prices).

For the management of asymmetric relationships (Case 3 and Case 4), different implications have been discussed in the literature. They aim to balance the dependence between the parties to a relationship and to protect against opportunism. Symmetry of dependence in relationships and protection against opportunistic behavior can be induced by offsetting investments [7] (Heide/John 1988), pledges (Anderson/Weitz 1992), relational norms (Heide/John1992), long-term contracts (Joskow 1987), or explicit and normative contracts (Lusch/Brown 1996). These means increase the dependence of the less dependent party and they rebalance the relationship thus safeguarding against opportunistic tendencies.

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[7]   Offsetting investments are specific assets which are intended to increase switching costs and to balance dependence in buyer-seller relationships (Heide/John 1988).

Although the Resource Based View and the Resource Dependence Perspective have added considerable insights into the management of asymmetric buyer-seller relationships, two problems occur. (1) External risks are rarely studied in relationship research. A differentiation between different types of external risks and their interaction with dependencies in relationships has not been studied so far. (2) The analysis of dependencies in relationships is mainly based on theoretical reasoning.

To overcome these problems in dependency research, I propose to apply Real Options modeling in order to jointly analyze dependencies and environmental risks and to present a formal approach to the management of asymmetric relationships.

3.   A Real Options Approach to Relationships

Real Options Analysis explicitly considers different types of environmental risks. In the beginning of the 1970s, option pricing models have been developed measuring the theoretical value of financial options. An option is the right, not the obligation, to take an action at a predetermined price (exercise price) and for a predetermined period of time. Different kinds of options are usually distinguished: A call option is the right to buy the underlying asset by paying the predetermined price, while a put option is the right to sell the underlying asset to receive a predetermined exercise price.

The problem of valuing financial options is to measure the present option value that is affected by the risk of the underlying asset. Since this problem can be transferred to real investment issues, option pricing methods can be applied to assess real investment projects and to value investment strategies (Trigeorgis and Mason, 1987; Dixit and Pindyck 1994; Trigeorgis 1996). Therefore, investments into real options include the right, not the obligation, to take an action at a predetermined price (the investment expenditure) within a certain period of time. Under conditions of environmental risk, individuals choose the most attractive alternatives as soon as new information is available on the states of the environment.

Typically, Real Options Analysis focuses on the following real options: The option to abandon or to sell an investment project, the option to defer an investment, the option to expand or contract a project, to switch project operations and to shut down and restart operations. Real option pricing methods are widely applied to value investment projects, such as R&D projects (Trigeorgis 1996), natural resource investments (Brennan and Schwartz 1985), joint ventures (Kogut 1991; Folta 1998), etc. However, the analysis of close buyer-seller relationships has been largely disregarded in Real Options reasoning.

By analogy, an investment into a relationship includes the right, not the obligation, for a relationship partner

- to make further investments and to expand the relationship when environmental conditions improve in the future,
- to divest and to contract the relationship when environmental conditions deteriorate in the future, and
- to exit and to switch relationship partners when other, more profitable business opportunities prevail in the future.

Different types of environmental risks affect relationships. Mainly risks in demand and technology determine future decisions whether to expand or contract the relationship or even to exit and switch relationship partners.[8] Under conditions of demand risk caused on end-consumer markets, demand from a relationship customer can rise or fall during the relationship execution. When demand rises, the partners have the possibility to further invest into the relationship and to expand capacity thus increasing turnover and profits. In the opposite case, when demand declines, the partners may have the opportunity to reduce the volume of production and thus adapt to environmental conditions. In this way relationships can be adapted to fluctuating environmental conditions and can be optimally managed. In contrast to traditional investment theory, Real Options Analysis proposes that the higher the risk in demand, i.e. the higher the variance of demand, the higher is the potential rise in demand and the higher is the value of an option to expand.

Furthermore, technological risk has an impact on relationships. Technological risk and technological change can cause sudden shifts in relationships. It can even cause exit from relationships when better alternative technologies appear on markets, which the relationship partner is unable to provide. Consider Michael Porter's (1980) example of a Canadian cigarette producer, who backward integrated into the packaging material. Since technological change made this form of packaging inferior to other forms, which the captive supplier could not produce, the cigarette producer had to dissolve the existing partnership and to enter into a new relationship. When technological uncertainty is high in markets, better alternatives are likely to become available to relationship partners. Then, the one or other party to a relationship may have an option to exit and switch the relationship. This option can be interpreted as a call option to a relationship partner, i.e. the right, but not the obligation, to switch to a new partner.

Real Options Analysis has significantly contributed to an understanding of environmental risk affecting real investments. However, this approach has fundamentally disregarded behavioral aspects of uncertainty in asymmetric relationships (Roemer 2003, 2004). Therefore, a combination of both Resource Dependence reasoning and Real Options Analysis seems to be a promising way of providing new insights into the management of asymmetric relationships in the presence of environmental risk. Subsequently, I analyze the asymmetric, and most important cases 3 and 4, in order to derive implication for the management of these relationships in the presence of environmental risks.

4.   How to Manage Asymmetric Dependencies when there is Environmental Risk

4.1 The Setting

When partners make investments in order to start up and maintain a relationship with a partner, different types of risk will affect their resources in the relationship. First, the more dependent party may be exposed to the risk of opportunism when relative dependence is asymmetrically distributed. Second, the relationship may be affected by

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8   In this paper, we do not consider the risk of preemption, political or cultural risks as further types of environmental risk.

fluctuations in demand on end-consumer markets. Third, technological risk may have an impact on relationship because it makes an exit from a relationship and a change-over to a new partner likely.

To jointly analyze these three types of risk, a perpetual American call with dividends can be applied. The risk of opportunism in asymmetric relationships can be modeled as an erosion of future cash flows. The more these cash flows are safe-guarded against expropriation, i.e. the more the relationship is balanced, the higher will be the cash flows from the partner. Risk in demand affects volumes and respective returns which can be modeled by geometric Brownian motions. The arrival of a new business option by technological change can be simulated by an option to switch from one supplier to another.

To analyze the effects of these types of risk in relationships, consider the following stylized example. A seller S (the upstream party) and a buyer B (the downstream party) intend to start up a relationship in the sense that the upstream party employs an asset to produce a good that is used in the downstream party's production process. To establish this relationship the seller S must dedicate an investment I at date 0, i.e. she has to buy a machine in order to fabricate the product for the buyer. The investment is contingent to start up the relationship; without the investment no trade can occur. Moreover, the investment costs are fixed and cannot be varied. The price of the product is bargained between the two parties. For simplicity, assume that customer B is operating in a stable market which is not affected by fluctuations in demand. Seller S and buyer B is risk-neutral and share the discount rate r per period. The time horizon of this relationship is indefinite.

Because of technological innovation after date 0, the supplier S gets the chance to switch to customer C operating in a dynamic market, which is affected by risk in demand. To establish this new relationship with C, the supplier S has to dedicate a new investment J. Buyer C is risk-neutral and shares the discount rate r per period. The time horizon of this relationship is indefinite, as well.

In this setting, the seller has to face the following decision problems:

- whether to enter a relationship with customer B at date 0,
- whether and how to protect the resources from customer B against expropriation in asymmetric relationships,
- whether to exit the relationship with customer B and switch to the new customer C after date 0. Due to capacity restrictions, the seller can only be either in a relationship with customer B *or* with customer C.

Figure 1 illustrates the seller's decision problem.

A very simple way to determine the seller's optimal decision rule is to model the value derived from customer C as a perpetual American call option with dividends. As an alternative interpretation to the conventional option model we can conceive the present case as an option to switch from one asset to another (Sick 1995): From one asset, the owner of an American call (the seller) receives a constant dividend that is his/her minimum payoff (cash flows from customer B); from the other asset, the owner receives a stochastic net payoff (cash flows from customer C). We can interpret this model from the seller's perspective as that she has to abandon customer B and

therewith the certain payoff with the present value V_B/r in order to benefit from the risky asset (customer C).

Figure 1:   **The seller's switching problem**
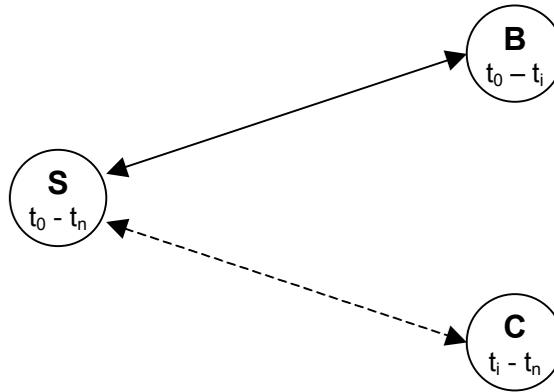
To investigate the different types of risk affecting the relationship and their interactions, we separately discuss the effects that opportunism, environmental risk, and technological change have on the relationship(s). The analysis will be supported by a numerical analysis.

4.2 The Effect of Opportunism in Asymmetric Relationships

Supplier S will enter the relationship with customer B, if she expects a positive net present value from the relationship with customer B. They agree on a price of $8.00 per unit at date 0, while the supplier incurs operating costs c of $3.00 per unit. Customer B will demand 1,000 units per period. Therefore, the supplier expects to receive a constant cash flow of $5,000 per period from customer B (V_B).

The initial investment I, which is necessary to start up the relationship with customer B, equals $10,000. Both S and B share a discount rate of $r = 10\%$. They do not fix a terminal date of the relationship. The perpetual net present value of the resources from customer B is

$$NPV_B = \frac{V_B}{r} - I = \frac{5,000}{0.1} - 10,000 = 40,000.$$

Since the seller expects to cover her investment expenditures in the future indicated by a positive net present value (NPV_B), she would enter the relationship with customer B. However, these considerations have not yet included opportunistic tendencies due to asymmetries in the relationship.

Consider the asymmetric Case 2 where the customer is more dependent on the relationship compared to seller S, since the resources delivered by the seller are important to the customer, the seller has discretion over the resource, and the customer lacks valuable alternatives in contrast to the seller. In this case of asymmetric dependence, the seller could exploit the buyer in price renegotiations. In the worst case, S

could raise the price until the customer is marginally able to cover his variable costs. From the perspective of the seller S, she can increase her profit shares from the relationship with B and raise the net present value from buyer B ($NPV_B > \$40,000$).

In the opposite case (Case 3), the supplier S is more dependent compared to customer B, since the resources from the customer are important to the seller, the buyer has discretion over his resources, and the seller lacks valuable trading options. Then, customer B could show opportunistic tendencies and renegotiate on the price. He could bargain down prices until the supplier is marginally able to cover her operating costs. Consequently, the present value from customer B would converge towards $0. This would result in a negative net present value ($NPV_B = \$0 - \$10,000 = -\$10,000$). Such a negative net present value indicates the supplier's inability to cover her investment expenditures. She would therefore refrain from a relationship with customer B. A similar effect would occur, if the buyer left the relationship after the seller has made the investment.

In both cases 2 and 3, the Resource Dependence Perspective recommends balancing dependence between the parties, for example, by making outside options less attractive to the less dependent parties. Sanctions and penalty payments against opportunistic behavior and against exit from relationships can rebalance asymmetric relationships since they reduce the value of alternative options. In this way, dependence of the less dependent party can be increased. To illustrate this argument, consider Case 2. If the supplier knew that she had to pay prohibitively high penalty fees ex ante, she would no longer try to renegotiate on the price or to exit the relationship. If the supplier's highest appropriable share equaled $70,000 and if she had to pay a penalty of say $40,000 in case of opportunism, her net present value would amount to $20,000 ($NPV_B = 70,000 - 10,000 - 40,000 = 20,000$). Since this NPV is considerably lower than the NPV without opportunism ($40,000), the seller would choose the option not to exploit the customer and to adhere to initial price agreements. In this way, the parties could prevent opportunistic tendencies due to asymmetries in relationships.

To determine an optimal penalty fee (K), which is efficient to deter opportunism and to rebalance the relationship, we have to consider the supplier's present value from customer B without opportunism (PV_B) and the highest appropriable present value from customer B with opportunism (PV_B^{max}). We have to consider appropriable present values in relationships after date 0, since initial investments will be sunk at future points of time. Assuming a linear relationship between the penalty fees and the present value of future cash flows, the penalty should rebalance the relationship in a way that non-opportunistic behavior and opportunistic behavior result in the same outcome. Therefore, $PV_B = PV_B^{max} - K$ so that

$$K = PV_B^{max} - PV_B. \qquad (1)$$

Transferred to our numerical example, the amount of penalty that is necessary to deter opportunism and to rebalance the relationship equals $70,000 - $50,000 = $20,000. The same calculus holds for the customer's perspective.[9]

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[9]   This problem can be studied by game-theoretic analysis (Rese/Roemer 2004)

4.3 The Effect of Demand Fluctuations on Relationships

In addition to the risk of opportunism, the supplier will be confronted with risk in demand when she considers switching to customer C. Since the new relationship with customer C will be affected by risk in demand, customer C's cash flows (V_C) can be described to follow a geometric Brownian motion with drift:

$$dV_C = \mu V_C \, dt + \sigma V_C \, dz , \qquad (2)$$

where μ is the drift parameter and $\mu \in [0, r)$ denotes the expected growth rate of V_C. σ is the expected volatility and dz is the increment of a standard Wiener process with $dz \sim N(0, dt)$. C's current customer value V_C is known today, but future values are log-normally distributed with variance of the logarithm growing linearly with time.

We denote $F(V_C)$ as the expected net present value when we start with a value V_C and supplier S is in a relationship with customer B. Therefore, the solution consists of this function and the optimal rule to switch to customer C, i.e. we are looking for a value V_C^* that triggers the supplier's switching from customer B to customer C: For $V_C < V_C^*$ supplier stays with customer B and receives V_B; for $V_C > V_C^*$ supplier switches to the new customer C.

For seller S, there is a continuation payoff V_B with customer B. She has a binary choice: Either to stay with customer B and receive the continuation payoff or to switch to customer C, make the new investment J and pay a penalty for leaving the relationship.[10] She will switch to customer C, if $V_C^* - J - K > V_B/r$, i.e.

$$F(V_C^*) = max \left\{ V_B / r , V_C^* - J - K \right\}, \quad (3)$$

with $V_C^* - J - K$ as the net payoff from customer C to be maximized when switching to customer C. She chooses the larger of the two values. Until the investment J is made and penalty payments (K) are paid, the supplier S cannot benefit from customer C, i.e. before the switch she earns V_B per period. In the continuation region, i.e. the values of V_B where it is not optimal to invest into C, but to stay with customer B (state B), the Bellman equation becomes:

$$r F \, dt = E(dF) + V_B \, dt , \qquad (4)$$

i.e. the total expected return from customer C over a time interval dt ($r F \, dt$) equals the expected rate of capital appreciation plus the stable value V_B from customer B over time. By substitution and rearrangement, we receive the asset equilibrium condition as a second-order ordinary differential equation, which is non-homogenous

$$\tfrac{1}{2} F''(V_C)\sigma^2 V_C^2 + F'(V_C)(r - \delta) V_C - rF + V_B = 0. \quad (5)$$

The solution of Equation (5), and the value of the option to switch resources, i.e. to switch from customer B to customer C, is

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[10]　We assume that the relationship with customer B has been safeguarded against opportunism so that the supplier will have to pay a penalty when leaving the relationship with customer B.

$$F(V_C)=\frac{1}{\beta_+ -1}(J+K+V_B/r)\left(\frac{V_C}{V_C^*}\right)^{\beta_+}+V_B/r \qquad (6)$$

with

$$\beta_+ = \tfrac{1}{2} -(r-\delta)/\sigma^2 +\sqrt{[(r-\delta)/\sigma^2 - \tfrac{1}{2}]^2 +2r/\sigma^2} >1 \qquad (7)$$

and the switching point

$$V_C^* =\frac{\beta_+}{\beta_+ -1}(J+K+V_B/r). \qquad (8)$$

Equation 6 displays the value of the resources from customer B including the option to switch to customer C.

The effect of demand risk on the value of the resources contributed by customer C can be studied by varying σ. Assume for our numerical example that the new customer C pays a price of $14.00 per unit and that the supplier incurs operating costs of $4.00 per unit. The demand volume is known for the beginning of the relationship with customer C (1,000 units) but future volumes are unknown. With an annual volatility of demand volumes of 10% (starting with the amount of 1,000 units), a dividend yield of 4% and a start-up investment J of $10,000, the value of the switching option assumes the curvature shown in Figure 2.[11]

Figure 2: **The effect of demand risk on relationships**
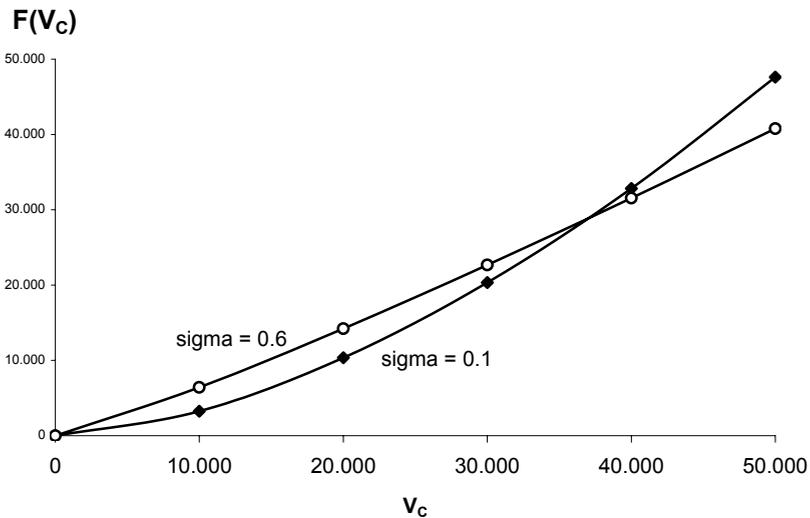
The effect of higher risk in demand (σ) can be demonstrated by varying the volatility in the underlying asset. Figure 2 includes a curvature for a higher degree of uncertainty

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[11] For simplicity, we study only the effect of demand uncertainty on the value of the resources from customer C. Therefore, we set $V_B/r = 0$ and $K = 0$.

($\sigma = 0.6$) in addition to the low risk case ($\sigma = 0.1$). For very low values of the resources contributed by the new customer C (V_C), higher uncertainty has a beneficial effect in that it increases the upward potential of the option. For increasingly high values offered by the new customer, higher uncertainty becomes value destroying. The reason is that an increasingly high volatility in demand reduces β_+ and thus raises the factor $1/(\beta_+ - 1)$. However, there is a countervailing effect since increased risk reduces β_+ and increases V_C^*. These two variables reduce $(V_C / V_C^*)^{\beta_+}$ when risk in demand increases. Raising the hurdle V_C^* makes the option less attractive. In sum, for low values of V_C, the rise in $1/(\beta_+ - 1)$ is higher than the decline in $(V_C / V_C^*)^{\beta_+}$. This relationship reverses as soon as V_C reaches a certain threshold.

Consequently, the effect of demand risk on relationship is ambiguous. For low values of alternative resources, demand risk increases the value of the switching option; for high values of alternative resources, demand risk diminishes the value of switching options in relationships.

## 4.4 The Effect of Technological Risk on Relationships

Technological risk and the related technological change can offer the opportunity to profit from future innovations. If the incumbent supplier cannot deliver these innovations or if the incumbent customer cannot use the innovation in his production process, partners have to exit relationships and start up new partnerships with more innovative and more profitable relationship partners. This decision problem can be modeled as a switching option.

Transferred to our example, supplier S has to decide whether and when to switch from the existing customer B to the new customer C. Supplier S will only switch to customer C, if his value surmounts the investment costs J and the value of customer B (V_B/r) which can be clearly seen in equation (8).[12] Another important aspect in equation (8) is the factor $\beta_+/(\beta_+ - 1)$. It shows that the simple NPV rule is incorrect, because it raises the switching point by this factor, since $\beta_+ > 1$ and therefore $\beta_+/(\beta_+ - 1) > 1$. On account of uncertainty the critical value V_C^* has to be higher than just $J + V_B/r$.

Assuming an annual volatility of customer C's demand volumes of 10% (starting with the amount of 1,000), a dividend yield of 4% and a start-up investment J of $10,000, the switching point is at $161,915.[13] The value of the option to switch resources, i.e. to switch from customer B to customer C equals $51,222. This value includes the present value from customer B ($50,000) plus the pure option to switch to the new customer C ($1,222). The simple NPV rule is thus incorrect because it disregards the value from future resources. Figure 3 illustrates the value of the switching option for different values from customer C.

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[12]   We assume that K = 0.

[13]   The switching hurdle is this high because the value of the outside customer C has to surmount the value of the present customer B (V_B/r) plus the new investment J.

Figure 3:   The value of the switching option
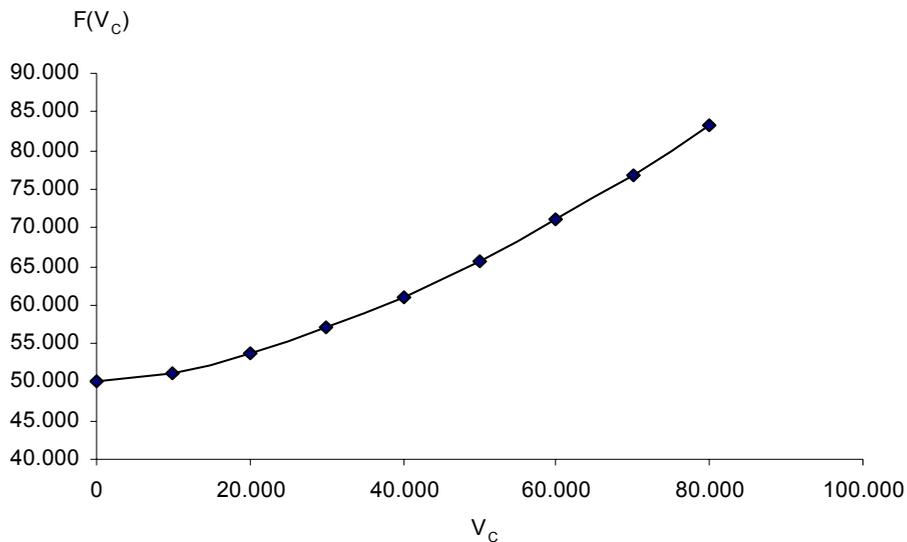
When there is a lack of alternative, future customers ($V_C = 0$), the value of the re-sources delivered from customer B amounts to $50,000. However, as soon as there is a value from alternative trading partners, the value of the switching option increases disproportionately due to risk affecting the underlying asset.

In sum, the value of potential outside options increases the value of resources to relationship partners.

4.5 Interaction Effects

In many real world situations, resources in relationships are affected by more than one type of risk. In this case, interaction effects may occur resulting in contradictory man-agement implications. For example, when a party to a relationship risks exploitation by the other party due its greater dependence, the part will tend to balance dependence. By imposing sanctions on opportunistic behavior and in case of exit from the relationship, dependence is increased for the less dependent party since the value of outside alterna-tives is reduced. When both parties commit each other to the relationship by concluding long-term contracts, which can enforce sanctions on the defecting party, the parties will be bound to the relationship. However, in the presence of technological change the exit from a relationship may be advantageous. An interaction effect occurs between the risk of opportunism and technological risk. The question is then whether and how much to safeguard against opportunism in order to remain open and to profit from future, more profitable alternatives provided by technological innovation.

This interaction effects in the presence of multiple sources of risk can be studied in our numerical example. Assume that the parties safeguard each other against oppor-tunistic behavior by concluding a contract that imposes sanctions ($20,000) in case of deviation from original agreements. In this case, the resources from the incumbent party are safeguarded. However, the exit from the relationship is made costly so that

outside options become unattractive. The real switching model can simulate the effects of opportunism, safeguarding, and technological change.

Figure 4:   Interaction effects between the risk of opportunism and technological change

$F(V_C)$

V_C
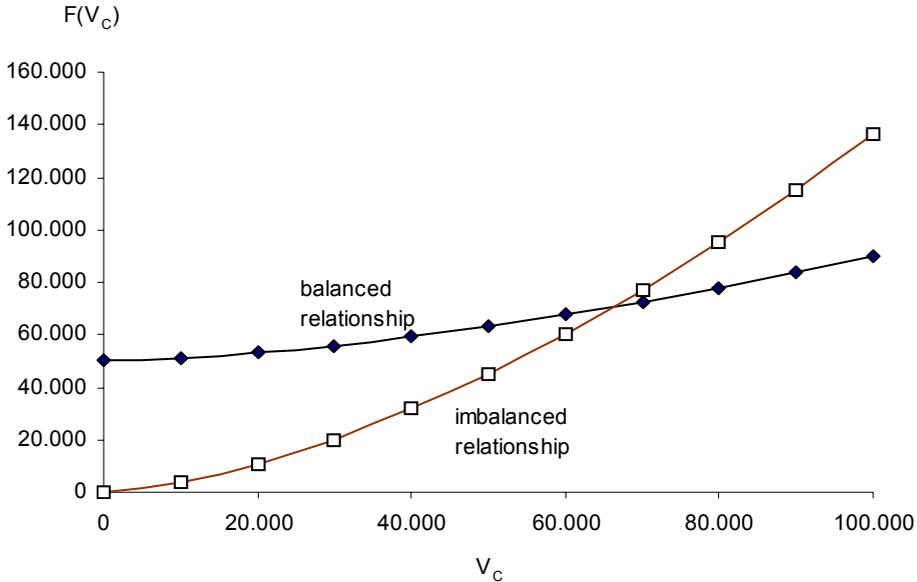
When the partners balance their relationship and safeguard against the risk of opportunism, they simultaneously increase the value of the resources delivered by the partner. In addition, they increase the hurdle to switch to attractive outside options that may appear in the presence of technological change which in turn reduces the value of switching options. When the partners leave their relationship imbalanced, they may risk opportunistic inclinations by their partners. This would lead to an erosion of the resources provided by the relationship partner. However, since they do not have to pay any penalties, the switching hurdle is very low ($26,985) and the value of the switching option rises disproportionately.

When there is the risk of opportunism and when there is technological change, we can now deduct clear management implications from the real switching model for our numerical example, regarding the question whether to balance dependence in relationships or whether to leave the relationship imbalanced in order to remain open for future opportunities (Figure 4). When technological change is modest and highly attractive alternative customers are not expected, the partners (supplier S and customer B) should balance their relationship in order to protect against opportunism. This strategy (balanced relationship) delivers a higher option value than the strategy 'imbalanced relationship'. In contrast, when technological change is likely to provide future attractive outside options, the strategy to leave the relationship imbalanced maximizes the value of the switching option. The effect of technological change outweighs the exploitative effect from opportunism.

According to this simple numerical example, implications can be derived for the management of asymmetric relationships in the presence of environmental risks.

5. Conclusions

In this paper, we have proposed to complement traditional resource dependence reasoning in asymmetric buyer-seller relationships by Real Options Analysis to account for external risks. In particular, we can summarize the following results:

- When asymmetric buyer-seller relationships are not affected by external risks, it is value-maximizing to balance relationships and to safeguard against opportunistic tendencies by relationship partners.
- When relationships are affected by risk in demand, high risk maximizes option values when alternative resources show low values. In contrast, low risk in demand maximizes option values when alternative resources show high values.
- When relationships are affected by technological change, potential outside resources created by technological innovation increase the value of resources to a relationship partner.
- Interaction effects may occur when there are is more than one type of risk affecting relationships. When there is the risk of opportunism due to asymmetry in dependence and when there is technological risk, the partners have to consider whether and how much to balance their relationship.
- A Real Options Approach, i.e. a perpetual American call with dividends, can be applied to provide concrete management implications when asymmetric relationships are affected by different types of external risk.

Although a Real Options Approach to asymmetric buyer-seller relationship is a very promising research area, some limitations have to be considered. First of all, we have made a lot of assumptions conscerning input parameters. The model is therefore highly sensitive to these given variables. Therefore, the rigid assumptions and the availability of data that are necessary to compute option values is crucial. For example, it may be problematic to estimate future profits that can be earned in a relationship with a current as well as with a new partner. For these estimations a broad array of additional information, e.g. from market research, internal audit, etc. will be necessary.

Second, we have only considered monetary resources in our analysis since they are easy to observe and to measure. Resources such as knowledge or skills have not been analyzed in this paper.

Third, we have exclusively investigated the seller's perspective. The analysis can be identically carried out from the customer's perspective. A simultaneous analysis of the buyer's and the seller's perspective by game-theoretic analysis would be an interesting avenue for future research. An integration of game-theory and real options analysis is still at an early stage of development.

Moreover, future empirical research has to submit detailed hypotheses that follow from a positive use of the model to full-fledged empirical tests.

However, even if practical problems may occur when using a Real Options Approach to dependence in buyer-seller relationships, the true value of this approach lies in the theoretical process of structuring decision situations in buyer-seller relationships and in reducing complexity in decision-making.

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