When a seller and buyer meet, they face a variety of different options. They may strike a deal immediately (in period 1) and thereby risk losing out on a better deal later on (in period 2). They may also decide to wait for better trading partners in period 2, but this option is risky as well because one agent may find himself without a trading partner. In order to alleviate these risks, buyers and sellers use contingent contracts. These contracts give one or both of the partners the right to insist on a deal in the second period.

We show how the optimal type and the terms of a contingent contract depend on transaction costs, probabilities of finding future trading partners, and gains from trade realizable in different constellations. We find that firms should agree on a one-sided contract benefiting the seller (the buyer) if the seller (the buyer) can hope to gain much more than the buyer (the seller) from the appearance of an alternative trading partner.

Keywords
Revenue management, contingent pricing, price risk, letter of intent

1. Introduction

Buyers in markets face risks concerning the quality and price of the product they buy. The quality risk may be alleviated by satisfaction guarantees (e.g., Moorothy/Srinivasan 1995 and Fruchter/Gerstner 1999). The price risk is sometimes addressed by best-price clauses: If the consumer happens to find a better price after making the purchase, he is refunded the difference (e.g., Belton 1987; Schnitzer 1994; Jain/Srivastava 2000). Best-price clauses are an instance of contingent pricing. For an introduction to this field, we refer to Biyalogorsky/Gerstner (2004). Of course it is not just buyers, but rather sellers as well, who may be subject to price risks.

We will look at a situation of price risks for both buyers and sellers. We focus on two risk-neutral agents, a buyer and a seller who meet in period 1. Let us imagine a seller of a house who meets a buyer in the first period. Of course, they may strike a deal immediately. This is what we will call agreement N. However, they might benefit by waiting for period 2 in the hope of finding more suitable trading partners. For the seller, a better trading partner would be a buyer willing to pay more. Likewise, the buyer would welcome a seller with a lower reservation price. Waiting for more suitable trading partners is risky because the seller (the buyer) may find himself without any buyer (any seller).

Contingent-pricing contracts may alleviate these risks. Depending on the appearance of alternative trading partners, the two agents may have conforming or opposing views on the desirability of doing business in the second period. If, after the uncertainty regarding the trading partners has been resolved, they both want to do business together; every efficient contract should allow them to do so. Similarly, if both would prefer to do business with other agents, they should have that opportunity. Therefore, the contractual arrangements of interest mitigate the situations in which one agent would like to strike the deal while the other would prefer not to.

Tab. 1 summarizes the four second-period agreements, i.e. those agreements relating to the second period. (Agreement N, dealing immediately, refers to the first period.) In accordance with the efficiency postulate, all agreements have the agents deal if both prefer to do so (second line) and foresee “no deal” if both have better options (second to last line). The agreements are abbreviated by R, S, B, and W. R is the reciprocal agreement whereby both agents are bound to deal with each other if at least one agent prefers to do so. Agreement S is a con-
tangible contract that obliges the buyer to keep up his offer to buy the house while the seller may opt out. Agreement B reverses the roles and benefits the buyer. According to agreement W, the agents do business with each other only if both want to do so.

Strictly speaking, agreement W is not a contract. It comes about whenever the two parties cannot agree on a price for dealing in the first period (agreement N) or on transfers to be paid for second-period agreements R, S, or B.

A possible alternative to these agreements is what we call agreement C. Here, C is reminiscent of callable products (see Gallego/Koul/Phillips 2008). Callable products are those whereby one or both agents reserve the right to back out. An application would be capacity allocation (as in airlines), whereby buyers allow the capacity provider to withdraw (“call”) capacity at a prespecified recall price. If only the seller has the right to withdraw his offer, we are very close to agreement S. However, in agreement S, the seller pays a transfer to the buyer before the uncertainty resolves, while in the call situation the buyer pays first and obtains the recall price (which is higher than the original price) later. Since, in our model, we consider risk-neutral agents only, this does not make any substantial difference. Similarly, if the buyer has the option to “call”, we are back to agreement B.

We may also consider reciprocal callability, which dictates that both the seller and the buyer have the right to withdraw the contract. There are two problems with this proposal. First, if both agents would like to dissolve the contract, each one would prefer to hide his wish in order to obtain a transfer rather than to pay one. A second point is more important, that being that agents can calculate the expected transfer they will pay or obtain. If an agent expects to pay rather than to obtain (on average), he will decline the contract and just choose agreement W, which he can enact unilaterally. After all, under agreement W he is free to simply wait for the second period. Again, if agents are risk averse, reciprocal callability may work well. Since our agents are risk neutral, such an agreement will never be preferred to agreement W by both agents. Therefore, we will concentrate on the second-period agreements introduced above (S, B, R and W).

Agreement B (giving the buyer the right to contract in period 2) is quite common for “big deals”, e.g. firms and estates. Typically, agents go through three preparatory stages of acquisition. First, the prospective buyer signs a nondisclosure statement obliging him to maintain strict confidentiality of all records the seller provides. Second, a letter of intent (also called a memorandum of understanding, terms sheet or agreement in principle) is signed by both parties, which binds the seller to uphold his offer while, third, the buyer engages in a due-diligence investigation of the firm or estate in question.

While in other countries (France: avant-contrat, Germany: Vorvertrag, see Stern 1994) some legal implications are different in practice, the main idea remains the same: The seller is awarded exclusive negotiating rights for a limited period of time (“no-shop clause”). A typical letter of intent also addresses the price, payment terms, and a deadline for signing the final contract.

Letters of intent can have serious consequences. One of the most famous litigation cases in the history of US business transactions resulted in $10.53 billion being awarded to Texaco, Inc. by Pennzoil ($7.53 billion in compensatory damages and $3 billion in punitive damages). In 1984, Texaco bought Getty Oil for $9.98 billion, although an “agreement in principle” had been concluded between Getty Oil (seller) and Pennzoil (buyer) beforehand. The court ruled (and this ruling was upheld later) that Texaco (which indemnified Getty’s shareholders against any possible litigation) tortuously interfered with this agreement. A very readable account of this case and of its aftermath is given by Petzinger (1987). We will come back to this exciting story later.

Legal difficulties notwithstanding, letters of intent remain popular for several reasons. First, buyers need to obtain financing and will not undertake the appropriate efforts to do so unless there is some certainty that the object will not be taken by another buyer in the meantime. Second, preparing definitive documentation for a transaction is so costly that both buyer and seller want to be reasonably sure that the other party means business. A third reason, on which we will concentrate, is that buyers (sellers) may hope to bind the prospective seller (buyer) while being on the lookout for a seller (buyer) with whom a more profitable deal is possible.

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**Tab. 1: The four possible second-period agreements**

<table>
<thead>
<tr>
<th>Second-Period Preferences</th>
<th>Contractual Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>both seller and buyer prefer to deal</td>
<td>deal</td>
</tr>
<tr>
<td>seller prefers to deal, buyer not</td>
<td>deal</td>
</tr>
<tr>
<td>seller prefers not to deal, buyer does</td>
<td>no deal</td>
</tr>
<tr>
<td>both seller and buyer prefer not to deal</td>
<td>no deal</td>
</tr>
<tr>
<td>R</td>
<td>S</td>
</tr>
</tbody>
</table>
In this paper, we will theorize about which of the contracts above will be agreed upon by the seller and the buyer. The general idea behind the individual results is efficiency. First of all, we look at efficiency from the point of view of the two agents, the first-period seller and buyer. The plus of contingent contracts is the assurance of finding a trading partner in the second period. For example, agreement S binds the buyer to uphold his offer so that the seller will not find himself without a trading partner in the second period. Of course, in this case, the buyer may forego the higher second-period gains from trade that may have become possible without contract S. Thus, contingent contracts have to weigh the guarantee of one agent finding a trading partner against the risk of the other agent to lose attractive business.

We view our paper as a contribution to revenue management. It originates in the airline industry (Chieng/Chen/Xu 2007, p. 98), where the no-show phenomena create either a danger of revenue loss or a chance for additional revenues. Examples of revenue management may also be found in the arenas of railway traffic (Erhardt 2006), car rentals (Anderson/Blair 2004), provision of gas (Dörband 2005) and non-profit organizations (Tschuelein 2004). Our paper is close to Biyalogorsky/Gerstner (2004) (henceforth B&G) and shares many of its characteristics. B&G and our paper differ from the general revenue-management literature in several respects:

- Revenue management is an instrument in the hand of suppliers facing many customers; in contrast, we deal with very few market participants on both sides.
- Information technology was and is vital to advances in revenue management; small-numbers contracts, however, do not depend on information technology.
- Revenue management concerns a broad variety of instruments such as discount coupons for off-peak periods, overbooking, capacity planning and scheduling, auctions, and price differentiation with respect to location, comfort, etc. Contrastingly, our approaches focus more specifically on uncertain future trading partners.

Although our paper and B&G share much in common, they differ in that while B&G (and revenue management literature in general) consider one-sided instruments, our paper stresses the two-sided nature of the problem. The paper is organized as follows: First, we present the model, its subgame-perfect solution, and the main results. Second, since our paper has been inspired by Biyalogorsky/Gerstner (2004), we revisit their model. Third, we take a closer look at the intriguing lawsuit concerning Getty Oil and focus on the managerial- and economic-policy take-aways implied by our model. Fourth, and finally, we offer some conclusions by broadening the theoretical perspective.

2. The model

2.1. 4 agents, 2 periods, and 4 stages

Our model has two first-period agents, seller $S_H$ and buyer $B_L$, and two second-period agents, seller $S_L$ and buyer $B_H$. In the first period (= first stage), seller $S_H$ and buyer $B_L$ decide on transacting in the first period with price $p$ (agreement $N$), waiting for the second period (agreement $W$), or entering into one of the three contingent contracts $S$, $B$, or $R$ with transfers $T_S$, $T_B$, and $T_R$, respectively. Unless they perform the transaction immediately, the second period comes into effect. This period hosts stages 2, 3, and 4. In stage 2, chance decides whether or not better trading partners ($S_L$ and $B_H$) emerge. In stage 3, the first- and second-period agents sort themselves into trading couples who bargain about the price in stage 4. We will now apply backward induction and begin with stage 4.

2.2. Stage 4: bargaining about the price

The four agents have reservation prices given by Tab. 2:

<table>
<thead>
<tr>
<th>Agents</th>
<th>$S_L$</th>
<th>$S_H$</th>
<th>$B_L$</th>
<th>$B_H$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservation prices</td>
<td>$r_L &lt; r_H &lt; w_L &lt; w_H$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Reservation prices

Reservation prices of sellers are denoted by $r$. The reservation prices of buyers (also called willingness to pay) are denoted by $w$. The indices $L$ and $H$ refer to the seller or buyer with that index. For example, $w_H$ is the willingness to pay of buyer $B_H$. Note that the inequalities imply that the gains from trade are positive for any seller and buyer pair. Also, first-period agents prefer to do business with second-period agents if gains from trade are split in half.

There are several reasons why reservation prices may differ between agents. For example, people may differ in their income or their use of specific items. Also, people may agree to disagree with respect to the value of assets.

For ease of notation, we abbreviate

\[
\frac{w_L - r_L}{2} \times g_{HL},
\]

\[
\frac{w_H - r_L}{2} \times g_{LH},
\]

\[
\frac{w_H - r_H}{2} \times g_{BH} \quad \text{and}
\]

\[
\frac{w_L - r_H}{2} \times g_{BL}.
\]

where $g$ represents “gains from trade”. By the above inequalities governing the reservation prices, we get

\[
0 < g_{HL} < g_{BH} < g_{LH} \quad \text{and}
\]

\[
0 < g_{HL} < g_{BH} < g_{LH}.
\]
Therefore,
\[ g_{LL} > 2g_{HL} - g_{HH}. \]

When agents bargain about the price in stage 4, they have already been sorted into couples (stage 3). Therefore, in this stage, one seller faces one buyer and we can use the Rubinstein (1982) bargaining model. Any pair of agents consisting of a seller \( S \) and a buyer \( B \) will split the gains from trade (Nash-Rubinstein solution), thus the price is equal to

\[ p_{S,B} = \frac{r_S + w_B}{2}. \]

Note that this result holds for stage 4 only, not for stage 1.

### 2.3. Stage 3: sorting into couples

In stage 3, we assume that the second-period agents do not know each other and cannot trade with one another. With this proviso (agents \( S_1 \) and \( B_1 \) cannot deal), buyers and sellers sort themselves into trading couples depending on the second-period event (stage 2: which second-period agents showed up?) and on the valid agreement (stage 1: which agreements (S, B, R, or W) were entered into?).

The general idea is this: Given the Nash-Rubinstein solution at stage 4, each seller searches for the best buyer (a buyer with the highest willingness to pay) and each buyer prefers the best seller (a seller with the lowest reservation price). In particular, we obtain the following results: If both second-period agents show up, the first period agents will be happy to deal with them. This is true irrespective of the contract agreed upon. If, however, buyer \( B_H \) shows up and seller \( S_L \) does not, first-period seller \( S_H \) will sell to second-period buyer \( B_H \), unless \( B \) or \( R \) has been agreed upon. In this case, the first-period buyer will oblige the first-period seller to do business in the second period. In other words, agents will not insist on striking the deal with their first-period trading partners if they have a chance to do business with a second-period one.

Note that the trading partner distribution is not necessarily efficient. Under agreements B and R, if seller \( S_L \) does not show up whereas buyer \( B_H \) does, the two first-period agents do business with each other in the second period (the first-period buyer insists) and the gains from trade to be divided among them are \( w_L - r_H \) If the first-period agent \( S_H \) were allowed to sell to second-period buyer \( B_H \) the gains from trade would be higher, expressed by \( w_H - r_H \). Recontracting becomes an issue here, which we will comment upon later. Of course, a corresponding result holds for agreement S.

**Result 1:** Contingent contracts do not necessarily ensure overall efficiency.

### 2.4. Stage 2: chance events

We assume that seller \( S_L \) and buyer \( B_L \) definitely appear in the first period. Seller \( S_L \) and buyer \( B_L \), however, show up in the second period with probabilities \( q_S \) and \( q_B \), respectively. Thus, we have four second-period events:

- Both \( S_L \) and \( B_L \) show up (probability \( q_S q_B \)).
- Seller \( S_L \) shows up and buyer \( B_L \) does not (probability \( q_S (1 – q_B) \)).
- Buyer \( B_L \) shows up and seller \( S_L \) does not (probability \( 1 – q_S q_B \)).
- Neither \( B_L \) nor \( S_L \) show up (probability \( (1 – q_S)(1 – q_B) \)).

### 2.5. Stage 1: first-period agreements

#### 2.5.1. Agreements and payoffs

Both first-period agents have reason to hope for a better trading partner in the second period. Foreseeing these possibilities, they have five options:

1. Agreement W: Waiting for another buyer or seller to arrive.
2. Agreement N: Dealing now and agreeing on price \( p \).
3. Agreement S: Agreeing on a contract stipulating that buyer \( B_L \) has to uphold his offer to buy if the seller \( S_L \) insists on concluding the deal in period 2. Seller \( S_L \) has to pay a transfer \( T_H \) to buyer \( B_L \).
4. Agreement B: Agreeing on a contract stipulating that seller \( S_L \) has to uphold his offer to sell if the buyer \( B_L \).

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insists on concluding the deal in period 2. Buyer $B_L$ has to pay a transfer $T_B$ to seller $S_H$.

5. Agreement R: Agreeing on a reciprocal contract that stipulates first-period agents to uphold their offers. Buyer $B_I$ has to pay a transfer (which might be negative) $T_B$ to seller $S_H$.

The agreements define expected payoffs $\pi_i$ for the two first-period agents $i (i = S_H$ or $i = B_I)$ under agreement $A$ ($A = N$, $S$, $B$, or $R$). Tab. A1 in the appendix contains these payoffs. For example,

$$\pi_{S_H} = [q_S(1 – q_B) + (1 – q_S)(1 – q_B)]g_{HIL} + q_Sg_{SL} + (1 – q_B)q_B \cdot 0 + T_S – c$$

is buyer $B_I$’s payoff under agreement $S$:

- If the second-period buyer $B_H$ does not appear (with probability $1 – q_B$), the first-period seller $S_H$ will insist on striking the deal and $B_I$ obtains $g_{HIL}$.
- If both second-period agents appear (with probability $q_B q_H$), seller $S_H$ will prefer to deal with the second-period buyer so that $B_I$ is free to deal with $S_L$ and obtains $g_{SL}$.
- If the buyer $B_H$ appears while the seller $S_L$ does not, $B_I$ finds himself without a trading partner.
- $T_S$ is the transfer for agreement $S$ that the first-period seller pays to the first-period buyer.

$c$ stands for the transaction costs associated with agreements $S$, $B$, and $R$.

### 2.5.2. Equilibrium price and transfers

Since the first-period agents are free not to agree to $N$, $S$, $B$, or $R$, agreement $W$ defines the threat point from the first-period agents. Invoking the Nash-Rubinstein splitting outcome once more, we calculate the price $p^*$ in the first period and the transfers $T_S^*, T_B^*$, and $T_R^*$ by solving the equal-gains conditions

$$\pi_{S_H} – \pi_{W_S} = \pi_{B_H} – \pi_{W_B},$$

$$\pi_{S_S} – \pi_{W_S} = \pi_{B_S} – \pi_{W_B},$$

$$\pi_{B_S} – \pi_{W_S} = \pi_{B_H} – \pi_{W_B},$$

and

$$\pi_{B_S} – \pi_{W_S} = \pi_{B_R} – \pi_{W_R},$$

for $p$, $T_S$, $T_B$, and $T_R$, respectively.

**Result 2:** At stage 1, the equilibrium price and the equilibrium transfers are given by

$$p^* = \frac{1}{2}(r_H + w_L) + \frac{1}{2}q_B g_{HIL} – \frac{1}{2}q_S g_{SL},$$

$$T_S^* = \frac{1}{2}q_S (1 – q_B) g_{SL},$$

$$T_B^* = \frac{1}{2}q_B (1 – q_S) g_{HIL} +$$

and

$$T_R^* = \frac{1}{2}q_B (1 – q_S) g_{HIL} – \frac{1}{2}q_S (1 – q_B) g_{SL}.$$
attractive, relatively speaking. However, while these costs do help determine the agreement into which the two parties enter, they have no impact on the terms of the alternative agreements.

The other derivatives are also quite intuitive. Consider, for example, the column $\frac{\partial \pi_i}{\partial q_i}$. If the probability for the second-period seller’s appearance increases (higher supply in the second period), the first-period price diminishes, $\frac{\partial q_i}{\partial q_i} = -\frac{1}{2}g_{\text{LL}} < 0$. In fact, the higher the gains from trade between the first-period buyer and the second-period seller, $g_{\text{LL}}$, the stronger the first-period price diminishes. If the first-period agents agree to postpone the deal to the second period, the probability $q_s$ influences its terms. The higher the chances for a better trading partner in the second period for the buyer, the higher the buyer’s compensation for agreeing to agreement S, $\frac{\partial \pi_i}{\partial q_i} = (1 - q_s)g_{\text{LL}} > 0$. In case of agreement B, the buyer has to pay less to the seller if the chances for a better seller increase. If $q_s$ increases, so does the chance that the buyer will not exercise his option, which is good news to a seller who expects a better buyer in the second period. Thus, the seller’s compensation for agreement B as a negative function of $q_s$: $\frac{\partial \pi_i}{\partial q_i} = -\frac{1}{2}q_s g_{\text{HH}}$.

2.5.3. Preferences for agreements

Substituting the equilibrium values from result 2 into the payoffs given by Tab. A1 (appendix), we find the equilibrium payoffs for the two agents. We are now interested in the differential gain (the gain above that obtained under $\text{W}$) achieved in equilibrium. This gain is the same for both players. For example, agreement S allows the differential gain $\Pi_i$ given by

$$
\Pi_i = \pi_{iS} - \pi_{iW} = \left[ q_i(1 - q_s) + q_s q_b \right] g_{\text{HH}} + \left[ q_i(1 - q_b) - (1 - q_s)(1 - q_b) g_{\text{LL}} - T_b - c \right] \right) - \left[ ((1 - q_s)(1 - q_b) + q_s q_b \right] g_{\text{HH}} + \left(1 - q_i(1 - q_b) g_{\text{LL}} \right) - \frac{1}{2}q_i(1 - q_b) \left(2g_{\text{HH}} - g_{\text{LL}} \right) - c.
$$

Result 3: By entering into an equilibrium contract, each first-period agent gains

$$
\Pi_i = \left( q_i + q_s - q_s g_b \right) g_{\text{LL}} - \frac{1}{2} q_b g_{\text{LL}} - \frac{1}{2} g_b \left( q_i + q_s - q_s g_b \right).
$$

respectively.

Of course, these differential gains can be negative, in which case agreement W is preferred to the alternative equilibrium contract. Also, for sufficiently high transaction costs, contingent contracts S, B, and R are not viable.

By construction (equal splitting of gains from trade), the first-period agents’ preferences on the set of agreements are the same. The appendix provides a list of those identical preferences (Tab. A2) and the details behind Fig. 1. This figure shows the optimal agreements B, S, W, and R in $g_{\text{HH}} - g_{\text{LL}}$ space. By assumption, we restrict attention to $g_{\text{HH}} > g_{\text{LL}}$ and $g_{\text{HH}} > g_{\text{LL}}$. The figure also shows the $W > N$ line. Above and to the right of this line, both agents prefer agreement W to agreement N. Area N is never optimal.

Result 4: If there are no transaction costs, agreement N is dominated by agreement R. Agreement W is optimal if both agents can hope for relatively high second-period gains from trade. If only the seller (buyer) has such hopes, then agreement S (agreement B) is optimal. Agreement R is optimal only if second-period gains from trade do not exceed first-period gains by much.

These results are easily explained. Contingent contracts bind an agent $i$ ($i = B, S$) in order to guarantee that the other agent $j$ ($j \neq i$) will not find himself without a trading partner. However, contingent contracts come at a cost. It is especially expensive to bind an agent $i$ whose second-period gains from trade are high. This holds for the first-period seller (buyer) in area S (B) of Fig. 1. In areas S and B, the agent with the lower second-period gains from trade will be bound. If both agents can hope for significant second-period gains from trade, neither of them should be bound, thus agreement W is optimal. If gains from trade are modest for both of them, the reciprocal contingent contract R is optimal.

For $c = 0$, agreement N is dominated by agreement R. After all, agreement R binds both agents so that they cannot fare worse under R than under N. However, if both agents find better trading partners, they will be happy not to insist on binding the other agent.

For $c > 0$, the areas N and W gain more prominence. The transaction costs can be so high as to drive out any contingent contract. The line separating the N and W areas is depicted in Fig. 1.

We now reconsider the question of whether contingent agreements are efficient. Of course, they always increase expected payoffs for the first-period agents. This is
because these agents enter agreements only if they can both expect to gain more than they would were they to simply wait. It is more complicated to judge overall efficiency. In the triangle below the W > N line, contingent agreements will never harm second-period agents, but rather allow for the possibility that one or both of them will find a trading partner.

Above this line, an overall inefficiency may very well arise in accordance with Result 1. For example, if under agreement B the second-period buyer appears while the second-period seller does not, the first-period buyer will insist on pursuing the deal and will thus prevent the first-period seller from making the more attractive deal that would otherwise be possible.

2.6. Risk averseness

Our model assumes risk neutrality on the part of both agents. We cannot offer very specific results for risk averse (or risk loving) agents because the model is already quite complicated. We thus offer the following educated guess:

Conjecture: For any risk averse or risk loving preferences, agreement N is dominated by agreement R. If both agents are risk averse, agreement N is preferred to agreement W for a larger set of parameters. If seller S2 is risk averse while the buyer is risk neutral, agreement S is preferred to agreement B for a larger set of parameters.

According to Result 4, agreement N is dominated by agreement R. This result continues to hold for risk averse or risk loving preferences because no agent can do worse under R than under N. The waiting option (agreement W) is riskier for both agents than agreement N. Introducing risk-averseness for both agents shifts up the W > N line in Fig. 1. If seller S2 is more risk averse than buyer B1, the two agents agree to shift risk away from the most risk averse agent so that the area for agreement S (which reduces the seller’s risk) increases to the detriment of area B.

3. Revisiting the Biyalogorsky-Gerstner model

The general two-period set-up of our model has been copied from the model by Biyalogorsky/Gerstner (2004) (B&G). These authors imagine a seller of a house who meets a buyer B1 in the first period. The seller has some hope of meeting a buyer B2 with a higher willingness to pay in the next period. If he waits, buyer B1 will not be on the market any more. The seller now has three options: selling the house immediately (our agreement N), waiting for the buyer with the higher willingness to pay (agreement W), or signing a contingent contract that obliges the buyer to keep up his offer to buy the house (agreement S).

While our debt to the B&G model is obvious, the B&G model differs from ours in several respects.

First of all, the number of second-period agents differs. The B&G model allows only another buyer to appear in the second period while in our model, another buyer and another seller may make an appearance. This has three implications:

1. Two second-period agents allow the introduction of additional agreements and additional results, for example the domination of agreement N by agreement R when transaction costs are nonexistent.

2. B&G find that contingent contract S increases overall efficiency because agreement S allows the seller to deal with the best buyer: the second-period buyer if he shows up, the first-period buyer otherwise (Result 5, p. 152 in B&G). Our model (Result 1) shows that contingent contracts do not generally increase efficiency. First-period agents may use a contingent contract S (or B, or R in a similar fashion) to safeguard against business done with the second-period agents (if the second-period seller shows up, but not the second-period buyer, the first-period seller will insist on dealing with the first-period buyer). For this reason, contingent contracts may fare worse than agreement W from an overall efficiency viewpoint. We can only reach this different conclusion because we introduce the second-period seller, and therewith the gains from trade between him and the first-period buyer.

3. While B&G must assume that the first-period buyer is not available in the second period under agreement W (assumption 4 (a) in B&G), we endogenize his disappearance. The first-period buyer will simply prefer to deal with the second-period seller who appears with some probability qS. In this respect, our model approaches the B&G model if we concentrate on the special case qS = 1.

The second difference concerns the power of negotiation. B&G use a principal-agent type bargaining process whereby the buyers’ participation constraints are binding. This implies that negotiation power is exclusively vested in the seller. Our model uses the Nash-Rubinstein bargaining process whereby constraints are not binding, thus the power of negotiation does not necessarily lie with the seller. In contrast to B&G, we can show how the first period price (i.e. the price if the house is sold in the first period) depends on the probabilities of the second-period agents arriving. Also, since the participation constraint of the first-period buyer is binding, it is neither clear what kind of costs he incurs by agreeing to contract S, nor why he should obtain a positive transfer. In our model, the contract in favour of the seller may incur a loss for the buyer because he may not be allowed to trade with the better seller he hopes to find in the second period.

The third point of difference concerns a peculiarity of B&G’s model. They employ both the buyer’s valuation of a product and his willingness to pay for that product.
According to the authors, the willingness to pay is the price that equalises the utility for the difference of the valuation and the price to the minimum acceptable utility. Normally, the concepts valuation and willingness to pay coincide, as in our model.

Fourth, in contrast to B&G, we introduce transaction costs for setting up contingent contracts (assumption 5). This is not a major difference and the B&G model could easily be extended to include transaction costs.

Finally, while B&G allow for risk neutral, risk averse and risk prone behaviour on the buyers’ side, we restrict our analysis to risk neutrality for sellers and buyers alike (but see the conjecture at the end of the previous section).

Above, we argue that \( q_* = 1 \) in our model replicates the B&G model. Indeed, for that case, we obtain Fig. 2 (for the underlying preferences, see Tab. A3 in the appendix) and the following result:

**Result 5:** Let \( q_* = 1 \). Then, equilibrium values are given by

- agreement N: \( p_* = \frac{1}{2} (r_H + w_c) + \frac{1}{2} q_B g_{HH} - \frac{1}{2} g_{LL} \)
- agreement S: \( T'_S = \frac{1}{2} (1 - q_B) g_{LL} \),
- agreement B: \( T'_B = 0 \), and
- agreement R: \( T'_R = -\frac{1}{2} (1 - q_B) g_{LL} \).

For \( c = 0 \), both W and B are optimal for \( g_{LL} > g_{HH} \) whereas both S and R are optimal for \( g_{LL} < g_{HH} \).

Agreements B and R are irrational and therefore put in brackets in Fig. 2. When \( q_* = 1 \), agreements S and R are equivalent. (Note that the transfers are identical and that the sign difference stems from the convention that the buyer pays \( T'_S \)). The relevant effect is that both bind the first-period buyer. Binding the seller is of no interest to the first-period buyer, who knows that the second-period seller will appear with probability 1. For the same reason, W and B are equivalent for zero transaction costs and the first-period buyer is not prepared to pay a transfer for agreement B \( (T'_B = 0) \). Of course, for minimal transaction costs, W is preferred to B.

### Managerial, and other, implications

#### 4.1. The main results

Having gone through the model in some detail, we now sketch the main results. In rough terms, an agreement will not be possible that binds an agent who hopes to gain a lot from the second-period encounter. Therefore, if the additional gains from trade (second period over first period) are high for S and low for B, agreement S may come about while agreements B or R are not possible. If both agents’ additional gains are high, no contingent contract will be entered into. Binding both agents (agreement R) can be possible only if the additional gains are rather low for both agents. However, the strong point about agreement R is its dominance over agreement N. Agreement N forestalls business with second-period agents while agreement R leaves this option open if both first-period agents wish.

The problem of efficiency is somewhat intricate. If we consider the point of view of the two first-period agents only, efficiency cannot be a problem. If, however, we interpret efficiency from the point of view of all present and future agents, contingent contracts do not necessarily increase overall efficiency. After all, the second-period agents have no say in the contingent contracts. Therefore, it may well happen that the first-period agents find agreement S profitable (efficiency with respect to the two first-period agents) while overall efficiency is not achieved because the second-period seller has a smaller probability of finding a trading partner.

Our model allows not only prediction of the agreement chosen by the first-period agents but also calculation of the equilibrium transfers to be paid by the agents. Agreements S, B, and R are equivalent to “no shop” clauses in letters of intent. In case of agreement B, some real-world letters of intent have the buyer pay some money for the seller’s not soliciting competing offers. Alternatively, the buyer might have to pay a break-up fee to the seller if he does not proceed in good faith, for example because he himself is closing a deal with a third-party seller. This break-up fee is close to our transfer paid by the buyer for agreement B. Note, however, that this transfer will also be paid if the transaction is indeed carried out. This does not lead to serious interpretational difficulties because the agents can incorporate the transfer into the price.

We get quite intuitive values for the price (first-period agreement N) and for the transfers (second-period agreements S, B, and R). If the first-period seller has a lot to gain from a second-period buyer with a high probability, then the first-period price will be higher than otherwise. We now turn to the transfer part of agreement B to which the seller who demands compensation is bound. This compensation is zero if the probability of a second-period seller appearing is low because in that case, the first-period buyer will not insist on dealing with the first-period seller. It is also clear that the transfer is a positive
function of the gains from trade the first-period seller may achieve in the second period.

4.2. A case study: Pennzoil, Getty Oil, and Texaco

We will now apply our model to the fight for Getty Oil alluded to in the introduction. This multi-billion-dollar lawsuit provides material for several case studies, some legal, others communication- or media-related. Here, we will take on the Getty Oil lawsuit from a contingent-contract perspective.

Before delving into that story, some background information should be understood. After World War II, the US oil industry was worried for some time about declining oil reserves (“oil in the ground”). For example, according to Petzinger (1987, p. 69), as of 1980 Texaco had just 8 years of oil-in-the-ground left, thus it was easier not only to drill for oil (an increasingly frustrating venture) but also to buy other oil companies. Texaco eventually bought (and then regretted having bought) Getty Oil.

A principal character of our story is Gordon Getty, the son of late J. Paul Getty. Gordon was the trustee of a trust set up by his grandmother, J. Paul’s mother. Although a majority shareholder, Gordon, a man of artistic rather than business ambitions, did not have much say in the Getty Oil business. This was to change in 1984, when Gordon, against the wishes of Getty Oil’s management, insisted on selling three sevenths of the Getty shares to Pennzoil Co., headed by Hugh Liedtke at the time. Indeed, a press release from January 1984 announced an “agreement in principle” according to which “Getty Oil will grant to Pennzoil an option to purchase eight million treasury shares for $110 per share” (Petzinger 1987, p. 198). In fact, by throwing in some extra in the course of negotiations, the actual price was close to $112.5 rather than $110, amounting to

$$112.5 \cdot 8,000,000 = $900 million$$

However, this agreement was violated when Texaco Inc. made a better offer, so that all of Getty Oil changed hands for $128 per share. In February 1984, Pennzoil filed a complaint against Texaco alleging that Texaco had tortuously induced Getty to breach the contract. Texaco indemnified Getty Oil’s shareholders against any possible litigation. A complicated lawsuit unfolded and Joseph Jamail, the “King of Torts”, succeeded in having huge actual and punitive damages of more than $10 billion awarded to Getty Oil in 1983 (Petzinger 1987, pp. 86 and 145). Second, the power play within Getty Oil (between Gordon Getty, the management of Getty Oil, and the J. Paul Getty Museum of Malibu, California), gave Gordon Getty a strong incentive to push ahead (see Petzinger 1987, p. 131). We will assume $r_B = 100$, Liedtke’s first offer to Gordon Getty (Petzinger 1987, p. 145). We then obtain

$$g_\mu \leq \frac{15}{20}g_\mu \wedge \frac{20}{30}g_\mu$$

Liedtke’s remark about the “once-in-a-lifetime deal” also shows that his estimate of similar chances were slim. In our terms, $q_\mu$ takes on a low value in the mind of the relevant actors. We will work with $q_\mu = 0.1$.

On the other hand, the probability of a better buyer, $q_B$, was rather high. We assume $q_B = 0.9$. Rumour had it that Exxon Mobil, Gulf Oil and Chevron were also interested in Getty Oil (Petzinger 1987, p. 218). Referring to Fig. A1 (Appendix) and keeping a low $q_\mu$ and a high $q_B$ in mind, we see that the $B > N$ line is close to slope $\sim 1$ (all but erasing area R) while the $B > S$ line running through $(2g_\mu, 2g_\mu)$ is very steep. Under these circumstances, $g_\mu < g_\mu < 2g_\mu$ leads to the prediction that the agents find agreement B profitable. In our interpretation, Getty Oil and Pennzoil did indeed settle on agreement B. The court ruling confirms this view.

We will now estimate the expected gain accruing to both Getty Oil and Pennzoil. Excluding transaction costs, Result 4 leads to an expected gain of
\[ \Pi_B = \frac{1}{2} q_B (1 - q_S) (2g_{HL} - g_{HH}) = \frac{1}{2} \cdot 0.9(1 - 0.1)(30 - 20) = 4.05, \]

per share. Multiplying by the number of shares involved, both Getty Oil and Pennzoil could have had in mind an expected gain of about

\[ 4.05 \cdot 8,000,000 = 32.4 \text{ million} \]

Note also

\[ T_B = \frac{1}{2} q_B (1 - q_S) g_{HH} \cdot 8,000,000 \\
= \frac{1}{2} \cdot 0.9(1 - 0.1) \cdot 20 \cdot 8,000,000 = 64.8 \text{ million} . \]

This means that Getty Oil would have gotten $65 million upfront while the expected gain would have been only half as much.

As an afterthought, one might take these results to question whether Getty Oil really had a contract in mind. Not only did Getty Oil not receive the transfer of $65 million for granting an option to Pennzoil, but the price was also rather low, at $112.5 instead of

\[ \frac{r_H + w_L}{2} = \frac{100 + 130}{2} = 115 \]

in our model under the assumed reservation prices.

### 4.3. Managerial take-aways

Firms are well advised to use contingent agreements more often whenever there is a substantial chance that significantly better sellers or buyers may arrive in the near future. Of course, the benefits of those contracts have to be weighed against the transaction costs. More specifically, our model indicates that

- firms should consider reciprocal contingent contracts more often;
- firms should agree on a one-sided contract benefiting the seller (the buyer) if the seller (the buyer) can hope to gain much more than the buyer (the seller) from the appearance of an alternative trading partner;
- firms should not use a one-sided contingent contract if both expect to gain significantly from the appearance of alternative trading partners, in which case the waiting alternative would be optimal;
- firms should not use a one-sided contingent contract if both would gain only limitedly from the appearance of alternative trading partners, in which case dealing immediately or concluding a reciprocal contract would be optimal.

In contrast to our results, letters of intent of agreement type B are much more prevalent than those of agreement type S. Presumably, the reason for this is that the buyer needs to incur costs of information about the object offered by the seller. Also, the financing is the buyer’s problem, which may prove to be time and labour-intensive. These differing informational and financial require-
ments have not been modelled in this paper and require further research efforts. We also find that reciprocal letters of intent can be optimal although they are very rare. The reason is that a reciprocal letter of intent is somewhat similar to closing the deal immediately and undoing the contract later if both parties wish.

Our model also makes a contribution to the field of pricing policy – a contribution that Getty Oil could have profitably used. It concerns the pricing of agreements and the pricing of the object in question. For example, a seller should ask for a relatively high price if the chances of a future buyer arriving are higher than the chances of a future seller arriving, or if his gains from a future buyer would be substantial.

In the Getty-Pennzoil dispute, the seller violated the no-shop clause. Legal problems may also arise if a buyer tries to back out. In the US, many prospective buyers find that courts consider letters of intent binding even if their non-binding character has been spelled out explicitly. See, for example, Foreca, S.A. v. GRD Development Co., Inc., 758 S.W.2d 744 (Tex. 1988) and Arcadian Phosphates, Inc. v. Arcadian Corp., 884 F.2d 69, 72 (2d Cir. 1989); an opposite example is Philmar Mid-Atlantic, Inc. v. York Street Associates II, 566 A.2d 1253 (Pa. Super. Ct. 1989).

Obviously, the propitious gains from contingent contracts can be threatened by legal problems. One way to alleviate these problems is to make transfers explicit as proposed by our model. If one party actually pays the other to uphold the offer, it is much easier to convince the court that “a deal is a deal,” and for the court to distinguish the bound party.

### 4.4. Economic policy conclusions

One important result of our paper is that contingent contracts may lead to inefficiencies. However, we do not assert that our model contains a message for competition policy, for whenever these inefficiencies occur, they make recontracting worthwhile (see following section).

Given our theoretical results, it is not surprising that contingent contracts are an important legal concept in many countries. However, our discussion of the Getty-Texaco-Pennzoil case shows that letters of intent are very complicated legal entities. From the outset, it is often unclear how courts are going to interpret them. If lawmakers and courts were able to make their consequences more foreseeable, much more substantial economic benefits could be accrued from these contracts.

### 5. Conclusions

The model presented in this paper shows how expected future gains from trade influence the specific agreements and their terms chosen by the two first-period agents. In the preceding section, we discussed the practical take-aways for managers and lawmakers. In this final section, we discuss alternative extensions and approaches.
Our paper rests on the assumption that the second-period agents do not know about each other and can trade with the agents from the first period only. One might as well have discussed an alternative model wherein all second-period agents meet on a market and all trades are possible a priori. This model is detailed in a working paper to be found at http://www.uni-leipzig.de/~micro/wopap.html.

Our model can be related to the search and bargaining models presented by McMillan/Rothschild (1994). While we parsimoniously model the search and bargaining aspects, we explicitly model contingent contracts which are absent in that literature. It may be a particularly challenging task to introduce contingent pricing into search and bargaining models. Alternatively, one may view our model as a special (and certainly unorthodox) instance of a general equilibrium model. After all, contingent contracts can be accommodated in the Arrow-Debreu world.

Finally, one might consider contracts S, B, and R as instances of real options. The first-period actors consider the option to wait for the second period or to engage in a contract that obliges one or both of them to uphold their offers. Examples are common most usually found in finance. For example, a call option gives the right to buy a share at a fixed price at a certain point in time (or at any time on or before that given date). The economics of option prices can be found in Cox/Ross/Rubinstein (1979). Inspired by financial-options literature, a rich and vast literature on real options has sprung up (for a simple example, see Amram/Kulatilaka 1999). The main area of application concerns investment decisions. For example, the real-options approach invites creative thinking about when to invest. Delaying or staging an investment might be worthwhile in order to make use of new information to arrive (timing option, staging option). Also, an investment might bring future opportunities for business that have to be taken into account (growth option). Of course, the analogy with financial and real options can only be carried so far. In our model, agreements S, B, and R do not fix the prices in advance (although they are foreseeable by our agents).

In spite of the positive insights generated by our model, we would like to add some critical remarks. First, it would be interesting to redo the whole exercise with risk averse agents (possibly of varying degrees). In this paper, we confine ourselves to some rather obvious circumstances. Second, we leave to another paper the task of removing the assumption that first-period agents know the exact reservation prices of the second-period agents whom they expect to arrive with certain probabilities. Instead, one could introduce probability distributions on these reservation prices.

Third, in order to derive our results within a rather complicated model, we could not avoid the problem of recontracting. If agreement S is effective in the second period (the additional seller shows up but not the additional buyer), then the first-period buyer may ask the first-period seller permission to deal with the new seller. Given our assumptions about reservation prices, recontracting will indeed be profitable. While recontractability may be a desirable property from a theoretic point of view, real-life bargaining will certainly not have this attribute.

Our paper owes a lot to the seminal paper by B&G. By extending the perspective and considering a two-sided, rather than just a one-sided risk, we arrive at a very different model with helpful new conclusions for marketing managers.

Appendix

Payoffs resulting from the agreements

Tab. A1 contains the payoffs defined by the agreements. In this table, \( \pi_{ai} \) denotes the payoff to agent i (\( i = S_N \) or \( i = B_i \)) under agreement A (\( A = N, S, B, \) or R).

<table>
<thead>
<tr>
<th>( W )</th>
<th>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</th>
<th>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( N )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
</tr>
<tr>
<td>( S )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
</tr>
<tr>
<td>( B )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
</tr>
<tr>
<td>( R )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
<td>( \pi_{ai} = q_i - q_{ai} + q_{ai}\left{ \left[ \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\left[ q_{ai} + \left[ 1 - q_i \right]\left[ 1 - q_{ai} \right]\right]\right} )</td>
</tr>
</tbody>
</table>

Tab. A1: Expected payoffs

Justifying Fig. 1

The two agents’ preferences on the set of agreements are identical and given in Tab. A2. Fig. A1 translates this table into \( g_{BH} - g_{BL} \) space for the special case of transaction costs \( c \) equal to zero. In this figure, the dashed lines represent binary preferences. The areas above (or, if above is not defined, to the right) of these lines are those where the corresponding preferences hold. The bold lines separate the areas where the two agents prefer the agreements S, B, R, or W.

Fig. A2 does not represent a special case insofar as the inequalities \( \frac{q_i}{q_0} \geq 2(1 + q_i - \frac{q_0}{q_0}) \geq 2 \geq 2q_i - q_0 \) hold. \( 2q_i - q_0 \) may be positive or negative. It is easy to check that the W > N line lies above the intersection point \( (2q_i - q_0)B_i, 2(1 - q_i)B_i, 2q_i - q_0)S_i \) of the \( S > N, B > N, \) and \( B > S \) lines and below the point \( (2q_i - q_0)H, 2q_i - q_0)H_i \). The figure represents 9 binary preferences, i.e. all preferences with the exception of W > R. This line’s ordinate lies above \( (1 + q_i - \frac{q_0}{q_0}) \) but possibly below \( \frac{q_i}{q_0} \). In any case, it is of no relevance for the agreement areas S, B, R, or W. Agreement areas are to satisfy \( g_{BH} > g_{BL} \) and \( g_{SL} > g_{BL} \) by assumption. Depending on the probabilities, the lower point of intersection \( (2q_i - q_0)B_i, 2q_i - q_0)S_i \) does not need to fulfill both conditions. Indeed, area R is somewhat small, with a maximal expansion in case of small \( q_i \) (then the S > N
line is relatively steep) and in case of small $q_B$ (then the $B > N$ line is gently sloped).

Fig. 1 (in the main text) is a stripped-down version of Fig. A1.

### Justifying Fig. 2

Tab. A3 follows from Tab. A2 by inserting $q_L = 1$. The only line in need of explanation is “$S$ indifferent to $R$ everywhere”. The argument is given in the last paragraph of section 3. Fig. 2 is an immediate consequence of Tab. A3 for $c = 0$.

### References


