Playing with Nested Dolls: Complementarity between contracting forms in the wine grape supply industry

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Abstract

Our paper provides a theoretical rationale for some recent empirical evidence on institutional arrangements design in the wine grape supply industry. First, we explain the increasing recourse to formal coordination by showing that a written contract is needed to improve efficiency upon spot or oral contracting. But we also show that formal coordination cannot be reduced to an explicit contract since this latter cannot solve by itself the underinvestment problem in grape quality. Thus, formal coordination has to be viewed as an efficient “system” of different contracting forms which complement the written contract. Second, we explain this complementarity effect. We first consider the implicit dimension of the contract as an additional incentive mechanism and we show that combining implicit and explicit contracts generates an efficient hybrid form (simple relational contract) which dominates both previous contracting forms. In such a simple relational contract, the complementary effect is magnified when we introduce an authority mechanism that delegates to the winery some decision rights on the grower’s asset.

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1 Introduction

In the literature on agri-food organization, protecting product quality has been identified as a motivation for vertical coordination (references). Recent empirical studies on contracting in the wine grape supply industry show two main empirical results (Goodhue et al., 2003; Fraser, 2004; Codron et al., 2005): (i) among the variety of vertical arrangements (spot, oral, written and “complex” contracts), a more formal coordination is associated to a higher quality; (ii) there is some complementarity effects between those different vertical arrangements.

Goodhue et al. [2003] dealing firstly with the efficiency of the formal coordination, show that growers in the Californian regions where quality is the highest are significantly more likely to have written contracts. Moreover, analyzing the written contract provisions they show that more “complex” arrangements, like authority decision allocation on the production process, are needed to implement high quality of grapes. More precisely, reference in provisions to best viticultural practices, more vineyard visits and more active involvement in viticultural activities is associated with high-quality grapes. In contrast when quality is not high and thus quality attributes are easily measured, then “market” incentives provisions like bonus or penalty payments are more frequent. Fraser [2004] found similar results in the case of the Australian wine grape industry. Codron et al. [2005], analyzing the vertical arrangements of the two major wineries in the region of Mendoza (Argentina), also support the previous result that the more formal the arrangement, the higher the level of grape quality.

Second, with regard to the complementarity issue between different arrangements, Goodhue et al. [2003] find that implicit and explicit dimensions of a contract may be entwined. For instance, they show that the longer the relationship with the winery, the more likely written contracts can be signed and specific production practices provisions may be included. That is, repeated interactions is not a substitute to the use of (complex) formal contracting. Codron et al. [2005] also suggest that those different arrangements may not be viewed as rival mechanisms since only an original combination of those arrangements can achieve the highest quality. That is when the winery switches from a low grape quality to a high grape quality, and thus adopts a more formal contracting, she does not replace an oral contract by a written contract. She chooses a formal contracting that allows to embed the implicit dimension of the oral contract.

Our paper provides a theoretical rationale for those empirical results. Using an incomplete contract model we define the conditions under which an explicit (written) contract can be an efficient contractual arrangement. We mainly show two results. First, an explicit (written)
contract is a necessary condition to solve the hold-up problem since it improves efficiency upon oral (handshake) contracting. But it is not a sufficient one because an explicit contract cannot solve by itself the hold-up problem when the investment generates some externalities, as it is generally the case in the viticultural industry where the winery may ask for the grower to undertake specific investments that increase her own benefit. However, such a contract may become efficient in a dynamic setting where the relationship is repeated since implicit contract can play a role as an additional incentive mechanism. Thus, we show that a combination of implicit and explicit contracts emerges as an hybrid form which improves upon both types of contracts. We call such an hybrid form a \textit{simple relational contract}. Second, we extend further our analytical framework and consider three levels of investment corresponding to three levels of quality. This allows us to adress the issue of how the highest level of investment, and thus quality, may be sustained. Then, the question is which bundle of mechanisms can implement the highest level of investment. To do this, suppose that the simple relational contract allocates to the winery some decision rights on the grower’s assets\textsuperscript{1}. Then we show that this new contracting form, which we call an \textit{authority relational contract}, may dominate the previous \textit{simple relational contract} because it implements the highest level of investment.

Therefore, our approach consists in considering the different contracting forms like nested dolls. First, we begin with an explicit contract (1\textsuperscript{st} doll) to which we add an implicit dimension (2\textsuperscript{d} doll) by repeating the relationship. Then, we obtain the “simple relational contract” in which the explicit contract is embedded. Furthermore, when an authority mechanism allocation (3\textsuperscript{d} doll) is added we get the “relational authority contract” in which the previous simple relational contract is nested. Nestedness is efficient because of complementarity effects. That is, the more dolls are nested the more efficient may be the contract mix. When all the dolls are nested, the highest investment in quality may be achieved. In contrast, when the third doll (the authority mechanism) is dropped, only an intermediate level of investment in quality can be implemented. And when the second doll (repeated relationship) is also dropped, only the low investment level can be achieved.

\textbf{Related literature.} Recently, a burgeoning empirical and theoretical literature in economics, management and sociology tries to examine the relationship between repeated interactions, the form of contractual arrangements and governance structures. On the empirical side, some papers find a complementarity effect between relational and formal contracts. Using survey data on outsourcing relationships in information services, find that relational

\textsuperscript{1}In the viticultural industry, such an allocation allows the buyer to decide on some dimensions of the seller’s production process.
contracting is associated with greater levels of complexity in formal contracts. Poppo and Zenger [2002] also find some evidence of a complementarity effect by examining how contracts clauses vary according to whether firms have prior exchange experience. There is also some evidence of such an effect in the interaction of explicit and implicit incentive mechanisms in the franchise relationship (Lafontaine, 2007). The explicit mechanism is defined by the contractually specified royalties rate that share the revenue to give incentives to the franchisee’ sales effort and/or franchisor’s brand name reputation effort (Battacharyya and Lafontaine, 1995). The implicit mechanism is linked to the repeated franchise relationship, which termination discipline the possible opportunist behaviours (Klein, 1995; Kaufmann and Lafontaine, 1994). Mayer and Argyres [2004] and Argyres et al. [2007] argue that through repeated interactions firms gain experience in drafting more effective contracts which, in turn, changes the form of optimal contracts. In experimental economics, if Fehr et al. [2007] and Gachter et al. [2007] present evidence that implicit incentives considerably increase voluntary cooperation and thus make explicit incentives redundant, Lazzarini et al. [2004] challenge this result. Indeed, they find evidence of reciprocity as an enforcement mechanism of formal contracts and no evidence that contracts “crowd out” the reciprocity effect and hence substitute for social norms. In contrast, some other papers find that the substitute effect dominates. Examining, factors that explain the choice between equity and non-equity strategic alliances, Gulati [1995] find that firms substitute trust for contractual safeguards in their repeated alliances. Similarly to Corts and Singh [2004], Kahins and Mayer [2004] find that information technology firms repeated interactions lead to less use of formal and high powered contracts.

On the theoretical side, this issue is also a disputed view. The sociology literature has strongly argued that repeated interactions build up trust and decrease reliance on formal contracts (Macaulay, 1963; Bradach and Eccles, 1989). In management, if Dyer and Singh [1998] argue that informal self-enforcing agreements which rely on trust and reputation often supplant the formal controls characteristic of formal contracts, Poppo and Zenger [2002] show in contrast that well-specified contracts promote trusting exchange relationships. In economics, Baker et al. [1994], Pearce and Stachetti [1998] and Schmidt and Schnitzer [1995] study interactions between explicit and implicit contracts in a Principal Agent model and show that when available objective performance measures are imperfect, implicit contracts may be valuable and thus these two contracting forms can be complementary. Baker et al. [2002] and Baker et al. [2006] show a similar result of complementarity in interaction between asset ownership (who owns the asset) and relational contracts both within (employment) and between firms (outsourcing). Our paper follows Baker et al. [2002] by introducing the effect of implicit relationship (or reputation). But we depart from it: (i) by focusing on contract
design and not on ownership allocation; (ii) by analyzing the general case where investments provide “conflicting market incentives” as well as “aligned market incentives”. Then, we mainly show that the allocation of decision rights via explicit contracts may enlarge the set of self-enforceable arrangements.

The remaining sections are organized as follows. Sections 2 presents a simple model, where the grower has a binary choice on the investment level, and analyzes the efficiency of the formal coordination and the complementarity between its components (written and oral contract). Section 3 extends this framework by introducing the possibility of implementing a higher level of investment using an authority mechanism. Section 4 brings some concluding remarks.

2 The basic model

2.1 A static framework

Consider a vertical structure between a winery (the buyer) and a grower (the seller). Denote \( e \in \{e_0, e_1\} \) the grower’s investment where \( e_0 \) is the generic investment and \( e_1 \) is the specific investment. The cost of undertaking such investment is supposed to be \( g_0 = 0 \) when the investment is generic and \( g_1 = g > 0 \) when the investment is specific.

We can distinguish two cases according to the grower’s investment effect on the payoffs (Che and Hausch, 1999). First, when the investment is “purely cooperative” the grower’s investment has an effect only on the winery’s valuation. Since it has no impact on the production cost, we can consider without loss of generality that \( c = 0 \). Denote \( v_i \) the winery’s valuation for the product under investment \( e_i, i = 0, 1 \). We suppose that the specific investment \( e_1 \) generates higher valuation \( \Delta_v \equiv v_1 - v_0 > g \), i.e. the specific investment generates a differential of valuation higher than its cost. Therefore, it is socially efficient to implement such an investment. Second, when the investment is “purely selfish”, the grower’s investment has an effect only on its own production cost, and no effect on the winery’s valuation (\( v_i = 0 \)). Denote \( c_i \) the grower’s production cost for the good under investment \( e_i \). We suppose that the specific investment \( e_1 \) generates a lower production cost than the general investment \( e_0 \) such that \( \Delta_c \equiv c_0 - c_1 > g \). That is the specific investment generates a differential of production cost higher than its own cost. Therefore, the efficient solution consists on implementing the specific investment. When the parties cannot agree to trade they go back to the market where the investment is assumed to have an alternative-use value.
We suppose that the specific investment generates a lower alternative-use value than the general investment, i.e. \( e_1 \) generates \( a_1 \) and \( e_0 \) generates \( a_0 \), such that \( \Delta_a \equiv a_0 - a_1 > 0 \).

This can be explained by the fact that a relationship-specific investment generates a higher value inside the relationship than outside. We also assume that \( \Delta_c \geq \Delta_a \) and \( \Omega_c \geq \Omega_a \).

The timing of the events is the following. Ex ante, at date 0 parties sign the initial contract, and at date 1 the grower invests \( e_t \). Ex post, at date 2 there is a renegotiation of the initial contract, and at date 3 production and trade occur.

First, we consider that the parties can write only an oral (handshake) contract. Since this null contract is incomplete, the parties fill in it at date 2 during the renegotiation process. If we suppose that the winery has the whole bargaining power in the renegotiation subgame, then she can make a “take-it-or leave it” offer such that the contingent price offered equals to the alternative use-value of the investment, i.e. \( p_t = a_t \) when she observed \( e_t \). That is, the grower gets \( a_1 \) when \( e = e_1 \) and \( a_0 \) when \( e = e_0 \). Since \( a_1 < a_0 \), then the grower never implements \( e_1 \), and thus always underinvests. Note that this result holds even when the investment has no impact on the alternative use-value. Suppose that \( a_1 = a_0 = a \). Then, the winery will offer a price \( p = a \) regardless of the investment \( e_t \) chosen by the grower. Anticipating this outcome, the grower knows at the ex ante period that whatever the level of investment \( e_t \) he chooses, he will receive a fixed price. Therefore, he chooses \( e_0 \) which minimizes the investment cost \( (g_0 = 0) \). Since only the generic investment can be implemented, there is an underinvestment result or a hold-up problem.

Now, suppose that the parties can sign a written contract. They can sign a contract that specifies a price \( p \) for the delivery. Such a contract is feasible if the court is willing to enforce the specific performance or expectation damages rule if breach occurs (Edlin and Reichelstein, 1996). Such a contract can solve the hold-up problem, depending on the nature of the investment. When the investment is “purely selfish”, efficiency can be achieved. Indeed, if \( e = e_1 \) then the grower will get \( p - c_1 - g \) and if \( e = e_0 \) then he obtains \( p - c_0 \). Since \( \Delta_c > g \), the grower will choose the efficient investment \( (e = e_1) \). However, when the investment is “purely cooperative”, the efficient result does not hold. Indeed, if \( e = e_1 \) then the grower gets \( p - g \), and if \( e = e_0 \) then he obtains \( p \). Therefore, the grower always prefer to implement \( e = e_0 \) in order to save \( g \). In other words, the hold-up problem cannot be solved.

### 2.2 A dynamic framework

We have seen above that if a written contract may solve the hold-up problem when the investment is “purely selfish”, it cannot deal with a “purely cooperative” investment. But
if we consider a long term relationship, where the previous static game is repeated, this negative result may be overturned. To show this, we analyze in what follows an infinitely repeated version of the previous static game with perfect monitoring and common discount factor $\delta \in (0, 1)$.

First, we suppose that the winery offers, at the beginning of each period, a “take-it-or-leave-it” oral contract which takes the form of a bonus/penalty menu $(w_1, w_0)$ contingent to the investment observed. We consider only stationary self-enforced contracts, that is contracts where at each period the grower promises $e_i = c_1$ and the winery promises $w_i$ if $e_i$. If one party deviates, e.g. the grower chooses $c_i = c_0$ instead of $c_1$ or the winery does not pay $w_i$ if $e_i$, the relationship becomes a spot contracting in the following periods. That is, the grower chooses $e = e_0$ and the winery pays the market price defined by the alternative use-value of the investment. Consider first the grower strategy. The winery offers at the beginning of each period, a contract that satisfies the grower’s incentive constraint to invest efficiently, that is

$$w_1 - g \geq w_0$$  \hspace{1cm} (1)$$

After accepting such a contract, the grower can be opportunistic and chooses $e = e_0$. Then, he gets a static gain $p_0(= a_0) + g$. Since reneging at one period implies that the relationship becomes a spot contracting in the following periods, a future loss $[\delta/(1 - \delta)] [(w_1 - a_0) - g]$ may appear. Thus, the grower will honor his agreement if and only if

$$a_0 - w_0 \leq \frac{\delta}{1 - \delta} [(w_1 - a_0) - g]$$  \hspace{1cm} (2)$$

Consider now the winery’ strategy. If the grower chooses $e = e_1$, the winery can decide not to pay $w_i = p_1$ but to renegotiate in order to pay only the alternative-use value of the investment $(a_1)$. Such an opportunistic behavior generates a static gain $w_i - a_i$ for the winery. However, being opportunistic at one period implies that the relationship becomes a spot contracting in the following periods (that is $e = e_0$ is implemented and thus $v = v_0, w_0 = a_0$). This implies a future loss

$$\frac{\delta}{1 - \delta} [(v_1 - w_1) - (v_0 - a_0)] = \frac{\delta}{1 - \delta} [\Delta_v - (w_1 - a_0)]$$

therefore, the winery will honor his agreement if and only if

$$w_1 - a_1 \leq \frac{\delta}{1 - \delta} [\Delta_v - (w_1 - a_0)]$$  \hspace{1cm} (3)$$

The winery will choose the oral contract that minimizes $w_1$ subject to (1), (2) and (3). Substituting, we get the following proposition.
\textbf{Proposition 1} With an oral oral contract, the efficient investment \(e_1\) can be implemented if

\[ g + \Delta_a \leq \frac{\delta}{1 - \delta}[\Delta_v - g] \]  \hfill (4)

Now suppose that the parties sign a written contract. That is, at the beginning of each period the winery promises to pay a fixed price \(\bar{p}^w\) enforced by the court, and the grower promises to choose the efficient investment \(e = e_1\). As above, if one party deviates the relationship becomes a spot contracting. Consider first, the grower strategy. After accepting the contract offered by the winery, the grower can be opportunistic and chooses \(e = e_0\). The initial contract is then breached and the grower obtains \(a_0 + g\) as a static gain from reneging. As previously this behavior implies a future loss \([\delta/(1 - \delta)][(\bar{p}^w - g) - a_0]\), which is nonegative if the grower's incentive constraint to invest efficiently

\[ \bar{p}^w - g \geq a_0 \]  \hfill (5)

is satisfied. Therefore, the grower will honor his agreement if and only if

\[ a_0 + g \leq \frac{\delta}{1 - \delta}[(\bar{p}^w - g) - a_0] \]  \hfill (6)

Consider now the winery's strategy. If the grower chooses \(e = e_1\), the winery cannot be opportunistic after having been committed to a fixed price. Indeed, suppose that he decides not to pay the fixed price \(p^*\) but to renegotiate by making a “take-it-or-leave-it” offer \(a_1 \leq \bar{p}\). Then, the grower will not accept the winery’s offer, and he will demand the performance of the fixed price contract. This implies that the winery obtains no gain from reneging and has no future loss, i.e.

\[ \bar{p}^w = a_1 = \Delta_v + a_0 \]  \hfill (7)

The winery's program is then to minimize \(p\) subject to (5), (6), (7). After substitution, we get the following proposition.

\textbf{Proposition 2} With a written contract, the efficient investment \(e_1\) can be achieved if

\[ g \leq \frac{\delta}{1 - \delta}[\Delta_v - g] \]  \hfill (8)

Suppose now that the parties write a relational contract. A relational contract is an hybrid form \((\bar{p}^r, w_0, w_1)\) which contains a written (fixed price) contract \(p\) and an oral contract \(w_i\), contingent to the investment \(e_i\). With such a relational contract, the grower gets \(\bar{p}^r + w_1 - g \geq \ldots\)
a_1 if e = e_1, and \( \bar{p} + w_0 \geq a_0 \) if e = e_0. That is, the incentive constraint to implement e = e_1 is
\[
w_1 - w_0 \geq g \tag{9}
\]
The winery is ready to pay such a bonus \( w_1 \) when he observes \( e_1 \). If \( (w_1 - w_0) \) is lower than the present value of the net surplus generated by \( e_1 \),
\[
w_1 - w_0 \leq \frac{\delta}{1 - \delta} [\Delta_v - g] \tag{10}
\]
substituting the incentive constraint in (10) yields the condition for a relational contract to implement \( e_1 \).

**Proposition 3** With a relational contract, the efficient investment \( e_1 \) can be achieved if
\[
g \leq \frac{\delta}{1 - \delta} [\Delta_v - g] \tag{11}
\]

Finally, we will compare these three kind of contracts and define which one is the less costly for the winery to implement the efficient investment. The following proposition shows that the relational contract is the best solution.

**Proposition 4** a relational contract \((\bar{p}, w_0, w_1) = (a_0, 0, g)\) is the less costly mechanism to implement the efficient investment.

**Proof.** In order to support this efficiency condition, the winery can first choose the bonus menu \((w_0, w_1) = (0, g)\) such that it satisfies the incentive constraint (9). Second, he can define the fixed price such that the grower gets no rent if he invests efficiently \( \bar{p} + w_1 - g = a_0 \). Then, a relational contract such that \((\bar{p}, w_0, w_1) = (a_0, 0, g)\) satisfies the efficiency condition. Note that the constraints to be satisfied in order to implement the efficient investment are (4) with an oral contract, (8) with a written contract, and (11) with a relational contract. On can draw three main conclusions from these results. First, introducing a written contract in a repeated relationship facilitates the implementation of the efficient investment, since (8) is easier to satisfy than (4). Second, if both conditions are satisfied, the winery prefers not to commit to a fixed price contract. Indeed, if we compare the prices that satisfy the grower’s incentive contract in both settings we get: \( p_1 = a_0 + g \) and \( \bar{p}^w = a_0 + g/\delta > p_1 \). That is, the fixed price in a written contract is higher than the oral contract contingent price. The relational contract, a hybrid contract between a fixed price contract and a contingent contract, has the advantages of both contracts and thus dominates them. First, it is very
similar to the fixed price contract with its less stringent implementation condition. Indeed, the implementation condition (11) is the same than with a written contract, and much less stringent than with an oral contract. Second, it is very similar to the contingent price with its low price. Indeed, the fixed price in a relational contracting is equal to the oral price and lower than the fixed price of the written contract: $\bar{p'} = a_0 + g = p_1 < \bar{p}''$.

3 The general model

We consider now the general case, where the grower can undertake three levels of investment $e \in \{e_0, e_1, e_2\}$, corresponding to the three levels of quality (low, medium and high) that he can produce. The cost $g_i$ of the investment $e_i$, $i = 0, 1, 2$, is such that $0 = g_0 < g_1 < g_2$ and we assume that $\Delta_g \equiv g_2 - g_1 > g_1$. Consider now the winery’ side. The value for the grape is a function of its quality: the higher the quality, the higher the valuation. That is $v_0 < v_1 < v_2$. For simplicity, we assume that $\Delta_v = v_2 - v_1 = v_1 - v_0$. We continue to assume that investment can have an alternative use-value, which is different according to the chosen level of investment $a_i$. For simplicity, denote $\Delta_a = a_2 - a_1 = a_1 - a_0$. As previously, the investment is relationship-specific, that is $v_0 \geq \max \{a_0, a_1, a_2\}$ and $\Delta_v \geq \Delta_a$. Thus, it is socially optimal that the grower undertakes the highest investment. Therefore, $e_2$ is the first best investment if $\Delta_v \geq \Delta_g$. Moreover, we add some new structures on contracting. That is, we suppose that the winery can decide ex post on some dimensions of the good to be traded. It means, whether the contract considered (oral or relational), this latter may delegate some authority to the winery on the grower’s asset use. Therefore, we will see if adding an authority mechanism in oral and relational contracting may implement the higher level of investment $e_2$.

3.1 Oral market and authority contract

Suppose first that we are back to an oral contracting. In this situation, no contract can be signed but the winery may fill in the contract by deciding ex post on some crucial dimensions of the good to be delivered by the grower. Therefore, we can distinguish between two kinds of oral contracting: (i) market contracting, where the grower has the whole rights on his asset; (ii) authority contracting where some rights are delegated to the winery, i.e. the winery can restrain uses of the grower’s physical assets (monitoring of some cultural practices).

Under oral market contracting, only the grower has rights on his asset. Therefore, if the
grower chooses \( e_i, i = 0,1,2 \), ex ante and the renegotiation ends without any agreement, the grower gets a payoff defined by his threat point in the game, i.e. \( a_i \) the alternative-use value of his investment \( e_i \). That is, in case of breach of the oral contract, the grower can find in the market some alternative uses for his investment which value is \( a_i \) if he invests \( e_i \). That is why this oral contracting is called market contracting. The winery gets nothing since she is not the owner of the asset. Since cooperation is socially optimal because \( S = v_i - a_i > 0 \), then this surplus \( S \) is shared according to the Nash bargaining solution \((50:50)\). The grower's and the winery's ex post payoffs are then

\[
\begin{align*}
\pi_G &= a_i + \frac{1}{2}(v_i - a_i) = \frac{1}{2}(v_i + a_i) \\
\pi_W &= 0 + \frac{1}{2}(v_i - a_i) = \frac{1}{2}(v_i - a_i)
\end{align*}
\] (12) (13)

Expecting this payoff, under market contracting the grower chooses ex ante \( e^{MC} \in \{e_0, e_1, e_2\} \) that maximizes le grower's ex ante profit \( \Pi_G^{MC} = \pi_G - g_i \). Let denote the \( \Phi^{MC} \) the social surplus under oral market contracting such that \( \Phi^{MC} = \Pi_G^{MC} + \Pi_W^{MC} = v_i - g_i \), when \( e = e^{MC} \) and where \( \Pi_W^{MC} \) is the winery's ex ante profit. Similarly, let denote \( \Phi_i = v_i - g_i \) the ex ante social surplus when \( e = e_i \).

**Proposition 5** Assume that \( e^{MC} < e_2 \), then the optimal investment under market contracting is

\[ e^{MC} = e_1 \text{ if } \Delta_v + \Delta_a \geq 2g_1 \text{ and } e^{MC} = e_0 \text{ if } \Delta_v + \Delta_a < 2g_1 \]

**Proof.** Since \( e_2 \) cannot be implemented, then only \( e_1 \) or \( e_0 \) can be achieved. The net gain from choosing \( e_1 \) instead of \( e_0 \), is such that

\[
\frac{1}{2}[(v_1 - v_0) + (a_1 - a_0)] \geq g_1 - g_0
\]

or

\[ \Delta_v + \Delta_a \geq 2g_1 \]

Similarly \( e_0 \) will be chosen, instead of \( e_1 \), if

\[ \Delta_v + \Delta_a < 2g_1 \]

\( \square \)

Now consider the case of an authority contract, where the winery can restrain the grower's alternatives physical asset uses by supervising some of the production practices. This implies
that the grower gets nothing outside the relationship. Indeed, since the winery supervises the use of his investment, then the alternative-use value of the investment in the market equals 0. Even if the winery has some rights on the assets, we assume that she cannot gain anything without the grower since the latter is dispensable to the asset (Hart, 1995). Then, as before, she continues to get nothing outside the relationship. The renegotiation outcomes are thus

\[ \pi_G = \pi_W = \frac{1}{2} v_i \]

Expecting this payoff, under authority contract the grower chooses ex ante \( e^{AC} \in \{e_0, e_1, e_2\} \) that maximizes \( \Pi_G^{AC} = \pi_G - g_i \). Let denote the \( \Phi^{MC} \) the social surplus under oral authority contracting such that \( \Phi^{AC} = \Pi_G^{MAC} + \Pi_W^{AC} = v_i - g_i \), when \( e = e^{AC} \).

**Proposition 6** Assume that \( e^{AC} < e_2 \), then the optimal investment under authority contracting is

\[ e^{AC} = e_1 \text{ if } \Delta_v \geq 2g_1 \text{ and } e^{AC} = e_0 \text{ if } \Delta_v < 2g_1 \]

**Proof.** The proof follows the same reasoning as above. \( \square \)

The following proposition compares the ex ante social surplus that can achieved with market contracting and authority contracting.

**Proposition 7** If \( \Delta_a > 0 \), then \( W^{MC} \geq W^{AC} \). But if \( \Delta_a < 0 \), then \( W^{MC} \leq W^{AC} \).

**Proof.** When \( \Delta_a = a_2 - a_1 = a_1 - a_0 > 0 \), market contracting dominates because there are aligned “market incentives”. The higher the specific investment level \( e_i \) developed inside the relationship, the higher the grower’s alternative-use value \( a_i \) of his investment in the market. Since from (12), the grower’s payoff depends on \( \Delta_a \) a high alternative-use value will give him incentives to invest. But when \( \Delta_a < 0 \), authority contracting dominates because there is conflicting “market incentives”: a high specific investment level will reduce the alternative-use of this investment. That is investment specificity may reduce the outside options. If market contracting were used, then the grower would have an incentive to reduce his optimal investment level in order to increase his outside option. Authority contracting, by reducing the grower’s rights on his assets, implies \( \Delta_a = 0 \). This eliminates conflicting incentives, and therefore increases incentives to invest in specific investment. \( \square \)
3.2 Market relational contracting vs authority relational contracting

We suppose that the relational contract, i.e., a contract that contains a fixed price $\bar{p}$ and a bonus $p_i$ to pay when the level of investment implemented is $e_i$, may stipulate an authority allocation mechanism. Then, we analyze if adding such authority mechanism may improve the efficiency of the relational contract. Thus, we compare the efficiency of two contracting forms: (i) market relational contract, where the contract specifies only a bonus contingent to the realized investment (indirectly observed by some proxies like sugar content, brix index,...); (ii) authority relational contract, where the contract specifies a bonus and furthermore delegates some authority to the winery. We suppose that renegotiation occurs whether the winery has some decision rights on the grower's asset or not (delegation of authority). For simplicity, we also suppose that the parties can renegotiate only the bonus\(^2\).

3.2.1 Market relational contracting

In this situation, at the beginning of each period, there is no authority delegation mechanism and the winery offers a simple relational contract $(\bar{p}, p_0, p_1, p_2)$ with the grower promising $e = e_2$. When a deviation occurs, then parties return to a market contracting from the next period on. That is, when the winery refuses to pay $p_i$ after observing $e = e_i$, there is a renegotiation which outcome is the same as in the market contracting case, i.e., the winery must pay a price $\frac{1}{2}(v_i + a_i)$. Therefore, when the winery reneges, he saves $p_i - \frac{1}{2}(v_i + a_i)$. But since after reneging, deviation results in market contracting outcome until the end of the game, the winery losses $[\delta/(1 - \delta)](v_2 - p_1) - (\bar{p} + \pi^{MC})$ where $(v_2 - p_2)$ is the net valuation when the efficient investment $e_2$ is implemented and $(\bar{p} + \pi^{MC})$ is the winery's payoff under market contracting. Therefore the winery honors the agreement if and only if for all $i = 0, 1, 2$:

$$p_i - \frac{1}{2}(v_i + a_i) \leq \frac{\delta}{1 - \delta}(v_2 - p_2) - (\bar{p} + \pi^{MC})$$  \hspace{1cm} (14)

Similarly, if the grower reneges he looses the bonus $p_i$ for not having implemented $e_i$ and will get only the renegotiation payoff $\frac{1}{2}(v_i + a_i)$. His net payoff is then $-p_i + \frac{1}{2}(v_i + a_i)$. But after reneging at one period, the game continues in market contracting from the next period and then the grower will lose $\frac{\delta}{1 - \delta}[(p_2 + \bar{p}) - (\pi^{MC} - g_2)]$. Therefore, the grower honors the agreement if and only for all $i = 0, 1, 2$

$$-[p_i - \frac{1}{2}(v_i + a_i)] \leq \frac{\delta}{1 - \delta}[(p_2 + \bar{p}) - (\pi^{MC} - g_2)]$$  \hspace{1cm} (15)

\(^2\)Whether the authority mechanism is renegotiated or not does not matter (Chu, ??/??).
we can rewrite (14) and (15) as a unique constraint

\[
\max_i [p_i - \frac{1}{2}(v_i + a_i)] - \min_i [p_i - \frac{1}{2}(v_i + a_i)] \leq \frac{\delta}{1 - \delta} [(v_2 - g_2) - (\pi_{\text{w}}^{MC} + \pi_{G}^{MC})] \\
\leq \frac{\delta}{1 - \delta} (\Phi_2 - \Phi_{\text{MC}})
\]

(16)

To implement the efficient investment \(e_2\) under market relational contracting, the initial contract must satisfy the grower’s incentive constraints

\[p_2 - p_1 \geq \Delta_g \text{ and } p_2 - p_0 \geq g_2\]

The following proposition gives the conditions under which a market relational contract can be efficient.

**Proposition 8** The first best level of investment \(e_2\) can be implemented under relational outsourcing: (i) if \((\Delta_v + \Delta_a) < 2g_1\), then the condition is

\[g_2 - (\Delta_v + \Delta_a) \leq \frac{\delta}{1 - \delta} (\Phi_2 - \Phi_{\text{MC}}), \quad \text{with } \Phi_{\text{MC}} = \Phi_0\]  

(17)

(ii) if \((\Delta_v + \Delta_a) \geq 2g_1\), then the condition is

\[\Delta_g - \frac{1}{2}(\Delta_v + \Delta_a) \leq \frac{\delta}{1 - \delta} (\Phi_2 - \Phi_{\text{MC}}), \quad \text{with } \Phi_{\text{MC}} = \Phi_1\]  

(18)

**Proof.** If \((\Delta_v + \Delta_a) < 2g_1\), then \(\Phi_{\text{MC}} = \Phi_0\) since \(e_{\text{MC}} = e_0\) (prophecy 4). Therefore to induce the grower to choose \(e_2\) in the relationship outsourcing, the grower’s incentive constraint \((p_2 - p_0) \geq g_2\) must be binding. Substituting in (18) we get (17). Similarly, if \((\Delta_v + \Delta_a) \geq 2g_1\), then \(\Phi_{\text{MC}} = \Phi_1\) since \(e_{\text{MC}} = e_1\) (prophecy 4). If \(e = e_1\), the incentive constraint \((p_2 - p_1) \geq \Delta g\) must be binding. Substituting in (18) we get (18). \(\square\)

Now we will consider the possibility for the parties to sign a relational authority contract, that is a relational contract where an authority mechanism is included. Then, suppose that at the beginning of each period the winery offers \((\bar{p}, p_0, p_1, p_2)\) and the grower promises \(e = e_2\). When a deviation occurs, then parties return to an authority contracting from the next period on. Therefore, at the beginning of each period the winery honors the agreement and pay the bonus \(p_i\) after observing \(e_i\) if and only if for all \(i = 0, 1, 2\)

\[p_i - \frac{1}{2}v_i \leq \frac{\delta}{1 - \delta} [(v_2 - p_2) - (\bar{p} + \pi_{\text{w}}^{AC})]\]  

(19)
where $\pi^A_W = 1/2v_i$ is the payoff that the winery gets in the renegotiation process when she can monitor the grower’s alternative use of investment. Similarly, the grower honors the agreement and decides to implement $e_2$ if and only if for all $i = 0, 1, 2$

$$- [p_i - \frac{1}{2}v_i] \leq \frac{\delta}{1 - \delta} [(p_2 + \bar{p}) - (\pi^{AC}_G - g_2)] \quad (20)$$

Constraints (19) and (20) can be rewritten as follows

$$\max_i [p_i - \frac{1}{2}(v_i + a_i)] - \min_i [p_i - \frac{1}{2}(v_i + a_i)] \leq \frac{\delta}{1 - \delta} [(v_2 - g_2) - (\pi^{MC}_W + \pi^{MC}_G)]$$

$$\leq \frac{\delta}{1 - \delta} [\Phi_2 - \Phi^{MC}] \quad (21)$$

To implement the efficient investment $e_2$ under relational outsourcing, the initial contract must satisfy the grower’s constraint

$$p_2 - p_1 \geq \Delta_g \text{ and } p_2 - p_0 \geq g_2$$

**Proposition 9** the first best investment $e_2$ can be implemented under relational authority: (i) if $(\Delta_v + \Delta_a) < 2g_1$, then the implementation condition is

$$g_2 - \Delta_v \leq \frac{\delta}{1 - \delta} (\Phi_2 - \Phi^{SA}), \quad \text{with } \Phi^{AC} = \Phi_0 \quad (22)$$

(ii) if $(\Delta_v + \Delta_a) \geq 2g_1$, then the implementation condition is

$$\Delta_g - \frac{1}{2}\Delta_v \leq \frac{\delta}{1 - \delta} (\Phi_2 - \Phi^{AC}), \quad \text{with } \Phi^{AC} = \Phi_1 \quad (23)$$

**Proof.** the reasoning is the same as previously. \[\square\]

The following proposition compares the efficiency of the two kinds of contracts.

**Proposition 10** When $\Delta_a < 0$ (conflicting market incentives) and $\Phi^{AC} = \Phi^{MC}$, the relational authority contract dominates the relational market contract. When $\Delta_a > 0$ (aligned market incentives) and $2g_1 > \Delta_v \geq 2g_1 - \Delta_a$ (so that $\Phi^{AC} = \Phi_0 < \Phi_1 = \Phi^{MC}$), then the relational authority contract may continue to dominate the relational market contract.

**Proof.** If $\Delta_a < 0$ (conflicting market incentives) and $\Phi^{AC} = \Phi^{MC}$, then the future loss of the relational market contract and relational authority contract, given by the right-hand side of (16) and (21), are the same. Therefore, to compare these two contracts we have to look at the reneging temptation that they generate.
(i) if \((\Delta_v + \Delta_a) \geq 2g_1\) so that \(\Phi^{AC} = \Phi^{MC} = \Phi_1\), then the reneging temptation payoff with a relational market contract is
\[
\Delta_g - \frac{1}{2}(\Delta_v + \Delta_a) \leq \frac{\delta}{1 - \delta}(\Phi_2 - \Phi_1)
\]
and the reneging temptation payoff with a relational authority contract is given by
\[
\Delta_g - \frac{1}{2}\Delta_v \leq \frac{\delta}{1 - \delta}(\Phi_2 - \Phi_1)
\]
Since \(\Delta_g - \frac{1}{2}\Delta_v \leq \Delta_g - \frac{1}{2}(\Delta_v + \Delta_a)\) because \(\Delta_a < 0\), then the relational authority contract dominates since it has a lesser reneging temptation than the relational market contract for the same future loss;

(ii) if \(\Delta_v + \Delta_a < 2g_1\) so that \(\Phi^{AC} = \Phi^{MC} = \Phi_0\), then the reneging temptation payoff with a relational market contract is given by
\[
g_2 - (\Delta_v + \Delta_a) \leq \frac{\delta}{1 - \delta}(\Phi_2 - \Phi_0)
\]
and the reneging temptation payoff with a relational authority contract is defined by
\[
g_2 - \Delta_v \leq \frac{\delta}{1 - \delta}(\Phi_2 - \Phi_0)
\]
Since \(\Delta_g - \Delta_v \leq \Delta_g - (\Delta_v + \Delta_a)\) because \(\Delta_a < 0\), then, as previously, the relational authority contract dominates because it generates a lesser reneging temptation.

Now consider the case where \(\Delta_a > 0\), i.e. where the market incentives are aligned. Then, the relational authority contract may dominate the relational market contract. Indeed, if \(2g_1 \geq \Delta_v \geq 2g_1 - \Delta_a\) (so that \(\Phi^{AC} = \Phi_0 < \Phi_1 = \Phi^{MC}\)), then a relational market contract implements the efficient investment if
\[
\Delta_g - \frac{1}{2}(\Delta_v + \Delta_a) \leq \frac{\delta}{1 - \delta}(\Phi_2 - \Phi_1) \tag{24}
\]
and a relational authority contract achieves the efficient solution if
\[
\Delta_g - \Delta_v \leq \frac{\delta}{1 - \delta}(\Phi_2 - \Phi_0) \tag{25}
\]
that is there is a larger future loss ((\(\Phi_2 - \Phi_0\) \geq (\(\Phi_2 - \Phi_1\))) and also a larger reneging temptation (\(\Delta_g - \Delta_v \geq \Delta_g - \frac{1}{2}(\Delta_v + \Delta_a)\)) under the relational authority contract than under the relational market contract. To prove that the relational authority contract dominates the relational market contract, subtract (24) from (25). The difference is then
\[
\frac{1}{2}(\Delta_a - \Delta_v) \leq \frac{\delta}{1 - \delta}(\Phi_1 - \Phi_0)
\]
or
\[ \frac{1}{2}(\Delta_a - \Delta_v) \leq \frac{\delta}{1-\delta}(\Delta_v - g_1) \]  \hspace{1cm} (26)

since \(2g_1 > \Delta_v\). Substituting this inequality in (26), we get
\[ \frac{1}{2}(\Delta_a - \Delta_v) < \frac{\delta}{1-\delta}(\Delta_v - \frac{1}{2}\Delta_v) \]
or
\[ \Delta_v > (1-\delta)\Delta_a \]

which always holds true since by assumption \(\Delta_v \geq \Delta_a\). Therefore, condition (26) is always satisfied when \(2g_1 > \Delta_v \geq 2g_1 - \Delta_a\). \square

4 Conclusion

Our paper provides a theoretical rationale for some empirical results on contract arrangements in the wine grape supply industry. Using an incomplete contract model, we show firstly that an explicit (written) contract is a necessary condition to solve the hold-up problem since it improves efficiency upon spot contracting. But it is not a sufficient one because an explicit contract cannot solve by itself the hold-up problem when the investment generates some externalities. Such a contract may become efficient in a dynamic setting where the relationship is repeated because implicit contract can play a role as an additional incentive mechanism. We mainly show that a combination of implicit and explicit contracts emerges as an hybrid form which improves upon both types of contracts. We call such an hybrid form a simple relational contract. Second, when we extend further our analytical framework and we show that an authority delegation mechanism is needed to implement the highest level of specific investment. More precisely, suppose that the simple relational contract allocates to the winery some decision rights on the grower's assets. Then this new contracting form, which we call an authority relational contract, may dominate the previous simple relational contract.

However, major gaps remain in our model such as allowing for the fixed price to be renegotiable. Moreover, if we caught theoretically the idea of complementarity between the different contract forms, this idea has to be more clearly stated empirically in the wine grape supply industry. Indeed, empirical positive correlations exhibited in the previous works do not necessarily mean complementarity. To do so, the emergent econometrics on complementarity (Arora and Gamberdella, 1990; Ichniowski et al., 1997; Athey-Stern, 1998, Cokburn et al.,
may be very helpful. Even if, assessing complementarity is not an easy task since this kind of econometrics is very data demanding.

References


