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Perishability as a determinant of vertical coordination

The case of the US egg, poultry, and pork industries

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Abstract

Purpose – The purpose of this paper is to present a simple model to demonstrate how a trade-off between incomplete contract distortions and excessive governance costs determine an agricultural firm's organizational choices.

Design/methodology/approach – In this paper, it is argued that the perishable nature of products exaggerates the incomplete contract distortion, such that products with a short biological production cycle (e.g. eggs) are likely to be operated under vertical integration, products with a medium cycle (e.g. poultry) are likely to be operated under product contracts, and products with a long cycle (e.g. pork) are likely to be operated under marketing contracts.

Findings – This model helps explain why vertical integration dominates the US egg industry, why product contracts are prevalent in the turkey industry, and why marketing contracts have become common in the pork industry. The implications from this model are also applicable to other sectors and other countries, including China's agricultural sectors.

Originality/value – This paper illustrates that perishable products are more vulnerable to opportunism, because the incomplete contract distortion is exaggerated by the perishable nature of the products. However, a local government can reshape firms' choices of vertical coordination by improving its legal infrastructure to reduce the incomplete contract distortions and then weaken the role of the perishable nature of products, so that contracting (product or marketing) may take place. Note that agricultural producers benefit more in selling their products through product/marketing contracts than spot markets.

Keywords Food products, Agriculture, Contracts, United States of America, Vertical marketing

Paper type Research paper

1. Introduction

In recent years, the US poultry, egg, and pork industries have utilized substantial contracting and vertical integration in the vertical coordination of production and processing. Vertical integration alone accounts for over 60 percent of the egg industry, production contracts account for about 56 percent of turkey production, and marketing contracts have become prevalent in the pork industry (Martinez, 2002)[1]. This paper, by incorporating the perishable nature of food industries, presents a simple model to help explain why the vertical coordination varies among those food industries.

A firm adopting vertical integration incurs governance costs, while an increase in the hierarchy structure gives rise to more attenuated incentives and bureaucratic

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distortions, leading to greater governance costs (Williamson, 1985; McAfee and McMillan, 1995). Alternatively, the firm can reduce its hierarchy structure, thereby avoiding sizable governance costs, through either product or marketing contracting activities. However, the non-verifiability of the relevant state of the world often causes the contract to be incomplete (Grossman and Hart, 1986; Hart and Moore, 1988). Contracting parties in this situation are susceptible to opportunistic behavior when the contracts are renegotiated, in response to changing market conditions (Martinez, 2002; Antràs and Helpman, 2004)[2].

When a contract is incomplete, a party that has made the relationship-specific investment *ex ante* will be subject to a holdup, so that the other party can appropriate the quasi-rents and generate above-normal returns (Klein *et al.*, 1978; Martinez, 2002; Antràs and Helpman, 2004). Fearing a potential holdup, a producer might under-invest *ex ante* in order to avoid potential losses[3]. In order to reduce this tendency of underinvestment, a firm can acquire additional control over the production process by purchasing associated equipment and high-quality feed for the contracted producer's uses, as good quality product inputs normally generate high-quality products (Martinez, 2002)[4]. This situation illustrates that a trade-off between the incomplete contract distortions that stem from contracting and the excess governance costs associated with vertical integration determines a firm's organizational choices (Williamson, 1985; Grossman and Hart, 1986; Hart and Moore, 1990; Grossman and Helpman, 2002).

With regard to agricultural products, some empirical analyses (Knoeber, 1989; Joskow, 1988; Levy, 1985) have suggested that incomplete contract distortions promote increased utilization of vertical integration and discourage contracting in agricultural industries. Frank and Henderson (1992) introduced a vertical coordination measure, which is an index that considers uncertainty, input supplier concentration, scale economies, and asset specificity, to empirically support the hypothesis that incomplete contract costs are a primary motivation for vertical integration via contracting. Theoretically, Reimer (2006) argues that vertical integration in the pork industry increases with the potential underinvestment of growers and the need to manage the increasing burdens of food safety and environmental liability, etc. Kvaløy and Tveterås (2008) apply a repeated game model of self-enforcing rational contracting to explain a case of vertical integration in salmon aquaculture, where the relative present value of honoring the contract as opposed to retracting from it determines the form of vertical coordination. However, to my knowledge, none has discussed why the vertical coordination varies among food industries, and this paper aims to consider this variable according to the perishable nature of the food industries.

The draft of a complete contract regarding all contingencies, especially the specification of managers' efforts and products' quality presents an insurmountable cost, and the difficulties of renegotiations between two parties and the complexity of verification by the third party contribute to contractual incompleteness (Hart, 1995). In general, agricultural products are perishable in comparison to non-agricultural products. Both renegotiations and arbitrations are time consuming, and a perishable product likely incurs substantially higher storage costs than those of non-perishable products, so the product with a shorter biological production cycle may be forced to make necessary transitions and adaptations upon shorter notice in response to contingencies. This causes the producer of perishable products to become more susceptible to opportunism, since the incomplete contract distortion is exaggerated by the perishable nature of the products.

Therefore, I argue that the perishable nature of agricultural products exaggerates hold-up problems between farmers, processors, and retailers and therefore plays a key role in the vertical organization of food industries.

A firm (a processor firm or a marketing company) tends to take advantage of a contracted producer *ex post* once the producer has made specific investments *ex ante*. This is particularly true if the producer's product is perishable, as finding an alternative buyer for the perishable product on short notice might prove difficult, or the storage costs could become prohibitively high. Thus, time-consuming renegotiations or arbitrations add disproportionate pressure on the producer. As argued by Martinez (2002), producers of perishable products, such as poultry and eggs, are highly vulnerable to tactics used by the firms, such as delaying acceptance of products to obtain a more favorable deal. This implies that producers of products with a shorter biological production cycle might experience greater potential holdup than those of products with a longer biological production cycle. The providers of products with a shorter biological production cycle (e.g. Table eggs) might then consider vertical integration over contracting. In contrast, for providers of products with a long biological production cycle (e.g. hogs) that enjoy comparatively greater adaptability to production uncertainty, the strategy of marketing contracts becomes more prevalent. Although it is costly to delay marketing for hogs, since feed is expensive and weight gain eventually tapers off, in comparison to the hogs, the value of table eggs will diminish completely if the process is delayed for weeks.

The remainder of the paper is organized as follows. The model is presented in Section 2. Equilibrium is explored in Section 3, in which I address how the division of surplus is determined in contracting. In Section 4, I illustrate how the vertical coordination of the egg, poultry, and pork industries might vary with their biological production cycles, and conclude in Section 5.

2. The model

The seminal model of Antràs and Helpman (2004), which focuses on manufacturing sectors, provides the basic structure for my analysis. Agricultural products are, in general, perishable in comparison to non-agricultural products, and this model addresses how the perishable nature of products exaggerates the incomplete contract distortions and then reshapes the vertical coordination of the food industries.

The economy produces many products that are differentiated in the eyes of producers and consumers. Consumers have identical preferences for these differentiated products. Each consumer maximizes a utility function as follows:

$$U = \sum_{i=1}^{n} y_i^{\alpha}, \quad 0 < \alpha < 1 \tag{1}$$

where:

- y_i = the consumption of product i;
- n = measures the number of product varieties; and
- $1/(1-\alpha)$ = the elasticity of substitution among these differentiated products.

My model differs from Antràs and Helpman's (2004) model in that it introduces the perishable nature of agricultural products into the demand function as:

$$p_i = \left(\frac{y_i}{\lambda}\right)^{-(1-\alpha)} u\left(\frac{d}{l}\right)^{-\alpha}, \tag{2}$$

where:

p_i = the price of the product i.

With similarity in preferences, we have a constant parameter:

$$\lambda = \frac{E}{\sum_{i=1}^{n} p_i^{1/(1-\alpha)}}$$

where:

E = a consumer's total spending.

In equation (2), the adjusted factor $u(d/l)$ can be referred to as the duration discount, where l denotes a product's biological production cycle and d represents the distance between production to market. Here, the ratio d/l in the duration discount is to capture the impacts of transaction frictions on value of products with perishable nature. Note that we can also use $u(1 - d)$ to represent the duration discount, and this alternative will not alter the main results in this model.

This study argued that incomplete contract distortion augments d, due to the degree of specificity of the dedicated assets in the form of site, physical assets, human capital, and temporal specificity in contracts (Williamson, 1996). Implicitly, the distance d is also enlarged by the asymmetry information between a firm and a contracted producer regarding product quality and producer efforts (Leffler *et al.*, 2000). The incomplete contract distortion impedes proper communication between the two parties in vertical coordination and incites opportunistic behavior, but the opportunistic behavior is less likely within a vertical firm than contracting action (Dietrich, 1994)[5]. In this model, I assume that the product retains its full value if the distance is negligible as $\mu = 1$ while $l \gg d$. That is, when the perishable nature of product is not a concern (i.e. $l \gg d$), we return to the Antràs and Helpman's (2004) model. On the other hand, the product becomes valueless if the product's biological production cycle is not longer than the distance, as $\mu = 0$ when $l \leq d$. With regard to agricultural products with perishable nature, I argue that the value of the products decreases with the duration discount as $\mu'(d/l) > 0$.

The production function takes the form of the Cobb-Douglas production function:

$$y_i = \theta K^{1-z} L^{z}, \tag{3}$$

where $0 < z < 1$. Here, θ denotes neutral technology accessible to all producers. Let production input K be composed of feed, specific buildings, and equipment, while the other input L consists of mainly labor/managers inputs. In particular, a firm utilizing vertical integration provides both types of production inputs and dictates the transfer of resources and surplus across production and processing. By contrast, with regard to contracting, a firm offers production input K, and a contracted producer provides production input L in the relationship-specific investments. Note that if the contracted producer underinvests and provides inferior labor inputs, the output in equation (3) becomes zero (Antràs and Helpman, 2004).

For simplicity, we take away the subscript in the following discussion. If the coordination takes the form of vertical integration, the profit maximization of the product in monopolistic competition is given by the following:

$$\pi_{\mathrm{V}} = \max_{K,L} py - rK - wL - G, \tag{4}$$

where:

r and w = the exogenous factor prices of K and L, respectively.

Williamson (1985) emphasized that production by a vertically integrated firm may generate greater governance costs due to attenuated incentives and bureaucratic distortions, and the consequent governance costs increase in the length of the vertical integrated firm's hierarchical structure (McAfee and McMillan, 1995). For comparison, in this model, I define G in equation (4) as the governance costs that are associated with vertical integration and assume that no governance costs occur for outsourcing activities because of its lower hierarchical structure. In fact, outsourcing also incurs some governance costs, such as those from monitoring and enforcement. For simplicity, in comparison to vertical integration, I assume that the governance costs generated from outsourcing are negligible in this paper, as this assumption will alter our results. Furthermore, for convenience, the governance costs G, due to the bureaucratic cost of managing a larger operation, are positively related to a firm's revenue as $G = gR$, where R is the revenue of the firm and $g = 0$ if it is in contracting mode.

Taking the first-order conditions of equation (4) with respect to K and L, we obtain $K = (\alpha(1 - z)R_{\mathrm{V}})/r$ and $L = (\alpha z R_{\mathrm{V}})/w$, respectively. In equation (2), the revenue in the vertical integration is given by:

$$R_{\mathrm{V}} = py = \mu\left(\frac{d_{\mathrm{V}}}{l}\right)^{-\alpha/(1-\alpha)} \lambda\theta^{\alpha/(1-\alpha)} K^{\alpha(1-z)/(1-\alpha)} L^{\alpha z/(1-\alpha)}.$$

By inserting the optimal K and L into the revenue, after some algebra, we obtain:

$$R_{\mathrm{V}} = \mu\left(\frac{d_{\mathrm{V}}}{l}\right)^{-\alpha/(1-\alpha)} \lambda\theta^{\alpha/(1-\alpha)} \left(\frac{\alpha(1-z)}{r}\right)^{(\alpha(1-z))/(1-\alpha)} \left(\frac{\alpha z}{w}\right)^{\alpha z/(1-\alpha)}.$$

Here, the exogenous d_{V} denotes the "distance" in the mode of vertical integration within a firm. Let d_0 denotes the "distance" in the mode of contracting. The "distance" propagates opportunistic behavior, and the opportunistic behavior is less likely within an integrated firm than with contracting (Dietrich, 1994). In this way, we can assume $d = d_0 - d_{\mathrm{V}} > 0$. Without loss of the generality, let's assume the d_{V} in vertical integration mode is negligible in comparison to d_0, so that $d_{\mathrm{V}} \cong 0$ and $d_0 = d$. Finally, we obtain the optimal profit for the vertical integration form:

$$\pi_{\mathrm{V}} = (1 - \alpha - g)u(0)^{-\alpha/(1-\alpha)} \lambda\theta^{\alpha/(1-\alpha)} \left(\frac{\alpha(1-z)}{r}\right)^{(\alpha(1-z))/(1-\alpha)} \left(\frac{\alpha z}{w}\right)^{\alpha z/(1-\alpha)}. \tag{5}$$

Note that we can rewrite equation (5) as:

$$\pi_{\mathrm{V}} = (1 - \alpha - g)\lambda\theta^{\alpha/(1-\alpha)} \left(\frac{\alpha(1-z)}{r}\right)^{(\alpha(1-z))/(1-\alpha)} \left(\frac{\alpha z}{w}\right)^{\alpha z/(1-\alpha)}$$

because $u(0) = 1$ ($\because u(d/l) = 1$ if $l \gg d$).

Incomplete contracts and division of surplus

In particular, a firm that acquires almost all control over production but incurs governance costs is referred to as vertical integration. Upon shouldering sizable governance costs, the firm might outsource parts of the production activities to another party through contracting in order to reduce its hierarchical structure. However, outsourcing is limited due to the incomplete nature of the contracts. Considering the exceeding cost of specifying all possible contingencies or appropriate adaptations *ex ante* in a contract with bounded rationality, it becomes necessary for parties to renegotiate *ex post* (Williamson, 1985) in response to the changing market conditions.

Owing to the non-verifiability of the relevant state of the world, the presence of incomplete contracts generates distortion and leads to the parties involved with partial returns. The two parties bargain over the *ex post* surplus from the corporation as a generalized Nash bargaining game, and the division of surplus is positively related to the level of control over the specific production assets. As in Antràs and Helpman's (2004) model, I assume that, in contracting, a fraction β_C of the *ex post* surplus is attributed to the firm, and the remaining surplus, $(1 - \beta_C)py$, is attributed to the contracted producer, where $0 < \beta_C < 1$.

3. Equilibrium

The firm can acquire specific control over production by purchasing residual rights with a lump-sum transfer to a contracted producer. On the other hand, if numerous producers exist, a producer then bids for the outsourcing contract with a lump sum transfer to the firm. The net lump-sum transfer, either positive or negative, will disappear in our joint profit maximization, so it is neglected in the following analysis.

A process firm maximizes its profit as:

$$\max_M \beta_C py - rK \tag{6}$$

The first-order condition of equation (6) with respect to K is given by:

$$K = \frac{\alpha\beta_C(1-z)}{r} R.$$

A producer maximizes its profit with the following:

$$\max_L (1 - \beta_C)py - wL. \tag{7}$$

The first-order condition of equation (7) with respect to L is as:

$$L = \frac{\alpha(1-\beta_C)z}{w} R.$$

The profit of the contract is realized by the joint profit maximization:

$$\pi_C = \theta^{\alpha}\lambda^{1-\alpha}K^{\alpha(1-z)}L^{\alpha z} - rK - wL. \tag{8}$$

With the above two first-order conditions, the revenue can be rewritten as:

$$R_C = \mu\left(\frac{d}{l}\right)^{-\alpha/(1-\alpha)} \lambda\theta^{\alpha/(1-\alpha)}\left(\frac{\alpha\beta_C(1-z)}{r}\right)^{(\alpha(1-z))/(1-\alpha)}\left(\frac{\alpha(1-\beta_C)z}{w}\right)^{\alpha z/(1-\alpha)}.$$

As a result, the joint profit maximization in the relation-specific partnership is given by the following:

$$\pi_C = \left[\mu\left(\frac{d}{l}\right)\right]^{-\alpha/(1-\alpha)} \lambda\theta^{\alpha/(1-\alpha)}\left(\frac{\alpha(1-z)}{r}\right)^{(\alpha(1-z))/(1-\alpha)}\left(\frac{\alpha z}{w}\right)^{\alpha z/(1-\alpha)} A(\beta_C). \quad (9)$$

where:

$$A(\beta_C) = [1-\alpha z-\alpha(1-2z)\beta_C](\beta_C^{1-z}(1-\beta_C)^z)^{\alpha/(1-\alpha)}.$$

The firm prefers to carry out vertical integration rather than contracting production only when $(\pi_V/\pi_C) > 1$. By comparing equations (5) and (9), we can rewrite the inequality $(\pi_V/\pi_C) > 1$ as:

$$\left(\frac{A(\beta_C)}{1-\alpha-g}\right)^{(1-\alpha)/\alpha} < u\left(\frac{d}{l}\right). \quad (10)$$

The inequality equation (10) suggests that a trade-off between incomplete contract costs and excess governance costs determines a firm's organizational choices. Note that the assumption of lump-sum governance costs will not alter our main results. For example, if the G is a lump-sum cost, a firm prefers to carry out contracting production rather than vertical integration if:

$$1-\alpha-u\left(\frac{d}{l}\right)^{-\alpha/(1-\alpha)} A(\beta_C) < \frac{G}{(1-\alpha)R}.$$

This inequality exists when G is sufficiently large, implying that contracting activity is preferred when the governance costs are high enough. On the other hand, the inequality fails to exist when G is negligible, because the left-hand side of this inequality is always positive. That is, vertical integration is likely to dominate over contracting strategy when G is sufficiently low.

In a country with a specific contract environment that can be represented by a specific value of d, we can plot the $u(d/l)$ with respect to the biological production cycle l as a downward sloping curve, shown in Figure 1. It is a feasible arguement that the duration discount is increasing diminishingly in d/l, that is, $u' > 0$ and $u'' < 0$, leading to a concave curve as in Figure 1. However, it does not alter our results if we allow $u'' \geq 0$. Furthermore, it is easy to determine the inequality $0 < A(\beta_C) < 1$ because $0 < \alpha, \beta, z < 1$, which likely makes $A(\beta_C)$ a horizontal line that is lower than one if the governance costs are negligible, as in Figure 1. That is, if the governance costs are negligible relative to the incomplete contract distortions, vertical integration may dominate over contracting strategies.

However, if the governance costs become higher, causing $((A(\beta_C))/(1-\alpha-g))^{(1-\alpha)/\alpha}$ to be sufficiently greater than one, the "make or buy" decision arises, wherein the product's biological production cycle begins to play a role in choices of the organizational form. Figure 2 shows the equilibrium, in which vertical integration

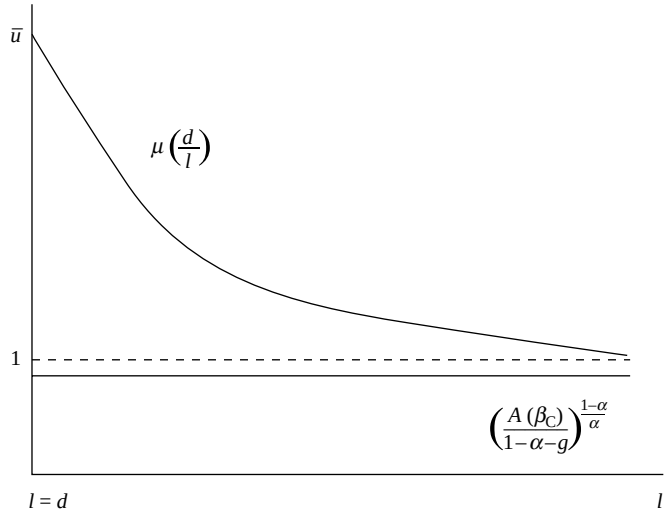

Figure 1.
When governance costs are negligible

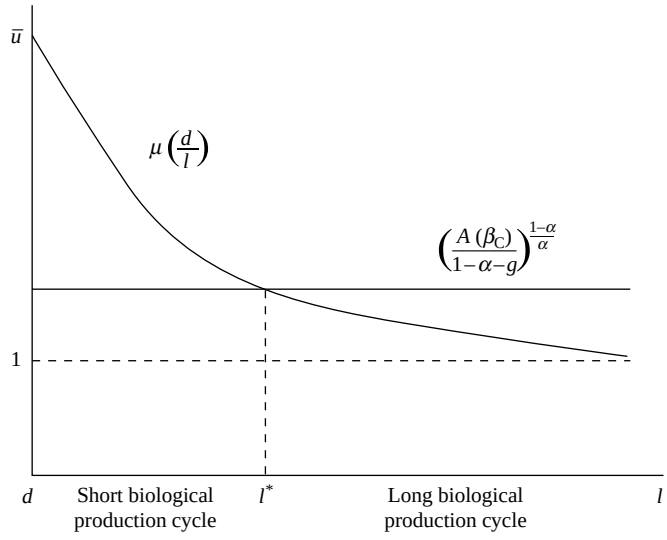

Figure 2.
Vertical integration or outsourcing contracts

is preferred over contracting for perishable products that have a shorter biological production cycle (i.e. $l < l^*$). In contrast, for products with a longer biological production cycle (i.e. $l > l^*$), contracting is preferred over vertical integration. My model demonstrates why the decisions of vertical coordination depend on a trade-off between the incomplete contract costs and the governance costs, but the role of incomplete contract distortions are exaggerated when the product has a short biological production cycle.

4. Product or marketing contracts

Once specific assets are locked into a relationship-specific contract, they can be redeployed only at a sizable loss in production value (Williamson, 1985). The contract, based on control allocation and risk being transferred across stages, can be classified into a product contract and a market contract. Specifically, as addressed by Martinez (2002), in a market contract, the processing firm and producers may negotiate the delivery schedule, pricing method, and product characteristics, but the firm participates in few of the producer's decisions on production. To the contrary, in a product contract, the firm provides a market for the goods, engages in many of the producer's decisions, and retains ownership of important production assets (Mighell and Jones, 1963). In other word, in a production contract, a firm contributes either more specific assets or more management efforts or both to the production than in the mode of the marketing contract, acquiring more leverage in bargaining than a marketing contract, because the former incurs a larger quasi-rent. We then assume that $\beta_{\mathrm{P}} > \beta_{\mathrm{M}}$, where the subscript "P" denotes production contracts and "M" represents marketing contracts. Since $A'(\beta) > 0$, the ranking is then given by $A(\beta_{\mathrm{P}}) > A(\beta_{\mathrm{M}})$. Suppose there exists an optimal division of surplus β^* if the contract is complete and is of no distortions; the ordering will then be given by $A(\beta^*) \geq A(\beta_{\mathrm{P}}) > A(\beta_{\mathrm{M}})$.

In the following analysis, we assume that governance costs are sufficiently large, causing the "make or buy" decision to arise. The incomplete contract distortion has a greater effect when the products have a short biological production cycle (i.e. $0 < l < l_{\mathrm{P}}$). As shown in Figure 3, a process firm prefers vertical integration over contracting as:

$$\left[\frac{A(\beta_{\mathrm{P}})}{1-\alpha-g}\right]^{(1-\alpha)/\alpha} < u\left(\frac{d}{l}\right) \quad \text{while } 0 < l < l_{\mathrm{P}}.$$

This is because when a product's l is shorter than the distance d, outsourcing contracts become infeasible due to substantial reservation costs, in comparison to vertical integration[6]. Explicitly, the role of the distance (indicating incomplete contract distortion)

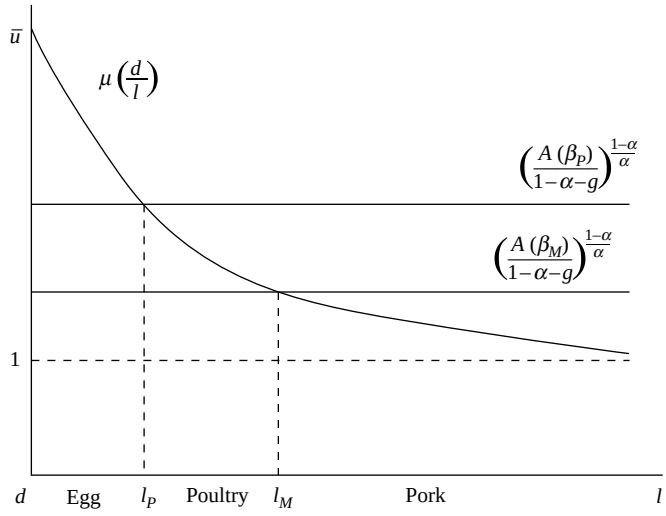

Figure 3.
Egg, poultry, and pork industries

becomes relatively less effective when a product's biological production cycle is sufficiently long. Thus, as shown in Figure 3, the long biological-production-cycle product prefers marketing contracts as:

$$\left[\frac{A(\beta_M)}{1-\alpha-g}\right]^{(1-\alpha)/\alpha} > u\left(\frac{d}{l}\right) \quad \text{while } l > l_M.$$

However, products with a medium length biological production cycle (i.e. $l_P < l < l_M$), prefer coordination with product contracts as implied by the conditions:

$$\left[\frac{A(\beta_P)}{1-\alpha-g}\right]^{(1-\alpha)/\alpha} > u\left(\frac{d}{l}\right) > \left[\frac{A(\beta_M)}{1-\alpha-g}\right]^{(1-\alpha)/\alpha}.$$

This is because the incomplete contract distortions intensify with the perishable nature of the product, resulting in the firm's greater acquisition of control of relationship-specific investments. This is shown in Figure 3, where vertical integration is engaged heavily by providers of products with a short biological production cycle (e.g. Table eggs), where product contracts are preferred for products with a medium biological production cycle (e.g. poultry), and where marketing contracts have become prevalent for products with a long biological production cycle (e.g. pork)[7]. For example, more than a third of eggs are now produced under production contracts and about 60 percent of eggs are produced under vertical integration. In the turkey industry, product contracts account for 56 percent, and vertical integration accounts for 32 percent (Martinez, 2002). In the hog industry, marketing contracts are used primarily (Grimes and Meyer, 2000).

While the contractual distance is region-specific, a local government can shorten these contractual distances by improving its legal infrastructure and law enforcement as shown in Figure 4. When d decreases, the curve $u(d/l)$ shifts downward as the bold curve in Figure 4, both of the critical points l_P and l_M shift to the left to l'_P and l'_M, respectively. Incidentally, marketing for the products with a short biological cycle benefits more from

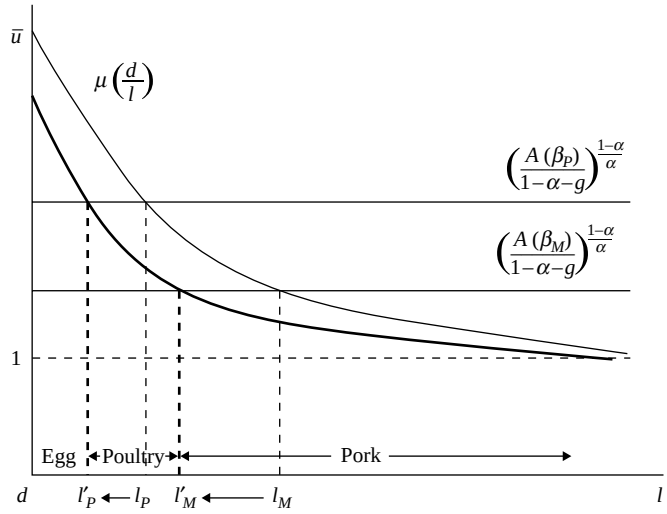

Figure 4.
Better contract environment

evolving from vertical integration to product contracting, and some producers of medium biological cycle products find it beneficial to evolve from a product contract to a marketing contract strategy. The illustration implies that a government can reshape the choices of vertical coordination by influencing the contract environment. An improvement in the legal infrastructure shortens the associated ambiguities and gaps and thus reduces incomplete contract distortions, making contracting production more favorable.

On the other hand, as argued by Reimer (2006), the rapidly evolving market conditions leave the contracting more gaps, missing provisions, and ambiguities in contracting, thus widening the door to opportunism, implying an increasing d in these circumstances. An increase in d shifts the curve $u(d/l)$ upward, so that both of the critical points l_P and l_M move to the right to l_P'' and l_M'', respectively, as shown by the curve in bold in Figure 5. This makes the range of vertical integration shift to the right and to expand, implying that more providers of short biological cycle products and some providers of medium biological cycle products might turn to vertical integration with the increase of incomplete contract distortions.

It is worthy to mention that, if the changes in contractual distances are so significant that they cause the curve $u(d/l)$ to shift upward further, even the long biological cycle products (e.g. hogs) are found to be beneficial in carrying out vertical integration. This finding is in line with Reimer (2006), who suggests that the fear of loss of control in the rapidly evolving world is one of the main reasons why the share of US pork raised on vertical integration firms is increasing relative to production through contracting.

5. Conclusions

In this paper, I develop a simple model to explain why vertical integration is largely undertaken by industries with short-biological-cycle products (e.g. table eggs), product contracts by the industry with medium-biological-cycle products (e.g. poultry), and market contracts by industries with long-biological-cycle products (e.g. pork) in the USA. I argue that the perishable nature of agricultural products matters in the

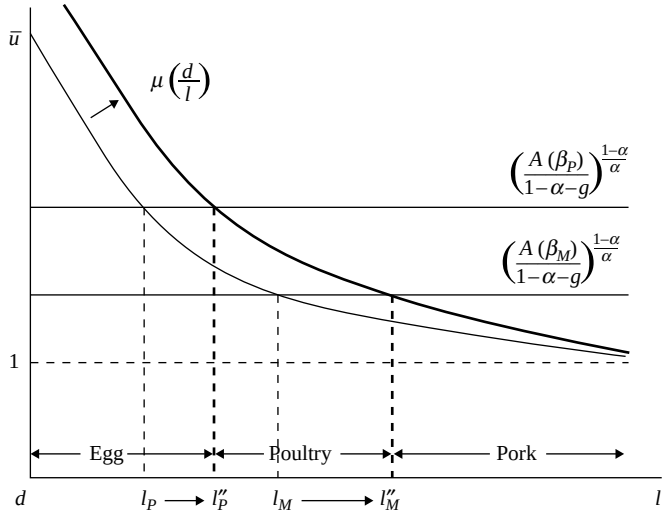

Figure 5.
The role of contract incompleteness

decisions of vertical coordination. However, the implication from this model is also applicable to other sectors that have the perishable nature, such as vegetables and fruit. For example, Dimitri (1999) argued that marketing contracts and production contracts are becoming more common in the fresh fruit and vegetable industries in the USA. Note that the fresh fruit and vegetable industry are perceived as short-biological-cycle products in this current model, Furthermore, the perishable nature of agricultural products is country-irrelevant, so that the implications from this model are also applicable to other countries, such as China.

It has been documented that incomplete contract distortions play an important role in firm organization. Contracts are incomplete not only because of human bounded rationality, but also due to the difficulties of renegotiations between two parties and the complexity of verification by the third party (Hart, 1995). However, both renegotiations and arbitrations are time consuming. Considering that a perishable product likely incurs high-storage costs, the product with a shorter biological production cycle may be scarce in time to make the necessary transitions and adaptation upon short notice in reaction to changing market conditions. This study determines that perishable products are more vulnerable to opportunism, because the incomplete contract distortion is exaggerated by the perishable nature of the products. In this model, I also argue that the perishable nature of the products plays a key role in the vertical coordination of food industries.

Rapidly evolving market conditions make the contract more incomplete and thus further encourage opportunism, making vertical integration more preferred. This model demonstrates that a local government can reshape firms' choices of vertical coordination by improving its legal infrastructure to reduce the incomplete contract distortions. The reduction of incomplete contract distortions weakens the role of the perishable nature of products, so that contracting (product or marketing) may take place. While a reduction of contract distortions imply a lower general production and a lower price, leading to more demand, the correspondingly increasing contracting activities may lead to more efficient usage of resources than pure vertical integration, generating greater value and job opportunities to the host regions.

Notes

1. Comparatively, spot markets account for less than 10 percent of production in the egg and turkey industries and 28 percent of the market in the pork industry in 2001 in the USA (Martinez, 2002). To focus on vertical integration and contracting coordination, I neglect spot market transaction in this paper.
2. In a product contract, a producer agrees to deliver a certain amount of their product to a particular contractor at an *ex ante* negotiated price. In marketing contracts, a producer might receive a formula-based price with premiums or discounts, based on the size and quality of the product (Martinez, 2002). The *ex ante* price or price formula stir up opportunistic behavior.
3. In addition to the hold-up, as argued by North (1981), there are other *ex post* costs that are associated with enforcing agreements, measuring damages or injury, and enacting penalties. Further, parties may not always honor contracts, and these actions may result in costs associated with court litigation (Klein *et al.*, 1978).
4. Integration increases the producers' temptation to behave opportunistically. However, in this model, I presume the contractors still have better hold-up power than the producers because agricultural products' perishable nature.

5. For example, Pirrong (1993) argued that the contractor might threaten to delay the acceptance of the product.
6. In this paper, I assume that the preservation cost is substantially high for focus on my analysis.
7. Turkeys are marketed at four-seven months of age. However, there is greater flexibility in the age at which hogs can be slaughtered (*Pork'99* Staff, 1999).

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