I. Introduction

Recently in the news there was a case about KPN a television channel provider and Fox Sports one of the channels KPN was willing to offer to their premium subscribers. KPN and Fox sports weren't able to agree on the price KPN had to pay to broadcast Fox Sports for the premium subscribers of KPN. Fox Sports was asking KPN for a price based on their total subscribers, while KPN was offering Fox Sports a price based on their premium subscribers because only premium subscribers have the channel in their package. Because there wasn't an agreement about the price Fox Sports was threating KPN to turn their channel to a black screen. Fox sports also offers their channel online directly to customers. So when Fox Sports decides to turn their channel to a black screen for KPN subscribers Fox Sports is still able to make a profit but KPN isn't. This case isn't an isolated incident and we've seen similar cases multiple times before.
In the case about KPN and Fox Sports is KPN the downstream firm since it buys the product from Fox Sports to sell to its' consumers and Fox Sports is the upstream firm since they sell its' product to KPN. In this case the upstream firm (Fox Sports) has an outside option which yield a positive expected profit.

In the cases we come across a couple of problems which exist when a price is agreed on during a bargaining process instead of the same for everyone. The first problem is a disagreement on which aspects the price is based on. The second problem is based on dependency because one of the firms is only able to make a profit when they work together, while the other firm also can make a profit on their own. Because this cases exists it's very likely that the firms which are able to make a profit on their own can make a bigger profit when they work together. The main goal of my paper is to analyse the bargaining process and how the outcome of this bargaining process is influenced by market power, outside options and uncertainty or risk. For my analysis I've created a model which consists of two firms and a population of consumers. The upstream firm produces half-fabricates which it sells to the downstream firm. The downstream firm needs this half-fabricates to produce the end product it sells to consumers. The half-fabricate is sold after a bargaining process which is influenced by various forces. The half-fabricates have a certain standard quality and the upstream firm has to decide if it invests to upgrade the half-fabricates to high quality. The

cost of investing are incurred by the upstream firm. Because the downstream firm is concerned with its' reputation, it always wants the upstream firm to invest in high quality half-fabricates. The downstream firm can't observe the quality of the half-fabricate during the period, but it will observe the quality at the end of each period. I also analyse the case that the downstream firm has an outside option. In my model the downstream firm will get the option to vertically integrate into the market of the upstream firm during the second period. This option for the downstream firm will give us insights in how the bargaining process between the firms change and if the investment decision of the upstream firm will change. In my model vertical integration eliminates the bargaining process because the downstream firm produces the products itself when they vertically integrate and it eliminates uncertainty about the quality because the downstream firm can make the investment decision itself when they integrate vertically. Vertical integration also can increase or decrease the cost for upgrading the half-fabricate to high quality. The cost can increase due to the upstream firm already having conquered part of the learning curve. Or decrease due to possible synergy effects. In my paper I will ignore the chance that there are synergy effects though.

The rest of the paper is organized as follows. In section II is the related literature discussed and in section III is the model presented. In section IV, V and VI are the analysis and results discussed. I will end the paper with the conclusion in section VII.

Section II: Related literature

In this paper I've discussed the bargaining process and the make or buy decision.

Nash (1950) created the first model trying to explain the dynamics and choices of players in a bargaining process. In Roth (1979) the assumption of symmetry made by Nash was relaxed. By relaxing this assumption both players could differ in their bargaining power which made it possible to consider a more non-cooperative case.

Binmore, Rubinstein and Wolinsky (1986) showed how the Nash bargaining solution could be applied on a bargaining problem. In their paper the bargaining solution is only influenced by time preference and the risk of breakdown of negotiation. In my model I've added an outside option for one of the firms making breakdown of negotiation less costly for the firm with the outside option.

Williamson (1971) argues that vertical integration may be used as a treatment when market failure occur. He mentions three possible categories of reasons for vertical integration: incentives, controls and inherent structural advantages. By vertical integration the incentives during the bargaining process get aligned or the bargaining process gets even eliminated, in my paper I've chosen to eliminate the bargaining process when the firm integrate vertically. Williamson denoted the decision rights and monitoring as controls. When the firm integrate vertically the firm can decide over its production process, which is align with my paper.
Tadelis (2002) creates a reduced-form model of contractual choice based on his earlier work with Bajari. In this model the cost of production are lower when the downstream firm buys the product from an upstream firm, but they have to face a costly renegotiation about the surplus revenues afterwards. In comparison to my model the cost are also lower when the half-fabricate is bought. But the difference in the models is that in my model there isn't a renegotiation, instead the chance to make the investment decision itself to improve product quality can make the downstream firm choose to make the product itself.
In Gibbons (2005) earlier literature of theory of firms are summarized and discussed. Gibbons discusses the commonalities, distinctions and potential combinations of the theories of firms. Gibbons considers four theories of firms: rent-seeking, property rights, incentive-systems and adaption. The incentive systems theory differs from the other theories in that integration changes payoff rights rather than decision rights. The shift of payoff rights can create new contracts which lead to a higher total amount of incentives. In the other three theories integration shifts decision rights rather than payoff rights. In adaption theory the shift of decision rights is valuable because of the shift of control. In the property rights theory the shift of the decision rights also means a shift in control, but the shift of decision rights also creates efficiency consequences. And in rent-seeking theory integration is seen as a way to cut out the transaction costs from the market process.
In my model the downstream firm sells experience goods to the consumers, in Gale and Rosenthal (1994) they try to explain the price quality relation during a product cycle. Gale and Rosenthal distinguish three stages: high quality and a low price, high quality and a high price and low quality and a high price. In the first stage the firm establish their reputation, in the second stage they live up to their reputation and earn more profits because their reputation is established and in the last period they take advantage of their reputation. In my model the downstream firm will never try to take advantage of their reputation. The

upstream firm might though because there exist a strategy in which the upstream firm only invests in the first period.

Section III: The model

Model Set-Up:

The model consists of two periods. The model considers two profit maximizing firms and a population of consumers. The upstream firm produces half-fabricates which can't be sold to consumers. The downstream firm needs half-fabricates to produce the end product it sells to the consumers. For simplicity the quality of the end product is assumed to be equal to quality of the half-fabricate. There exist two types of upstream firms which differ in the size of the investment cost. Nature assigns the upstream firm its type, either low cost denoted by C_L or high cost denoted by C_H. The type of the upstream firm is random assigned and the chance that the upstream firm gets either type is equal. At the begin of the first period the upstream firm gets a given q^L (low quality half-fabricate) and the upstream firm has the option to invest C to upgrade the half-fabricate to high quality (q^h). When the investment is made the quality will only improve for one period, so to sustain a high quality the upstream firm has to make investment every period. Also the investment has to be made for every half-fabricate sold, which for example could be a new feature added only when the half-fabricate is high quality. There is a unit mass of consumers [0,1]. The consumers try to maximize their individual utility by buying the product when the price of the product is lower than the private utility. There exist two types of consumers: a share of $\lambda \in (0,1)$ of the consumers is informed. The informed consumers observe the quality of the product and base the decision whether to buy the product on the observed quality. The uninformed consumers don't observe the quality of the product and base the decision whether to buy the product on the expected value of the product. The expected value is somewhere between low quality and high quality, $q^H \geq E[V] \geq q^L$.

The first period consists of four stages. The first stage is the investment stage in which the upstream firm has to decide if it invests C to upgrade to high quality (q^H), denoted by Y=1, or remain low quality by not investing, denoted by Y=0. The second stage is the bargaining stage in which the upstream firm and the downstream firm bargain over price P_h of the half-fabricate. During the bargaining process the downstream firm can't observe if the upstream firm has invested to upgrade the quality of the half-fabricate. The third stage is the decision

stage in which the downstream firm has to make the decision to either work with the upstream firm and try to make a profit or don't work with the upstream firm which results in a pay-off of 0. In the fourth and last stage the downstream firm has to sell the end product to consumers which it will do by making all consumers a take-it-or-leave-it offer, which implies that the product has a single price.

The profit functions in the first Period are as followed:

$$Expected\ profit\ upstream\ firm\ of\ type\ i\colon\ E(\pi_u) = T_1^U P_h - Y_1 C_i T_1^U \quad (1)$$

With T_1^U as the quantity of the transaction of the upstream firm during the first period.

$$Expected\ profit\ downstream\ firm\ \ E(\pi_d) = T_1^D P_e - T_1^D P_h \quad (2)$$

The downstream firm observes the quality of the end products after its production process. And because the quality of the end product is solely dependent on the quality the half-fabricate, the downstream firm also finds out if the upstream firm has invested during the first period. When the downstream firm observes that the upstream firm hasn't invested in the first period, it knows the upstream firm also isn't going to invest in the second period. The downstream firm has communicated that they will vertically integrate when the upstream firm doesn't invest. So when the upstream firm doesn't invest in the first period it basically tells its profit of not investing and only making a profit in the first period is bigger than investing in any period and making a profit in both periods. So when the upstream firms hasn't invested in the first period, it never invests in the second period. When the upstream firm hasn't invested in the first period the downstream firm will always integrate vertically in the second period. In the second period the uninformed consumers update their expected value of the product based on the experienced quality of the product in the first period. Informed consumers still observe the actual quality. Both type of consumers can't observe if the downstream firm make or buys its' half-fabricates.
The second period also consists of four stages. In the investment stage the upstream firm has to decide again whether to invest to improve the product quality. The downstream firm

can't observe the quality of the current period but knows whether the upstream firm had invested in the first period. In the bargaining stage, the upstream firm and the downstream firm bargain about the price of half-fabricate in the second period. The difference with the first period occurs in the decision stage. In the decision stage the downstream firm has to choose if it will work together with the upstream firm, denoted by X=0, or if it chooses to integrate vertically and produce the half-fabricate itself, denoted by X=1. I assume that when the downstream firm chooses to integrate vertically it will always produce high quality. The cost of investing for the downstream firm is higher than the cost for the same investment of the upstream firm due to learning curve effects. When the downstream firm vertically integrate the cost equals αC_2 with $\alpha>1$. In the last stage the downstream firm sells the end products to consumers again.

The profit functions in the second period are as follows:

$$Expected\ profit\ upstream\ firm\ of\ type\ i\text{:}\ \ E(\pi_u) = T_2^U P_h - Y_2 C_i T_2^U \qquad (3)$$

$$Expected\ profit\ downstream\ firm\text{:}$$

$$E(\pi_d) = X(T_2^D P_e - T_2^D \alpha C) + \ (1 - X)T_2^D P_e - T_2^D P_h \qquad (4)$$

Section IV: Analysis of the decisions of the downstream firm in the second period

I will start with the analysis of the decisions of the downstream firm in the second period. The downstream firm has to choose his actions in stage 2, 3 and 4 of every period. In the fourth stage the downstream firm sets the price of the end product to maximize its own profits and sells the end products to the consumers. Which results in a profit equal to:

$$Expected\ profit\ downstream\ firm\text{:}$$

$$E(\pi_d) = X(T_2^D P_e - T_2^D \alpha C) + \ (1 - X)T_2^D P_e - T_2^D P_h \qquad (4)$$

The profit is influenced by the composition of the population. As mentioned in section III the population exist out an informed share (λ) and an uninformed share (1-λ). The uniformed share of the population (1-λ) update their belief of the product quality to the experienced quality in the first period. Because of that the importance of investing in high quality products in the second period becomes less important when the relative share of the population which is uniformed (1- λ) increases. But because the uniformed share of the

population (1- λ) also bases their decision on the product quality on experienced quality of the first period it will increase the importance of investing in the first period. So when the relative share of the population which is uninformed (1- λ) increases in the first period the importance of investing in the first period increases as well.

In the third stage of the second the period the downstream firm has to make a make or buy decision. The downstream firm makes a decision based on its belief of the type of the upstream firm. When the upstream firm didn't invest in the first period, the downstream firm will always choose to vertically integrate. But the more interesting case is when the upstream firm has made the investment in the first period. Investing in the quality in the first period only upgrades the quality in the first period, so it doesn't mean they will produce the same quality in the second period. The downstream firm assigns value Y to the chance that the upstream firm indeed also in period 2 has invested in high quality half-fabricates and assign value (1-Y) to the chance that the upstream firm didn't invest in the quality of the half-fabricates in the second period.

There exist two type of upstream firms and the downstream firm bases its beliefs on the upstream firms' invested decision. If there exists a separating equilibrium the downstream firm is able to observe with which type of upstream firm they are dealing with. But when there exist a pooling equilibrium they can't observe which kind of upstream firm they work with. Basing the beliefs on the investment decision leads to the following beliefs:

$$\Pr(C = C_L|Y = 1) = 1$$
$$\Pr(C = C_L|Y = 0) = 0$$
$$\Pr(C = C_H|Y = 1) = 1$$
$$\Pr(C = C_H|Y = 0) = 0 \qquad (5)$$

Section IV.I Separating equilibrium:

Let's first suppose there is a separating equilibrium in the first period with the following type dependent strategies of the upstream firm:

$$\Pr(Y = 1|C = C_L) = 1$$
$$\Pr(Y = 1|C = C_H) = 0 \qquad (6)$$

That the high cost upstream firm didn't disguise themselves as a low cost upstream firm learns the downstream firm that the high cost upstream firm also isn't going to invest in the

second period since not investing and only receiving the profit of the first period is more profitable than only investing in the first period and receiving profit for both periods for them. So when the downstream firm works together with the high cost upstream firm, the downstream firm will always choose to vertically integrate. But that doesn't mean that the downstream firm will always choose to work together again if they were working together with a low cost upstream firm. Because there exist still a chance that for the low cost upstream firm only investing in one period reaps more profit than investing both periods. So in a separating equilibrium the downstream firm is willing to work with a low cost upstream firm if the following inequality holds:

$$\pi d(q_1^H) + \pi d\left(q_2^?\right) > \pi d(q_1^H) + \pi d(q_2^H) \quad (7)$$

In which $\pi d\left(q_2^?\right)$ represents working together with the upstream firm with a chance to be cheated on, and $\pi d(q_2^H)$ represents the choice to integrate vertically and which means they will have high quality half-fabricates for sure.

The downstream firm will opt to work together with the upstream firm and take the risk of getting cheated if:

$$Y > \frac{\alpha C\,(P_e - q^H) + \lambda P_{h^*}(q^L - q^H) + \lambda P_e(q^H - q^L) + P_{h^*}(q^H - P_e)}{\lambda P_e(q^H - q^L) + \lambda P_{h^*}(q^L - q^H)} \quad (8)$$

The result of the calculations tells us that in equilibrium the downstream firm will opt to work together with the upstream firm if their belief that the upstream firm will invest in high quality half-fabricates is sufficiently big.

Section IV.II Pooling equilibrium:

There exist two possible pooling equilibria. We will start off with the pooling equilibrium where both type of upstream firms invest:

$$\Pr(Y = 1 | C = C_L) = 1$$
$$\Pr(Y = 1 | C = C_H) = 1 \quad (9)$$

When the upstream firm has invested in the first period the downstream firm will belief there exist a chance that the upstream firm is of the low cost type. Which makes the downstream firm willing to work with the upstream firm if the following inequality holds:

$$\pi d(q_1^H) + \pi d\left(q_2^?\right) > \pi d(q_1^H) + \pi d(q_2^H) \quad (10)$$

In which $\pi d\left(q_2^?\right)$ represents working together with the upstream firm with a chance to be cheated on, and $\pi d(q_2^H)$ represents the choice to integrate vertically and which means they will have high quality half-fabricates for sure.

The downstream firm will opt to work together with the upstream firm and take the risk of getting cheated if:

$$Y > \frac{\alpha C\,(P_e - q^H) + \lambda P_{h^*}(q^L - q^H) + \lambda P_e(q^H - q^L) + P_{h^*}(q^H - P_e)}{\lambda P_e(q^H - q^L) + \lambda P_{h^*}(q^L - q^H)} \quad (11)$$

The result of the calculations tells us that when there exists a pooling equilibria where both type of upstream firms invest, the downstream firm will opt to work together with the upstream firm if their believe that the upstream firm will invest in high quality half-fabricates is sufficiently big.

There also exists a pooling equilibrium where both type of upstream firms don't invest:

$$\Pr(Y = 1|C = C_L) = 0$$
$$\Pr(Y = 1|C = C_H) = 0 \quad (12)$$

When there exist a pooling equilibrium where both type of upstream firms don't invest the downstream firm will always integrate vertically. The downstream firm has communicated that they will vertically integrate when the upstream firm doesn't invest. So when the upstream firm doesn't invest in the first period it basically tells its profit of not investing and only making a profit in the first period is bigger than investing in any period and making a profit in both periods. So when the upstream firms hasn't invested in the first period, it never invests in the second period.

Section IV.III: Credible threat?

In the second stage of the second period the downstream firm and upstream firm bargain about the price of P_{h^*} but this bargaining process will be discussed in section VI of the paper. Before the start of the first stage of the second period the downstream firm is able to threat the upstream firm with integrating vertical when the upstream firm doesn't invest in high

quality half-fabricates. Such a threat is only effective when the threat is credible.

For a threat to be credible the following condition has to be satisfied:

$$\pi d(Y = 1, X = 0) > \pi d(Y = 0, X = 1) > \pi d(Y = 0, X = 0) \quad (13)$$

The first part of the condition:

$$\pi d(Y = 1, X = 0) > \pi d(Y = 0, X = 1) \quad (14)$$

Is important because if this condition isn't satisfied the downstream firm will always vertically integrate and the upstream firm wouldn't have a reason to invest. Calculating the first part of the condition results in:

$$\alpha C > P_{h^*} \quad (15)$$

Which means that when there is certainty about the quality, the cost of making the half-fabricates has to be higher for the downstream firm than the cost buying the half-fabricate from the upstream firm.

The second part of the condition:

$$\pi d(Y = 0, X = 1) > \pi d(Y = 0, X = 0) \quad (16)$$

Is important because if this condition isn't satisfied the downstream firm will never vertically integrate and also wouldn't be able to threat to the upstream firm to get a lower P_{h^*} during the bargaining process since the upstream firm would know they would never vertically integrate. Calculating the second part of the condition results in:

$$\lambda q^H(P_e - P_{h^*}) - \alpha C(q^H - P_e) > \lambda q^L(P_e - P_{h^*}) - P_{h^*}(q^H - P_e) \quad (17)$$

Which means that integrating vertically have to yield a higher total profit for the downstream firm than buying low quality half-fabricates.

Proposition 1: *Suppose the upstream firm uses a type-dependent strategy as in equation 6. Then the downstream firm will always vertically integrate when they are working together with a high cost upstream firm. But when there exist a separating equilibrium and the downstream firm works together with a low cost upstream firm they will continue to work together with the upstream firm if the chance the upstream firm invest again is:* $Y > \frac{\alpha C\left(P_e - q^H\right) + \lambda P_{h^*}\left(q^L - q^H\right) + \lambda P_e(q^H - q^L) + P_{h^*}(q^H - P_e)}{\lambda P_e(q^H - q^L) + \lambda P_{h^*}(q^L - q^H)}$.

Suppose the upstream firm uses a strategy as in equation 9 or equation 12. When the upstream firm uses either of this strategies the downstream firm doesn't learn anything about the upstream firms' type. So the downstream firm will use the information they have observed, if the upstream firm has invested in the first period. Because the downstream firm hasn't any information about the size of the C_L / C_H of any type of upstream firm they will consider the exact same formula to decide if they work with the upstream firm again:

$$Y > \frac{\alpha C\left(P_e - q^H\right) + \lambda P_{h^*}\left(q^L - q^H\right) + \lambda P_e(q^H - q^L) + P_{h^*}(q^H - P_e)}{\lambda P_e(q^H - q^L) + \lambda P_{h^*}(q^L - q^H)}.$$

Section V: Analysis of the bargaining process

We continue to analysis with the second stage of every period, the bargaining stage. In the bargaining process the upstream firm and the downstream firm try to come to agreement about the price of the half-fabricate (P_h).

To calculate the price of the half-fabricate I will use the Nash bargaining theory. The Nash bargaining theory is part of Cooperative Game Theory, but the modification of the theory which I use becomes firmly non-cooperative. First both parties try to maximize the total profit together, after which they bargain to get the biggest share of the total profit.

I will use the following formula to determine P_h and P_{h^*};

$$(Uu-Du)^{1-\delta}(Ud-Dd)^{\delta} \qquad (18)$$

With:

Uu= Utility upstream firm

Du= Disagreement point upstream firm

Ud= Utility downstream firm

Dd= Disagreement point downstream firm

δ= Bargaining weight downstream firm

1-δ= Bargaining weight upstream firm

Since there exist two type of upstream firms the downstream firm has to consider dealing with both type of firms. If there was a separating equilibrium the downstream firm was able to observe with which type of upstream firm they are dealing with, but when there was a

pooling equilibrium they can't observe which kind of upstream firm they work with.
Let's first suppose there is a separating equilibrium in the first period which implies the high cost upstream firm C hasn't invested and the low cost upstream firm c has invested. That the high cost upstream firm C didn't disguise themselves as a low cost upstream firm learns the downstream firm that the high cost upstream firm also isn't going to invest in the second period since not investing and only receiving the profit of the first period is more profitable than only investing in the first period and receiving profit for both periods for them. So when the downstream firm works together with the high cost upstream firm, they aren't going to bargain with the upstream firm but will choose to vertically integrate instead. That doesn't mean that the downstream firm will always choose to work together again if they were working together with a low cost upstream firm. But it does mean that the downstream firm at least will bargain again with the low cost upstream firm.
When there exist a pooling equilibrium the downstream firm will base its' decision on the information they can obtain, if the upstream firm invested. When the upstream firm invested in the first period the downstream firm will bargain with the upstream firm again. But when the upstream firm didn't invest they won't work with the upstream firm again since even the low cost upstream firm chose that investing in the first period to reap benefits over both period rather than one period wasn't worth it.
I will start off with calculating price of the half-fabricate in the second period. In this period the downstream firm has an outside option. I only consider the case where the upstream firm has invested in the first period because when it hadn't invested the downstream firm wasn't willing to work with it again. The upstream firm has to decide if it also invests in the second period before the bargaining process, which results in the following disagreement point:

$$-Y_2 CT_2^U \tag{19}$$

Which tells us that when the upstream firm invests(Y=1) it takes the risk of making a loss of C * (q^H-P_e). And when the upstream firm doesn't invest (Y=0) they will at least maintain the status quo of zero profit. During the bargaining process the downstream firm will assign a value to Y based on the chance they think that the upstream firm invests. The disagreement point of the downstream firm is positive since they're also able to make a profit without the

upstream firm. The downstream firm has the following disagreement point:

$$T_2^D P_e - T_2^D \alpha C \tag{20}$$

Filling in the inequality gives:

$$[(Y(\lambda(P_{h^*} - C)(q^H - P_e) + (1-\lambda)(P_{h^*} - C)(E[V] + (q^H - E[V])P_e) + (1 - Y)\big(\lambda P_{h^*}(q^L - P_e) + (1-\lambda)P_{h^*}(E[V] + (q^H - E[V]) - P_e)\big) - (YC(q^H - P_e))]^{1-\delta} * [(Y(\lambda(P_e - P_{h^*})(q^H - P_e) + (1-\lambda)(P_e - P_{h^*})(E[V] + (q^H - E[V]) - P_e) + (1-Y)\big(\lambda(P_e - P_{h^*})(q^L - P_e) + (1-\lambda)(P_e - P_{h^*})(E[V] + (q^H - E[V]) - P_e)\big) - ((P_e - \alpha C)(q^H - P_e))]^{\delta}$$

Solving this inequality for P_{h^*} gives:

$$P_{h^*} = \frac{(1-\delta)\big(Y\lambda P_e(q^H - q^L) + \lambda P_e(q^L - q^H) + \alpha C(q^H - P_e)\big) + 2\delta YC(q^H - P_e)}{Y\lambda(q^H - q^L) + \lambda(q^L - q^H) + q^H - P_e} \tag{21}$$

The only difference between the periods is the outside option of the downstream firm, so filling in the formula for the price of the half-fabricate in the first period gives:

$$[(Y(\lambda(P_{h^*} - C)(q^H - P_e) + (1-\lambda)(P_{h^*} - C)(E[V] + (q^H - E[V]) - P_e) + (1 - Y)\big(\lambda P_{h^*}(q^L - P_e) + (1-\lambda)P_{h^*}(E[V] + (q^H - E[V]) - P_e)\big) - (YC(q^H - P_e))]^{1-\delta} * [(Y(\lambda(P_e - P_{h^*})(q^H - P_e) + (1-\lambda)(P_e - P_{h^*})(E[V] + (q^H - E[V]) - P_e) + (1-Y)\big(\lambda(P_e - P_{h^*})(q^L - P_e) + (1-\lambda)(P_e - P_{h^*})(E[V] + (q^H - E[V]) - P_e)\big)]^{\delta}$$

Solving this inequality for P_h results in the following;

$$P_h = \frac{(1-\delta)\big(Y\lambda P_e(q^H - q^L) + P_e(E[V] - \lambda E[V] - P_e) + \delta YC\big(\lambda q^H - q^H + E[V] - \lambda E[V]\big)}{Y\lambda(q^H - q^L) + \lambda q^L + E[V] - (1-\delta)(\lambda E[V] - P_e)} \tag{22}$$

Now we will take a closer look at the meaning of the following formulas and try to explain the intuitions. If you look at the numerator you see that the bargaining weight of the upstream firm affects the influence of the revenues on the half-fabricate price and the bargaining weight of the downstream firm affects the influence of the costs. Looking at the economic intuition behind this result it's very logical that the price of the half-fabricate has to be higher than the cost of producing the half-fabricate and lower than the selling price of the end product, otherwise it wouldn't be interesting for one of the parties to be involved in the process. Also it isn't surprising at all that the upstream firm, who sells the half-fabricate, wants the price to be as close as possible to the price of the end product. And that the downstream firm, who buys the half-fabricate, wants the price as close as possible to the production cost.

Looking at the last two terms of the part affected by the bargaining weight of the upstream firm there is an important difference though. Whereas in the result of P_h the revenues for the uninformed share of the consumers is considered, is in the result of P_{h*} the cost of the downstream when vertically integrated considered. Assuming $\alpha C < P_e$, for the downstream firm to even consider vertically integrating, implies that the bargained price of the half-fabricate (P_{h*}) is lower when the downstream firm can make a credible threat to vertically integrate. Proposition 2 summarizes the main result of this section.

Proposition 2: By u*sing a non-cooperative modification of the Nash Bargaining Theory I show that the price of the bargained product (half-fabricate price) will be positively affected by the bargaining weight of the selling firm(upstream firm) by getting the price closer to the selling price of the end product. And the price will be negative affected by the bargaining weight of the buying firm (downstream firm) by getting the price closer to the cost price. When the buying firm (downstream firm) can make a credible threat to use an outside option (vertically integrate) the bargaining price (half-fabricate price) will decrease. The decision of the downstream firm to enter the bargaining process wouldn't change when there is a separating or pooling equilibrium and is solely based on the information they obtain, if the upstream firm has invested in the first period.*

Section VI: Analysis of the investment decision of the upstream firm

The last part of the analysis is the investment decision of the upstream which is made in first stage of every period. At the start of the first period the upstream firm gets a half-fabricate quality assigned which we named q^L. At the start of every period the upstream firm has the chance to upgrade this low quality half-fabricate to high quality for cost; C*T. There exist two types of upstream firms, (i) one type with low investment cost (c) and the other type with high investment costs (C). The upstream firm is a profit maximizing firm so it will only invest when it yields a higher expected profit. The downstream firm can't observe if the upstream firm has invested and the upstream firm can't send a credible message about its' quality. The downstream firm discovers the quality of the half-fabricate during the production process. In the second period the downstream firm gets an outside option, it's possible for them to vertically integrate in the market of the upstream firm. The downstream firm will communicate to the upstream firm that they've this outside option and threat to use the option (vertically integrate) when the upstream firm doesn't invest in high quality half-fabricates. The upstream firm will never invest when the following inequalities are satisfied:

$$\pi u(q_1^L) > \pi u(q_1^H) + \pi u(q_2^H) \quad (23)$$

And

$$\pi u(q_1^L) > \pi u(q_1^H) + \pi u(q_2^L) \quad (24)$$

And the upstream firm will only invest in one period when the following inequality is satisfied:

$$\pi u(q_1^H) + \pi u(q_2^L) > \pi u(q_1^H) + \pi u(q_2^H) \quad (25)$$

The upstream firm will invest in both periods when the following inequalities are satisfied:

$$\pi u(q_1^H) + \pi u(q_2^H) > \pi u(q_1^L) \quad (26)$$

And

$$\pi u(q_1^H) + \pi u(q_2^H) > \pi u(q_1^H) + \pi u(q_2^L) \quad (27)$$

All the calculations are the same for both type of upstream firms, the only difference between the types is the size of the cost. Because the cost for the types differs it's possible that the outcome for both types differ but not the calculations.

Let's start off with calculating the case in which the upstream firm decides to not make an investment in any period. Remember that downstream firm hasn't option to vertically integrate in the first period yet, so the firms have to work together to make a profit. Calculating the case in which the upstream firm doesn't invest in high quality half-fabricate gives:

$$C > \frac{\lambda P_h(q^H - q^L) + P_{h^*}(q^H - P_e)}{\lambda(q^H - E[V]) - 2P_e + E[V] + q^H} \quad (28)$$

And

$$C > \frac{\lambda P_h(q^H - q^L) + \lambda P_{h^*}(q^L - q^H) + P_{h^*}(q^H - P_e)}{\lambda(q^H - E[V]) - P_e + E[V]} \quad (29)$$

Now we will calculate the case in which the upstream firm chooses to only invest once. Which results in the following inequality:

$$C > \frac{2P_{h^*}q^H + \lambda P_{h^*}(q^L - q^H)}{q^H - P_e} \quad (30)$$

Calculating when the upstream firm invests in both periods results in the following inequalities:

$$C < \frac{\lambda P_h(q^H - q^L) + P_{h^*}(q^H - P_e)}{\lambda(q^H - E[V]) - 2P_e + E[V] + q^H} \quad (31)$$

And

$$C < \frac{2P_{h^*}q^H + \lambda P_{h^*}(q^L - q^H)}{q^H - P_e} \quad (32)$$

For both type of upstream firms, low investment cost and high investment cost, the inequalities are exactly the same. But the most important (and decisive) variable of both, the investment cost, is different. When both type of firms make the same decision although the difference in the size of C there exist a pooling equilibrium and the downstream firm can't observe which type the upstream firm is. When the difference in the size of C leads to a different decision for both types of upstream firms the downstream firm can observe the type by looking if the upstream firm has invested. To hide being from the high cost investment type the upstream firm can decide to only invest in the first period to also work with the downstream firm in the second period.

Proposition 3: *When the second period is sufficiently profitable there won't exist a separating equilibrium because the high cost upstream firm will have an incentive to disguise itself as a low cost upstream firm, which it does by investing and will lead to a pooling equilibrium.*

Section VII: Conclusion

In my paper I consider the make or a buy the decision of a downstream firm. In the first period of the model the downstream firm always buys the half-fabricate from an upstream firm. The half-fabricate has low quality when the upstream firm obtains it and the upstream firm can decide to invest C to upgrade the half-fabricate to high quality. There exist two types of upstream firms which differ in the investment costs, C_L and C_H. In the second period the downstream firm can choose to integrate vertically, which make the downstream firm able to make the investment decision itself. But the investment cost of the downstream firm are even higher than the investment cost of a high cost upstream firm. This option to integrate vertically influence the decisions of both firms even when the downstream firm doesn't integrate vertically. My paper shows that the bargained price of the half-fabricate in the second period is lower when there exists an option to integrate vertically than when the option isn't there. When there exist a separating equilibrium the downstream firm can observe the type of the upstream firm. In a separating equilibrium the downstream firm will work together with a low cost upstream firm when the chance that the upstream firm invests again is sufficiently high. But when the downstream was working with a high cost upstream firm it will always choose to vertically integrate. When there exists a pooling equilibrium in which both firms invests the downstream firm works with the upstream when

the chance that the upstream firm will also invest in the second period is sufficiently big. But when there exist a pooling equilibrium where both upstream firms don't invest the downstream firm will always integrate vertically, because the downstream firm already made a threat that when the upstream firm doesn't invest it would integrate vertically, so by not investing in the first period the upstream firm basically tells the downstream firm they also don't invest in the second period. When the second period is sufficiently profitable there won't exist a separating equilibrium because the high cost upstream firm will have an incentive to disguise itself as a low cost upstream firm, which it does by investing and will lead to a pooling equilibrium.

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