The Profitability of Vertically Integrating Market Access Services

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I.INTRODUCTION

In this paper I develop a theoretical and empirical model of firm decisions to vertically integrate. The model uses a transaction cost approach and focuses on the relative transaction costs of vertically integrating specific services into the firm as opposed to paying for the services in the market. This decision is dependent upon the costs to the firm to complete the specific transactions under either the governance structure of the firm or the market. The determinants of these costs are dependent upon factors such as asset specificity, uncertainty and frequency of transactions. In this specific analysis, human asset specificity arises when customers and firms engage in relationships that require a bilateral exchange of knowledge and experience. Environmental uncertainty arises by unforseen shifts in market demand. And frequency arises as the number of opportunities a firm has to transact increases. All of these factors and their subsequent effects on overall transaction costs will be considered.

Empirically the focus is on decisions made by motor carriers to vertically integrate brokerage services for market access activities and the subsequent profitability of these decisions.

The data apply to motor carriers hauling grain from North Dakota to terminal markets. The process of finding this fronthaul load is relatively simple. It typically consists of telephone calls between the shipper and the trucker, who often lives nearby. On return movements, however, the process of accessing the backhaul market is more complicated. The non-integrated firm can access the market in one of two ways. It can engage in a direct search for freight and not utilize the services of specialized brokers at all, or it can hire an independent broker who will access freight for him. A firm also has the option of has vertically integrating brokering services. Vertically integrated firms also face two options. They can access the market by employing an in-house broker, whose specific, full-time job is to access loads only for that firm; or they can utilize both an in-house broker and an independent broker to access the market. From this array of alternatives, firms choose the most profitable. The profitability of their decision is directly linked to the transaction costs associated with the alternative chosen.

II. BACKGROUND

As a result of recent legislation, the question of how to access backhaul markets has gained considerably more attention than in the past. Contributing to this is the fact that the role of the brokerage function in trucking has become extremely important since 1980. In 1980, as a result of The Motor Carrier Act, the motor carrier industry became substantially deregulated. Accompanying this deregulation was a large influx of new trucking

firms. Because many of these new entrants were small and lacked marketing skills and resources required for serving an extensive geographical area, the demand for motor carrier brokers rose sharply. These brokers could afford newer, smaller firms economies in the acquisition of information and allow them to compete with the larger more established firms, when acquiring loads. [McMullen 1987]

The Motor Carrier Act not only increased the demand for brokers; it effectively increased supply by eliminating the public interest test as a requirement for entry [McMullen 1987]. Because of the greater availability of brokers, post-regulation firms now have a decision to make regarding how to serve a region and how to access loads. Regardless of whether the service is integrated into the firm or not, the brokerage function for locating loads must be performed if a carrier is to participate in the backhaul market. In performing this function a firm has many alternatives. It can vertically integrate the brokerage function or it can purchase the brokerage services. It also has the option of performing the function by accessing loads without the assistance of any brokers, integrated or otherwise. Any combination of these alternative governance structures may be used. From these alternatives, firms choose the particular alternative yielding the maximum profit. To determine the profitability of firm decisions the transaction cost approach dictates that the transaction itself can be used as the basic unit of analysis. The theory accordingly concentrates on the

transaction cost as an indicator of what tasks should be performed within the firm, which outside it, and why. Transaction cost analysis supplants the usual preoccupation with technology and distribution expenses with the comparative costs of planning, adapting and monitoring the task in question under alternative governance structures [Williamson 1981].

Oliver E. Williamson defines what is widely accepted as modern transaction cost theory. According to him the critical dimensions for describing transactions and the costs associated with them, are (1) the degree to which transaction specific investments are required to realize least cost supply, or asset specificity, (2) environmental uncertainty, and (3) the frequency with which transactions occur [Williamson 1976b]. To further clarify transaction cost theory and its relationship to vertical integration, these three defining dimensions can be expanded upon.

Asset specificity. Asset specificity can arise in three ways: site specificity, as when successive stations are located in such a way as to economize on inventory and transportation expenses; physical asset specificity, as where a very specialized product is required to produce a particular good and can only be used to produce that good; and human asset specificity that arises from learning by doing [Williamson 1981].

In the trucking industry human asset specificity is associated with motor carriers, motor carrier brokers and in-house brokers and their ability to access backhauls. Asset

specificity is important because when human assets become specialized to a relationship, the parties involved become locked into a bilateral exchange. The result is that opportunism and maladaptation are unchecked by market forces [Anderson and Schmittlein 1984]. Accordingly, the more specific human assets become, the more incentive there is for the firm to integrate and thus dampen the opportunism and maladaptation that arises when asset specificity is prevalent in the market.

Consider a broker experienced in the business of accessing backhauls for a particular region. The broker's industry skills are all that is necessary to effectively serve a non-integrated trucking firm. This holds as long as the trucking firm is not distinctive. If the firm has particular operating procedures, or offers a specialized product (e.g., ICC operating authority, LTL capacity, special routes or services) then the broker has to familiarize himself with these firm specific attributes. The knowledge and relationships the broker eventually acquires about the trucking firm are asset specific to the firm. The more these assets affect the broker's performance, the higher their value and the more the task is characterized by asset specificity [Anderson and Schmittlein 1984]. Thus as a non-integrated firm's asset specificity grows, its dependence on brokers and customers that require its specific assets grows. As a result of this dependence, opportunism and maladaptation can result and erode profits.

This scenario can be repeated on the customer side. A trucking company's customers may be distinctive in their way of doing business. To effectively serve them the firm often must acquire special information regarding any unique features they might have. As the trucking firm acquires this information and specializes its services to meet its customers needs, a bilateral arrangement begins to form. In this arrangement the customer becomes dependent on the firm or broker that has provided its services to its specific needs. Relationships associated with this dependence can lead to customers exhibiting loyalty to the vertically integrated broker and his firm. However non-integrated firms may find that customers with specific assets exhibit loyalty to the independent broker who was the person in charge of dealing with the customers specific assets. No loyalty will be shown to the firm by the distinctive customer. Thus, when a firm accesses backhauls from a number of key customers with distinctive, specific features, asset specificity is high and there is an incentive to vertically integrate. It follows that the greater the total value of company-specific assets (on the company and customer sides), the greater the likelihood of vertical integration in the form of an in-house broker [Anderson And Schmittlein 1984].

Uncertainty. Williamson (1979) highlights one form of environmental uncertainty, that of environmental unpredictability. The result is demand shifting in unforseen ways. In an uncertain market, transactions will be completed

the transactions involved asset specificity and the inherent

costs of opportunism and maladaptation associated with it, the

infrequency of the transaction would make these costs low enough

that the firm would choose not to vertically integrate. For

rarely occurring transactions, losses from opportunism and

inflexibility are likely to be lower than the integrated firms

fixed costs. As a transaction recurs more frequently, however,

integration becomes more desirable since potential losses from

not integrating outweigh the overhead costs of integration.

In trucking, the total trips taken per firm is the number of

transactions. Following this line of reasoning , firms that

transact more frequently should be more likely to vertically

integrate than less active firms because they are vulnerable to

opportunism and maladaptation more often than firms that transact

less.

III. THEORY

A firm's decision to vertically integrate affects its

profits. The model examines profit maximizing decisions made by

trucking firms when accessing backhaul markets. The firm faces

four different access options. These options are: independent

search, external brokers, inhouse brokerage, or a combination of

external and internal brokers.

Independent search. A firm that engages in an independent

search does not use the services of any brokers. Thus it faces

profit of;

(1) $\pi_i = (R_{bh} - C_{bh} - S_s) T,$

Where R_{bh}=revenue of a single backhaul, C_{bh}=production cost, S_s=transaction cost of independent search, T=trips.

The firm hires an independent broker. A firm that hires independent brokers and uses the market as the governance structure to access loads faces many of the same elements as the firm that engages in an independent search. That is Rbh, Cbh and T are as before. However, the transaction cost of search takes a different form. When using an external broker the transaction cost is commonly a proportion of the revenue received for the trip by the broker. Let $0 \le \alpha \le 1$ be that proportion. Additionally the firm has to engage in a search for a broker that has the access to the appropriate backhaul. Let this be represented by S_b. Then profit under this alternative is,

(2) $\pi_b = [R_{bh}(1-\alpha) - S_b - C_{bh}] T.$

Firm hires an in-house broker. A firm that hires an in-house broker and uses the firm as a governance structure to access loads will likely have lower search costs than a firm without an in-house broker. However, establishing an in-house broker involves set up costs. In addition to these set up costs, there is still a search cost that the in-house broker incurs while accessing backhauls. Profit in this case is,

(3) $\pi_{vi} = (R_{bh} - C_{bh} - S_{ib}) T - FC,$

where S_{ib}= the search costs involved with searching for and accessing loads on a single transaction; and FC=the fixed costs of the in-house broker (e.g. salary, office equipment etc.)

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Utilizing the firm and the market. A firm that chooses to
vertically integrate an in-house broker while still utilizing the
services of independent brokers faces the fixed costs and search
costs associated with an in-house broker, as well as the costs of
paying the independent broker a percentage of the backhaul
revenue. However, the in-house broker in this case does not only
access loads; he accesses other brokers when he is unable to
access a load himself. Thus, the total search cost incurred by
the in-house broker accessing loads and other brokers is given as
$S_{ib/b}$. Profits are thus given by:

$$(4) \quad \pi_{ib\backslash b} = (R_{bh}(1-\alpha) - C_{bh} - S_{ib/b})\, T - FC.$$

**Transaction costs and their role in profit maximization and
vertical integration.**

The transaction cost theory dictates that there are a number
of factors that will lead a firm to vertically integrate. As I
mentioned, asset specificity, frequency, and uncertainty all
cause transaction costs to rise. As these rise, they make the
fixed costs associated with vertical integration seem less
significant. By analyzing the transaction itself, comparisons
can be drawn as to which governance structure (or combination of
structures) is most profitable and what the determinants are of
these profits. Table 1 outlines the conditions necessary for a
firm to choose one of the four options I mentioned above over the
others.

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TABLE 1

HEAD TO HEAD COMPARISON OF FIRM PROFITS	CONDITIONS NECESSARY
$\pi_i > \pi_b$	$S_s < [1-R_{bb}(\alpha)]+S_b$
$\pi_i < \pi_b$	$[1-R_{bb}(\alpha)]+S_b < S_s$
$\pi_i > \pi_{vi}$	$S_s < S_{ib}+FC$
$\pi_i < \pi_{vi}$	$S_{ib}+FC < S_s$
$\pi_i > \pi_{ib/b}$	$S_s < S_{ib/b}+FC+[1-R_{bb}(\alpha)]$
$\pi_i < \pi_{ib/b}$	$S_{ib/b}+FC+[1-R_{bb}(\alpha)] < S_s$
$\pi_b > \pi_{vi}$	$1-R_{bb}(\alpha) < S_{ib}+FC$
$\pi_b < \pi_{vi}$	$S_{ib}+FC < 1-R_{bb}(\alpha)$
$\pi_b > \pi_{ib/b}$	$[1-R_{bb}(\alpha)]+S_b < TC_{ib/b}+FC+[1-R_{bb}(\alpha)]$
$\pi_b < \pi_{ib/b}$	$S_{ib/b}+FC+[1-R_{bb}(\alpha)] < [1-R_{bb}(\alpha)]+S_b$
$\pi_{vi} > \pi_{ib/b}$	$S_{ib}+FC < TC_{ib/b}+FC+[1-R_{bb}(\alpha)]$
$\pi_{vi} < \pi_{ib/b}$	$S_{ib/b}+FC+[1-R_{bb}(\alpha)] < TC_{ib}+FC$

As evidenced by Table 1, firm profits are dependent on how firms minimize the transaction costs associated with searching for and accessing loads. In analyzing these transaction costs, theory dictates that as asset specificity, environmental uncertainty and frequency of transactions rise so does the search and access costs of attaining loads and the probability of vertical integration. Accordingly it is relevant to empirically determine the transaction costs involved in accessing loads and apply these to the firms profit maximizing decisions.

DATA

The data employed have several features that allow an examination of firm decisions with regard to market access activities and vertical integration. These data apply to motor carrier firms that travel in round trips to various terminal markets. On outgoing legs carriers haul agricultural commodities and on return legs (the backhaul) carriers haul a variety of commodities or they travel empty.

The carriers haul grain from North Dakota to terminal markets including Duluth and Minneapolis, Minnesota, the Pacific Northwest, and local markets. These data were drawn from a mail survey, consisting of two mailings, follow up telephone calls to non respondents and personal and telephone interviews conducted from August of 1987 through October of 1988. In total, there were 113 usable surveys out of 449 estimated possible respondents, representing a response rate of about 25 percent. Firms were asked to provide responses to questions regarding revenue, cost, and backhaul information, as well as, firm characteristics such as years in business, size, degrees of operating authority and destinations of service and level of activity in backhaul markets. Responses regarding market access activities were also asked to be provided.

With regard to the four options a firm can use to access the market, of the respondents, 50 of them chose to engage in an independent search while 45 of them chose to utilize the services of an external broker. 18 firms chose to engage in a form of

vertically integrating the sales force, with 4 of them choosing to employ an in house broker, and 14 of them choosing to employ both an in house broker and utilize the services of external brokers.

Not all trucking firms choose to operate in backhaul markets. The truckers cite the lack of operating authority, the search time required, low rates and high broker commissions as reasons for inactivity. In accessing backhaul markets, there are dramatic differences across firm types. On a firm basis larger firms with ICC regulation are considerably more likely to access backhaul markets than the smaller non-regulated firms. On average, regulated truckers successfully access the backhaul market and are loaded 72 percent of the time on trips taken, while non-regulated carriers are only loaded about 46 percent of the time on trips taken. This data suggests that despite the Motor Carrier Act of 1980, there are still large transaction costs involved with accessing backhaul markets, regardless of which access method is utilized. They suggest that the transaction costs are occasionally to such an extent that they can out weigh the benefits of accessing and participating in the backhaul market.

Table 2 summarizes all of the relevant data that I utilized in observing firms market access activities. Included in this table is the number and percentage of firms that have ICC regulation, the average number of years the observed firms have been in business, the average size of the firm (in number of

tractors), the number and percentage of firms that lease a percentage of their operating capital, the average firm's percentage of key accounts and the average number of trips and miles traveled by the observed firms.

Table 2 Summary Statistics

Variable	Average	Number	Percentage
Years in Business	13.7	**	**
Size (# of Tractors)	2.4	**	**
Number of Trips	338	**	**
Capital Leased	**	24	21.2
Key Accounts	34.8	**	**
ICC Regulation	**	45	39.8
Miles traveled	204,832	**	**
Independent Search	**	50	44.2
External Broker	**	45	39.8
In house Broker	**	4	3.5
In house and external Broker	**	14	12.4

EMPIRICAL MODEL AND PROCEDURES

MODEL

The aforementioned theory points to the specific circumstances in which the firm accesses backhauls through a direct search, employment of external brokers, vertically integrating an in-house broker, or a combination of both vertically integrated and external brokers. Their decisions, I assert, are the result of profit maximizing methods. In this section I develop an empirical model that explains these methods

and decisions in terms of observable data.

In the model firm types are represented by is, ib, vi and vi/ib, representing independent search, independent broker, vertical integration and vertically integrated broker and independent broker. However, since the data reveals that only 4 of the 113 firms choose to solely utilize the services of an in-house broker, that option will be excluded from the empirical examination. For this section and the proceeding sections, when a firm is said to be vertically integrated, it is the equivalent of saying that the firm has vertically integrated the brokerage function, but also occasionally utilizes market brokerage functions to access loads. The model's dependent variables are thus the firm types of is, ib and vi and are represented by equations 5,6 and 7 below.

$$(5) \quad is = \alpha_0 + \alpha_1 I + \alpha_2 S + \alpha_3 Y + \alpha_4 T + \alpha_5 L + \alpha_6 KA + \epsilon$$

$$(6) \quad ib = \alpha_0 + \alpha_1 I + \alpha_2 S + \alpha_3 Y + \alpha_4 T + \alpha_5 L + \alpha_6 KA + \epsilon$$

$$(7) \quad vi = \alpha_0 + \alpha_1 I + \alpha_2 S + \alpha_3 Y + \alpha_4 T + \alpha_5 L + \alpha_6 KA + \epsilon$$

The independent variables that are represented in equations 5-7 are as follows. I=ICC certification. This variable is represented by a 1 if the firm in fact does have ICC operating authority, and by a zero if it does not. S=size of the firm, measured in amount of operating capital (number of tractors the firm operates). Y=years a firm has been in business. KA=the percentage of key accounts the firm deals with, that is, those backhaul accounts which the firm personally deals in and are not simply the grain terminal fronthaul customers. ICC operating

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authority, years a firm has been in business, size of the firm, and percentage of key accounts are all variables that define asset specificity.

Environmental uncertainty is explained by the variable L, which represents the percentage of operating capital that is leased by the firm. Firms with a large percentage of capital leased have recognized uncertainty in the markets they operate and thus have an incentive to vertically integrate market access activities.

Frequency of transactions is represented by T, the number of trips taken by the firm. As trips rises, the costs associated with any market imperfections rises as well. Thus a firm that frequently transacts will have an incentive to vertically integrate their market access activities.

Because the variables in equations 5-7 are predicted to affect transaction costs differently across different firms, it is relevant to examine the predicted affect of each variable on firm decisions.

As I mentioned ICC authorization, size, years and key accounts all describe asset specificity and thus all have the same predicted affect on firm decisions. Theory dictates that firms with the lowest figures in these categories should employ the services of independent brokers to access loads, because theoretically, inexperienced, small firms with few key accounts, that are limited to operating in a small, fixed market will minimize transaction costs by utilizing an independent broker's

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economies in the acquisition of information. These firms can utilize these economies while avoiding a bilateral, inefficient relationship associated with specific assets.

Theory also dictates that firms with the highest figures in these categories should vertically integrate the services of an in-house broker. This is because experienced, large firms with vast operating authority and many key accounts will have specific assets and customers with specific assets . Accordingly, they will be vulnerable to opportunism as a result of the bilateral relationships that result from assets being specified.

The intermediate case is firms that choose to engage in an independent search. These firms presumably have enough experience, authority and key accounts to access loads, but they are still invulnerable to the detrimental relationships that develop with asset specificity. Tables 3 outlines market access predictions across the variables that define asset specificity (I,S,Y,KA).

Environmental uncertainty is explained by the variable L, which represents the percentage of operating capital that is leased by the firm. A firm that leases operating capital has a more flexible operating capacity which would indicate that it operates in uncertain markets with unpredictable customers. Thus, the larger this percentage, the larger the firm's uncertainty about demand. Because transactions are made less smoothly in uncertain markets, firms that are operating in them have an incentive to vertically integrate market access

activities to internally economize adaptations that must be made when the market changes. A vertically integrated firm can make adaptations internally without revising agreements, formal or otherwise, between independent parties.

Firms that hire independent brokers are predicted to be in stable markets where transactions are completed smoothly. Firms in these markets are not worried about having adjustable operating capacity and are thus are not worried about shifts in demand. Because of the stability of their markets they have no incentive to vertically integrate market access services. Table 3 outlines the predicted effects of market access activities for firms across different levels of market uncertainty (L).

The variable trips indicates the number of times a firm transacts. Since any maladaptation, or opportunism brought on by asset specificity and environmental uncertainty will be amplified if the firm frequently transacts, firms that transact more often have an incentive to vertically integrate. A firm that transacts very little is not vulnerable to asset specificity or uncertainty and should thus hire an independent broker for its few transactions. However, as the number of trips rises, so does the sum of the transaction costs involved with accessing loads. Because of these rising transaction costs, firms with a large number of trips should vertically integrate. Thus, all of the independent variables are expected to positively affect vertical integration. Table 3 outlines the predicted effects as the independent variables rise from minimum to maximum values.

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Table 3

variables	minimum	>>>>>>>>>>>>>>>>	maximum
I,S,Y,T,Y L,KA	independent broker	independent search	vertical integration

PROCEDURES

The preceding empirical models outlined in equations 5-7 are estimated with weighted least squares. This approach estimates a fit for the different variables and determines the probability of each market access option across different firm attributes. However, because weighted least squares is a bivariate, linear model and there are three options to consider, an ambiguity in the results exists. For the cases where a firm chooses to either hire an independent broker or vertically integrate, the results are expected to be unambiguously linear. As all of the variables rise the probability of vertically integrating should rise, as all of the variables fall the probability of hiring an independent broker should rise. However, for the intermediate case where the firm accesses loads independently, the predictions are not linear. Theory predicts that firms with mid to low values for the variables should independently search and firms with mid to high values for the variables should independently search. The predicted results are thus parabolic. To correct for this, for the intermediate case involving an independent search by the firm to access loads, squared terms are added to all of the independent variables (with the exception of ICC authority which is a bivariate variable).

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These results are then used to analyze the effects of isolated variables across different market access options. By isolating a variable across all three market access options, equations are formed and values are plugged into the isolated variable. These results draw conclusions about the isolated variable's affect on vertical integration. Shown in equations 8-10 is an example of how the variable of size is isolated and different values are plugged in.

(8) $ib = \alpha_* + \alpha_2 S$

(9) $vi = \alpha_* + \alpha_2 S$

(10) $is = \alpha_* + \alpha_2 S + \alpha_3 S^2$,

where $\alpha_* = \alpha_0, +\alpha_1 \bar{I} + \alpha_3 \bar{Y} + \alpha_4 \widehat{T} + \alpha_5 \bar{L} + \alpha_6 \overline{KA}$, and $S = 1, 10, 20, 30$. The results of these equations give the probabilities of which market access option will be used as size changes independently from 1 tractor to 10 to 20 to 30. In the model all variables are isolated and evaluated at relevant points in this manner.

The two linear equations (8&9) are also set equal to the parabolic equation (10). The quadratic formula is then used to obtain critical points of intersection between the three. This allows for a framework to be developed to show specifically which method should be used to access backhaul markets as variables change. This framework can be shown graphically, with the critical points being where the firm would choose to switch market access methods.

EMPIRICAL RESULTS

The coefficient estimates for the extreme market access
options of hiring an independent broker or vertically integrating
are shown in Table 4. These results reveal that the equation
that estimates the probability of vertical integration has
positive coefficient estimates for size, years, trips, percentage
of capital leased, percentage of key accounts, and operating
authority. This indicates that as these variables rise the
probability of vertically integrating rises as well.
Accordingly, table 4 reveals that as size, years, percentage of
capital leased and percentage of key accounts falls, the
probability of hiring an independent broker rises. This is
evidenced by the negative coefficient estimates for these
variables. This is consistent with transaction cost theory. The
model's predictive power is substantial as well. In the 113
cases the model predicted the correct market access method for 65
of the firms for 57 percent.

In both of the cases documented in table 4, operating
authority has a positive coefficient, thus as operating authority
rises, so does the probability of utilizing both of the options.
However, in the case of hiring an independent broker, the
coefficient is only a small fraction of the magnitude that is
evident in the case of vertically integrating. By comparison the
t-ratio for operating authority in the case of the vertically
integrated firm is 141.77 and the estimated coefficient is
.987531. In the non-integrated case where a firm accesses the

market through independent brokers the t-ratio for operating
authority is only .882 and the estimated coefficient is only
.031. This is also consistent with transaction cost theory. A
complete summary of all of the t-ratios and standard errors for
the two market access options of hiring an independent broker and
vertically integrating are also included in table 4.

Table 4
Vertical Integration vs. Independent Broker

ESTIMATED COEFFICIENT	HIRE BROKER	VERTICAL INTEGRATION
CONSTANT	.928	-1.052
standard error	.1324	.1325
t-ratio	7.012	-7.943
ICC OPERATING AUTHORITY	.031	.987
standard error	.03564	.006966
t-ratio	.882	141.77
SIZE	-.002	.0003
standard error	.0065	.0002043
t-ratio	-.316	1.605
YEARS IN BUSINESS	-.0007	.00001
standard error	.001076	.00001783
t-ratio	-.679	.546
TRIPS	.0267	.00004
standard error	.004416	.000044
t-ratio	.605	.671
PCT. OF CAPITAL LEASED	-.089	.0028
standard error	.1191	.002374
t-ratio	-.751	1.191
PCT. OF KEY ACCOUNTS	-.0915	.00379
standard error	.1556	.004979
t-ratio	-.588	.763

Documented in table 5 are the estimated coefficients for the intermediate market access option of searching for loads independently, without the aid of brokers. Because this is theoretically the intermediated case, there are squared terms included. Accompanying the coefficient estimates are the t-ratios and standard errors for each of the variables.

Table 5
Independent Search

variable	est. coefficient	standard error	t-ratio
constant	-.170775	.1758	-.971
ICC authority	-.323059	.1317	-2.452
size	-.313445	.02062	-15.204
size^2	.008608	.0007622	11.92
years	.133046	.008551	15.559
years^2	-.31855	.0001993	-11.634
trips	-.00501752	.007032	-.714
trips^2	.00170112	.0002081	8.175
pct. lease	-1.31507	.4728	-2.782
pct. lease^2	2.13153	.4017	5.307
key accounts	1.07478	.3849	2.793
key accounts^2	-.274774	.3943	-.697

Utilizing these results to determine whether the option of independent search is, in fact, the intermediate case that firms use when accessing loads, all of the independent variables are isolated for all three equations. The linear equations documented in table 4 are set equal to the parabolic equation documented in table 5. Taking into consideration the slopes of the lines, the critical points of intersection and the direction

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of the parabola, conclusions about the data are drawn and are summed up in graphs which show a framework for firm decisions as variables change.

The variable that is first isolated is that of size. The three equations that result when all other variables are estimated at their mean values, are; $ib_s = .89686 - .002056S$ $is_s = 1.2158 - .31344S + .0086S^2$ and $vi_s = -.65735 + .00033S$. When ib_s is set equal to is_s the critical point of intersection is .35815081. When vi_s is set equal to is_s the critical point of intersection is .466460729. Taking into consideration the nature of the parabola defined by equation is_s and the slopes of the linear equations a framework is developed and outlined in figure 1. This figure shows the probabilities of each market access method as size grows.

Figure 1
Size
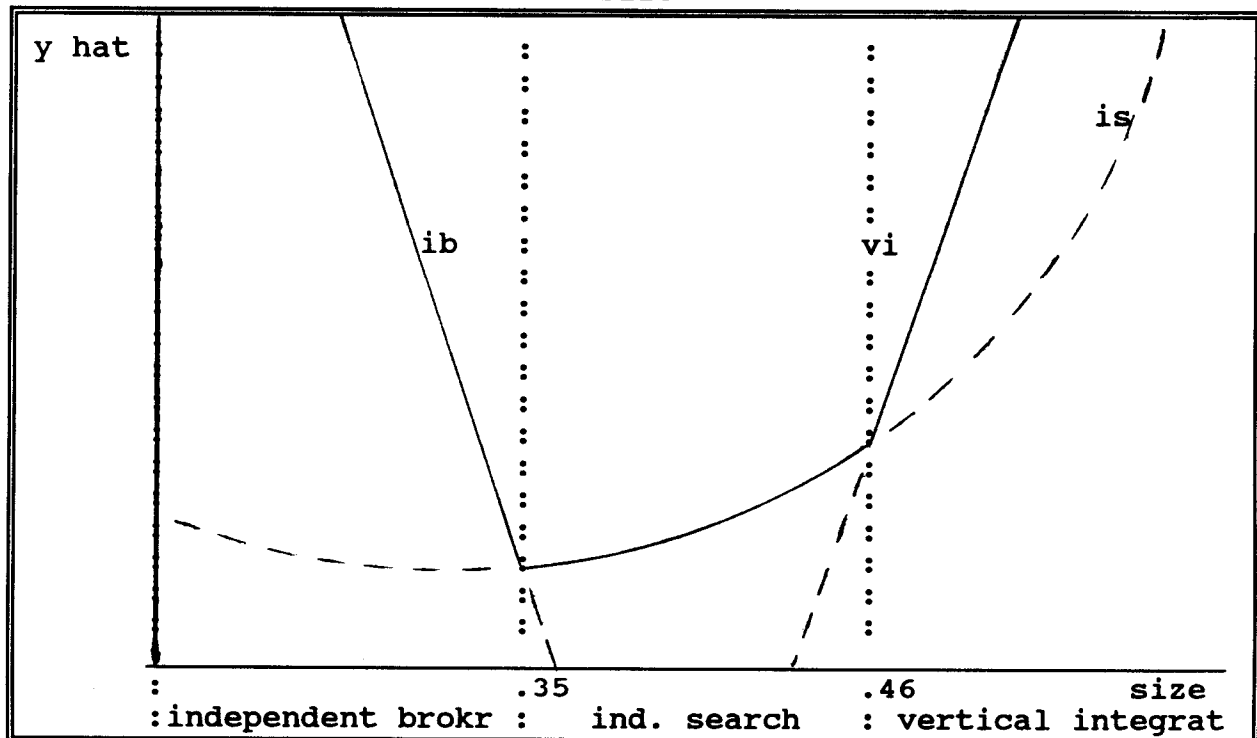
The next variable that is isolated is, years a firm has been

in business. Controlling all other variables at their means

yields, $ib_y=.90153-.00075Y$ $is_y=-.53582+.13305Y-.00232Y^2$ and

$vi_y=-.656527+.00001Y$. When ib_y is set equal to is_y the critical

points of intersection are $-.1558231$ and $-.1117698$. When vi_y and

is_y are set equal to each other the critical points of

intersection are $-.1247557$ and $-.141316$. Taking into

consideration the shape of the parabola and the slopes of the

lines involved, a framework is developed describing how number of

years a firm has been in business affects its market access

activities. This framework is shown in figure 2.

Figure 2
Years

years $-.15-.14$ $-.12$
use broker: independent search   :vertical integrat
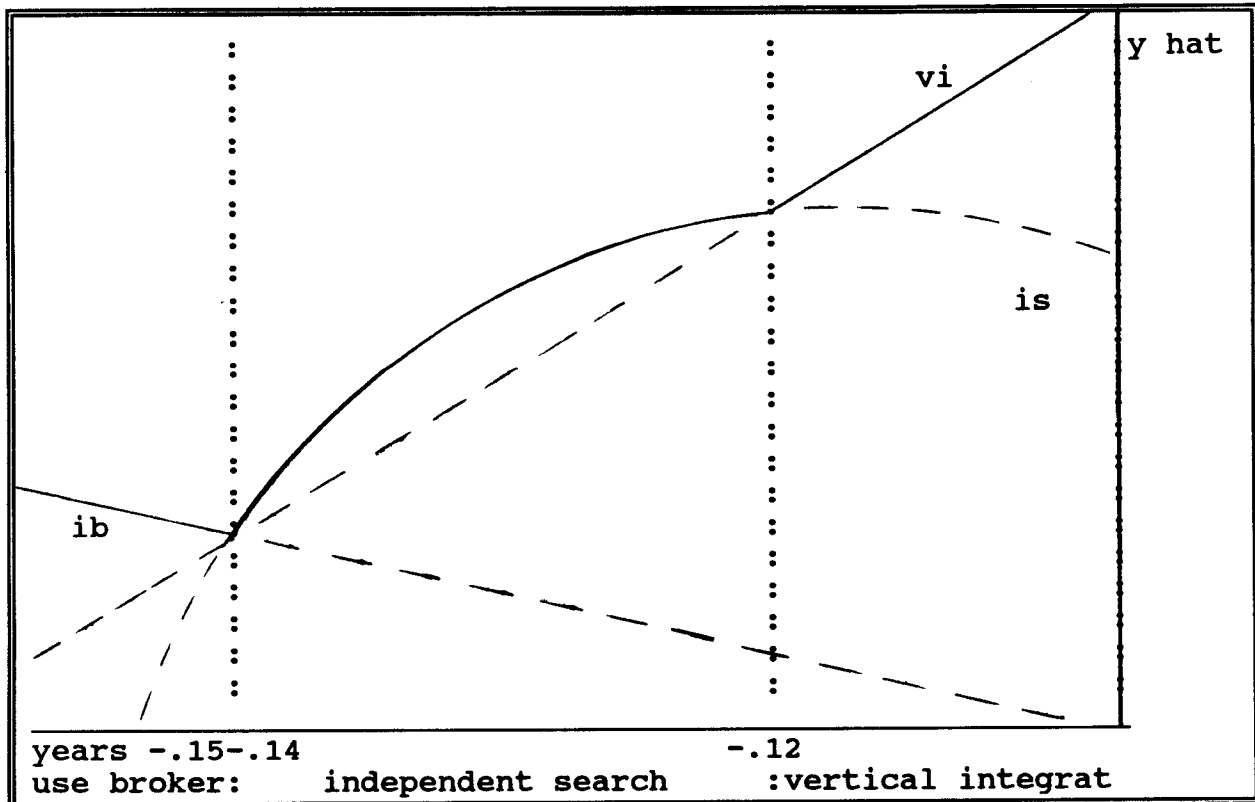
The next variable that is isolated for is the percentage of
capital that a firm leases. When this variable is isolated at
the other variable's means the following three equations result;
$ib_L = .90304 - .0894L$ $is_L = .49742 - 1.315L + 2.13153L^2$ and

$ib = -.6567912 + .002832L$. When ib_L and is_L are set equal to each
other, the critical point of intersection is .773988. When is_L
and ib_L are set equal to each other it is found that the two
equations have no common points. Thus to find the critical point
of intersection ib_L is set equal to vi_b. The resultant framework
that is developed describing how firms that lease different
percentages of capital is shown in figure 3.

Figure 3
Percentage of capital leased
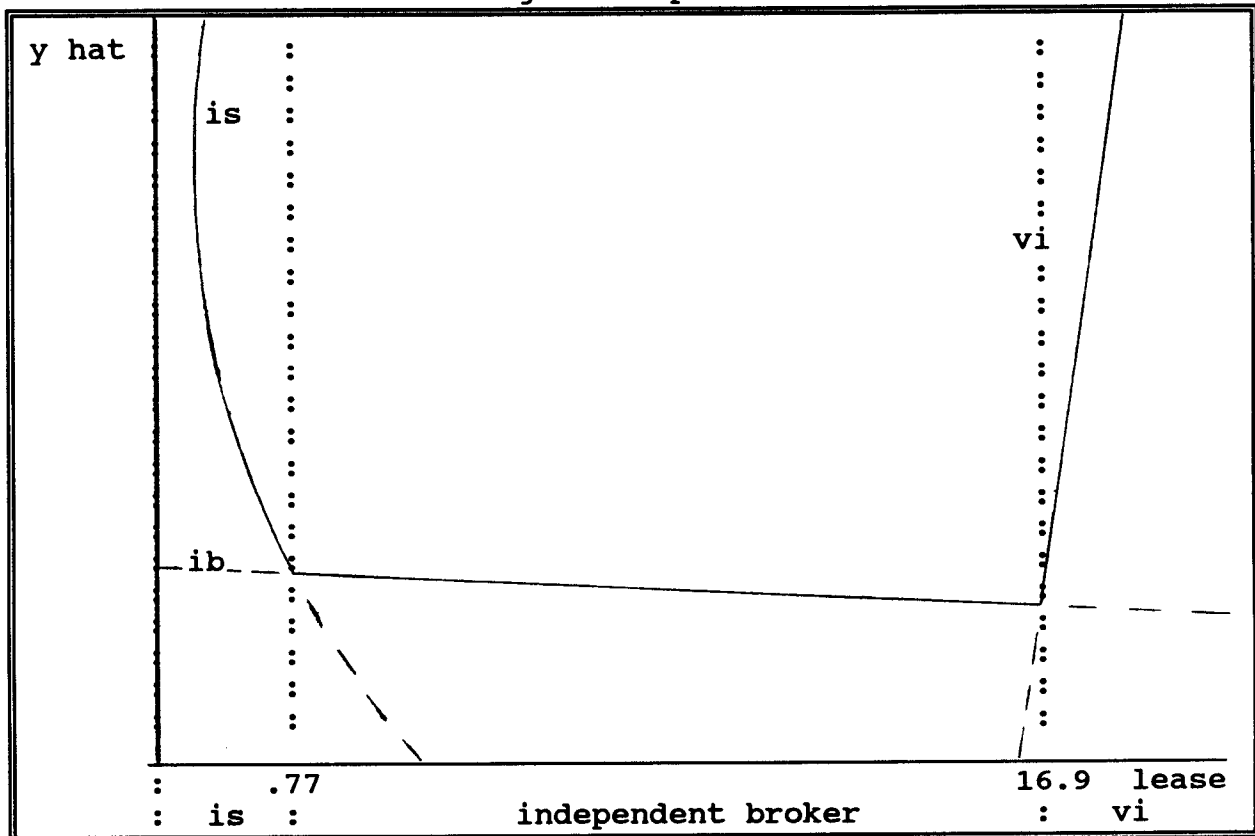
The next variable that is isolated for is the percentage of key accounts a firm has. When all other variables are controlled at their means the three equations that result are as follows; $ib_{KA}=.923-.0915KA$ $is_{KA}=.2364+1.075KA-.2747$ $vi_{KA}=-.6577+.0038KA$ When ib_{KA} is set equal to is_{KA} the critical point of intersection is -1.432345. When vi_{KA} is set equal to is_{KA} the critical point of intersection is -.4120398. Taking into consideration the shape of the parabola and the slopes of the linear equations involved, a framework is developed for the percentage of key accounts a firm has. This framework is shown in figure 4.

Figure 4
Key Accounts

KA   -1.43   -.412
use broker: independent search   :vertical integrat
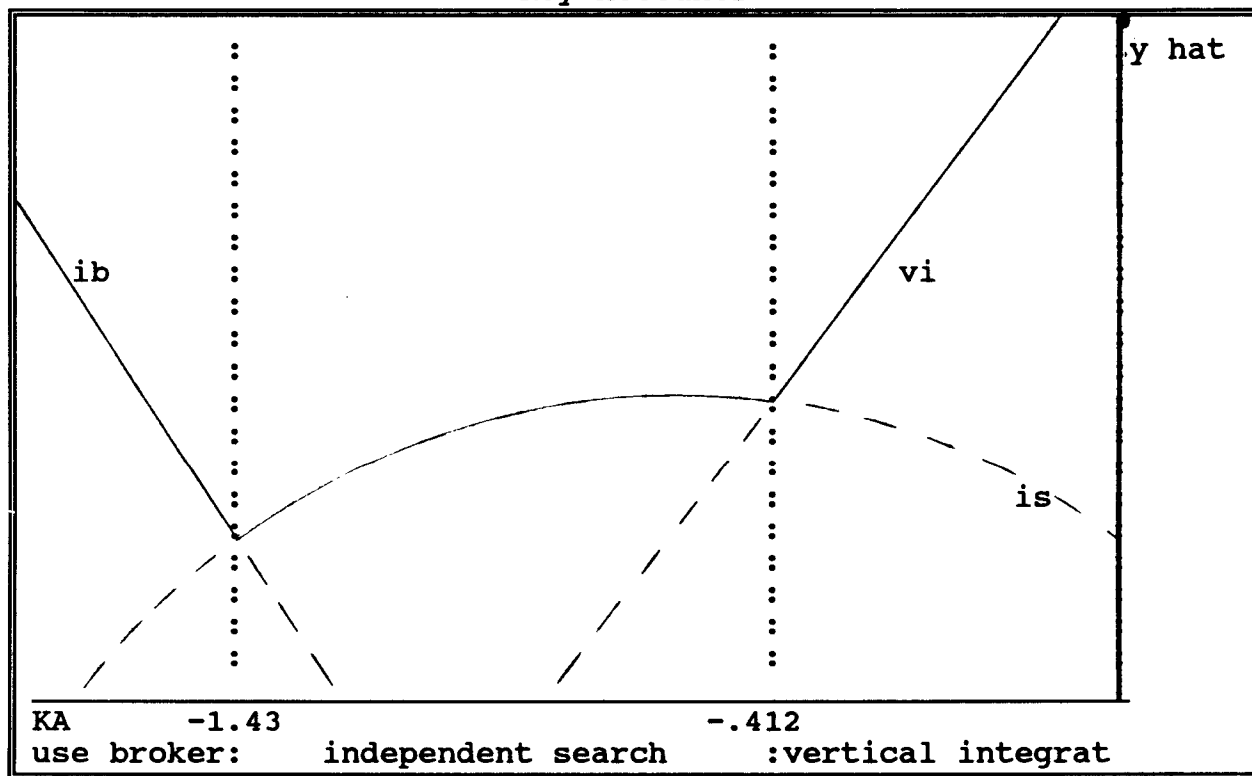
The final variable that is controlled for is ICC operating authority. Since this variable is a bivariate variable there is no squared term and thus, all of the results are linear. To examine the effects that operating authority has over market access options, the estimated coefficients can be evaluated. The largest estimated coefficient for authorization is for the vertically integrated case at .928, it dominates all other market access options. The ICC authority estimated coefficient for the option to hire an independent broker is .031, and for independent search is -.323. This suggests that as a firms operating authority rises it will shift from independent search to independent brokers to vertical integration to access loads.

Controlling for specific variables and plugging in specific values can also provide a way of analyzing firm behavior over specific variables. The market access probabilities documented in table 6 are for firms with extensive operating authority that are operating at the mean of all other variables except for the one being isolated. These figures show that, in most cases, as the independent variables rise firms move from utilizing independent brokers, to independently searching for loads, to vertically integrating market access activities.

Table 6

variable	value	prob. ib	prob. is	prob. vi
size	1	.94428747*	.38035600	.92480233
size	10	.92578464	-1.588457	.92775360*
size	20	.90522594	-2.240507	.93103279*
size	30	.88466724	-.9709570	.93431198*
years	1	.95025873*	.11068386	.92528991
years	20	.93600710	1.7134564*	.92547507
years	30	.92849649	1.8846414*	.92557251
years	50	.91348800	.83588100	.92576700*
trips	2	.93514821*	-.0246333	.92535832
trips	5	.94316457*	-.0193416	.92544819
trips	15	.96988577*	.27070720	.92574775
trips	25	.99660696*	.90098000	.92604730
% lease	0	.95341203*	-.0200436	.92500637
% lease	33	.92390235*	-.2218931	.92594104
% lease	66	.89439266	.04050468	.92687571*
% lease	100	.86398873	.79641641	.92783870*
% key accts	0	.97233892*	-.2869763	.9240928
% key accts	33	.94213904*	.03777822	.92534661
% key accts	66	.91193915	.30268695	.92660041*
% key accts	100	.88082412	.51302970	.92789221*
ICC op auth	0	.87753185*	.66907980	-1.049670
ICC op auth	1	.90898115*	.34602008	.06213900

*denotes market access option predicted

CONCLUSION

From the empirical results, the transaction cost approach outlined by Williamson proves to be an accurate predictor of transaction costs and there effects on firms decisions to

vertically integrate market access activities. Asset specificity is accurately defined by the degree of operating authority, size of the firm, years a firm is in business and the percentage of key accounts the firm has. The empirical model predicts that firms utilize the services of an independent, non-integrated broker at small values of these variables; and the model predicts vertically integrating an in-house broker at large values for these variables. The percentage of operating capital leased by the firm proves to be a good indicator of the stability of the markets the firms participate in. Again, as this variable rises, so does the probability of vertically integrating market access activities. As this variable shrinks, so does the degree of unpredictability in the market, and thus so does the probability of vertical integration.

The only aspect of Williamson's transaction cost theory that did not prove to be an accurate predictor of vertical integration, is that of frequency. It is explained in the model by the number of trips a firm takes, and when isolated consistently predicts that the firm should always utilize the services of an independent broker across all variables. One explanation for this may be that Williamson assumes that frequency causes transaction costs to rise because as the frequency of the transaction increases, so do the inefficiencies associated with transaction. In this case, however, firms appear to be consistently utilizing the proper governance structure to access loads. Thus under their specific governance structure

they may not experience any outstanding transaction costs and thus will not have an incentive to change regardless of how many times they transact.

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