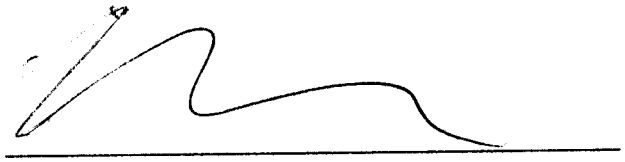
# Industry Evolution in Motor Carrier Commerce



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Abstract

*Prior research holds that, as a group, young firms will have higher costs than older firms resulting in a "noisy" selection where efficient firms survive and inefficient firms fail. In this paper this theory is tested by estimating the extent to which costs and revenues are influenced by the degree of experience of a firm in the motor carrier industry.*

## I. Introduction

Of increasing interest to industrial organization economists is the post-entry performance of new, small firms. Research by leading economists indicate that young firms, i.e., less experienced firms, as a group will have higher costs than older firms[1]. Boyan Jovanovich proposes a theory of "noisy" selection where efficient firms grow and survive while inefficient firms decline and fail.[2] On average, firms differ because over time they discover their relative efficiencies, i.e. costs. Uncertainty about the future, faced by new firms, inhibits informed decision-making, causing inefficient levels of operation.

In this paper I develop a model that tests this basic tenet underlying Jovanovic's theory of industry evolution, in the motor carrier industry. In evaluating the influence experience has on average costs and revenues, first a baseline is employed demonstrating the effects experience has on a firms average costs and revenues. By then adding other relevant variables to the model, and comparing to the baseline, hypotheses can be made about the differing coefficient magnitudes. If these results are consistent with theory, experience should be a significant variable in explaining average costs and average revenues.

However, estimates of the empirical models show that before and after controlling for firm attributes, such as ICC regulation and average length of haul, experience does not significantly affect average cost or average revenue.

## II. Theory

In the theory developed by Jovanovic, new entrants face random costs and are unsure about their own success, as they are uncertain about relative costs and efficiencies.[3] Therefore, it is not until actual performance, through a trial and error method, that firms discover their relative costs and efficiencies, and are able to determine their ability. It is through this process that efficient firms expand and survive and inefficient firms contract and fail.

Tracing new firms over time, it is assumed the first few years will be characterized by many firm deaths, as firms realize early they cannot compete. As years in the industry increase, the death rate of firms should decrease as the most efficient firms succeed. Therefore, when following firms in an industry over time, the number of firms should decline, as only the firms with lower costs, survive. (Fig. 1)

Fig. 1

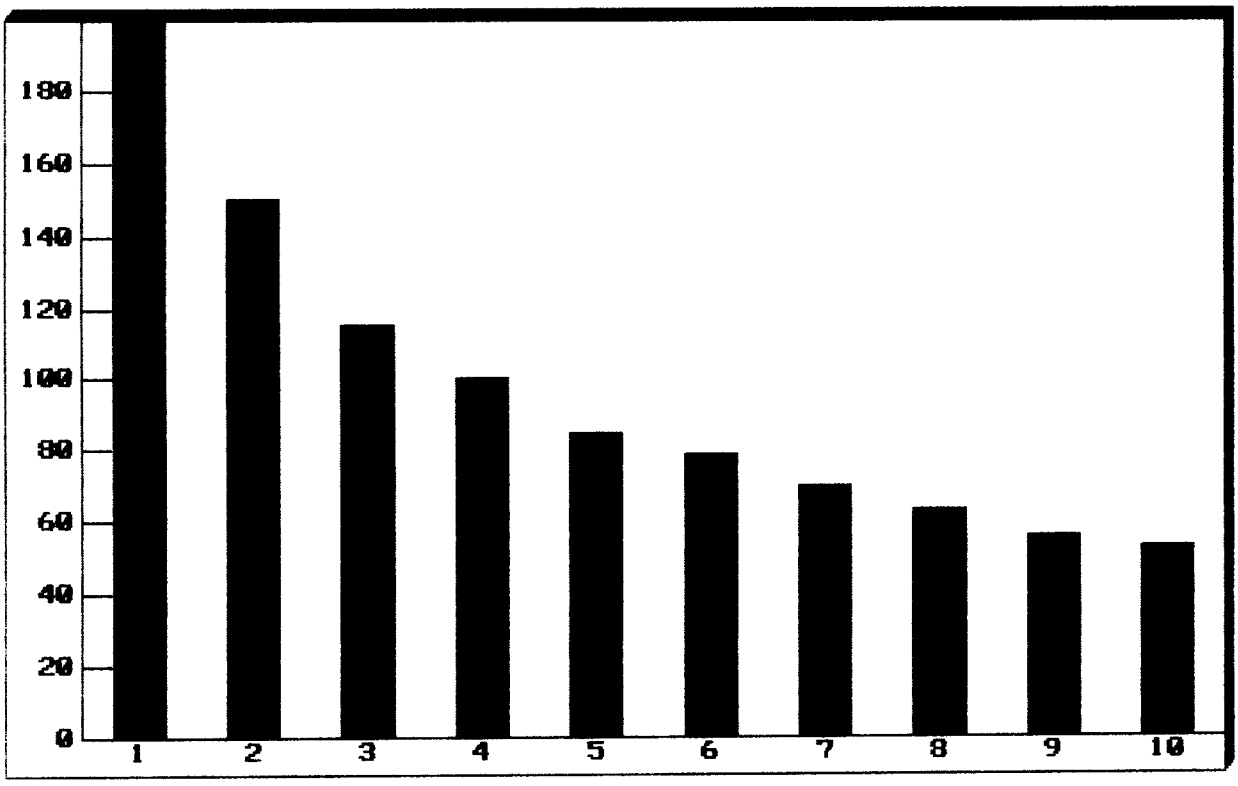
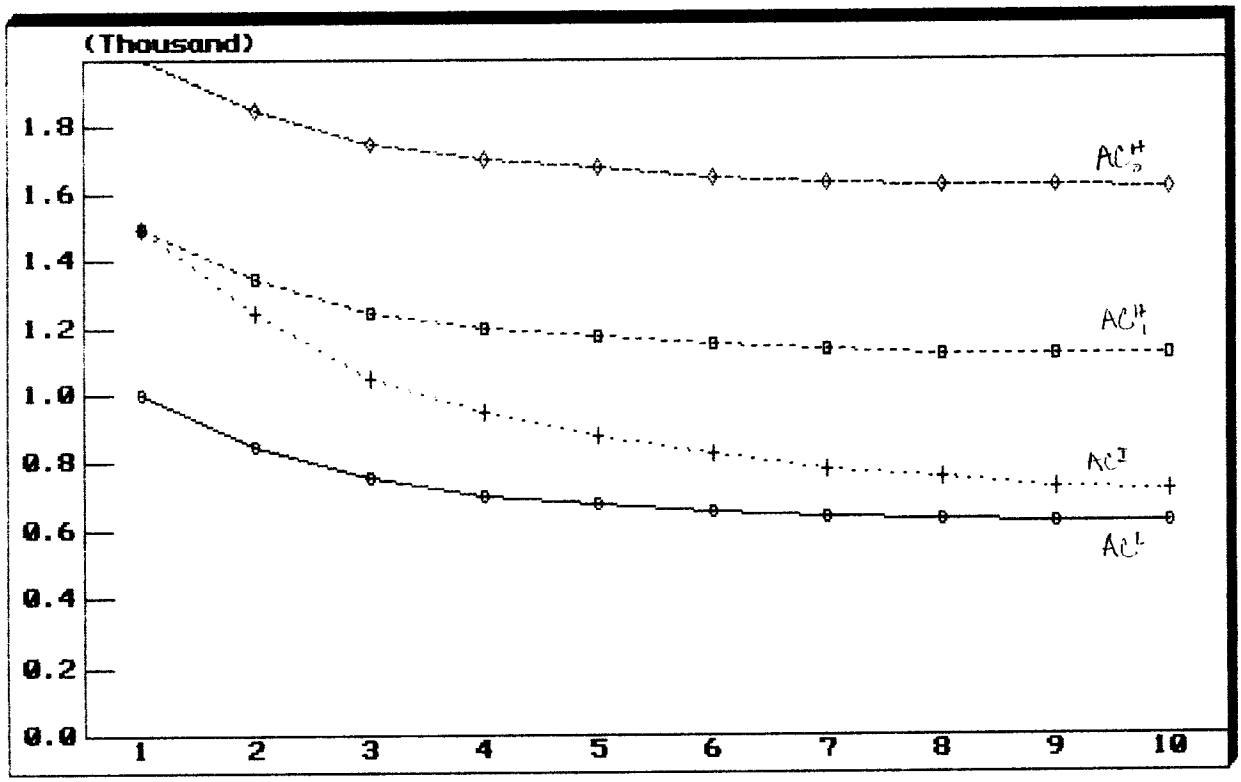

# of Firms
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
Years

Fig. 2


Average Cost
(Thousand)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
8
9
10
Years

Furthermore, it is assumed the industry average cost curve, driven by the relatively less efficient firms leaving the market, decreases. For example (Fig. 2), the average cost curve for low cost firms is $AC^{L}$ and the initial average cost for the high cost firms is $AC_0^H$ . As the high cost firms leave the market, the average cost curve for this group shifts downward ($AC_1^H$ ). The industry average cost curve lies between the low cost and high cost firms ($AC^I$ ) and as more high cost firms fail, the industry average cost curve approaches the low cost firm's average cost curve.

## III. Data Summary and Empirical Model

The source of data for the empirical estimation is a survey of motor carrier firms originating in North Dakota.[4] Out of 105 responses, there are 103 used after correcting for possible outlier problems.

The models illustrate average cost and average revenue in the motor carrier industry and are assumed to satisfy the classical assumptions. The explanatory variables include whether a firm has regulatory operating authority, the average length of haul, and the number of years they have been operating.

Wilson and Dooley[5] showed regulatory operating authority enhances a firms ability to obtain backhaul loads. Therefore, this variable is expected to be significant in positively affecting average revenues and negatively affecting average costs.

The average length of haul is expected to increase costs at a decreasing rate, illustrating the tapering principle.[6] Under this principle, per unit volume rates increase with distance, but the rate of increase diminishes as distance increases.[7] Thus, as an explanatory variable for average cost and average revenue, a positive effect is expected for average cost and a negative effect for average revenue.

Years is the focal pont of this paper. Considering Jovanovic's theory,[8] firms are ignorant about their relative costs and efficiencies when they enter the industry. Once they have been operating, they discover their true costs. Those with low costs will survive, whereas those with high costs will exit. Therefore, it is expected as years increase, the cost structure of firms will decrease, as the industry is now characterized by more efficient firms. Analogously, a firms's average revenue is expected to increase.

## IV. Empirical Results

The models, summarized in Table I, were estimated using two specifications each for average revenue and average cost.[9] Model 2 and Model 2A consist of a constant, experience (YEARS), the average length of haul (ALH) and a dummy variable demonstrating if a firm has regulatory operating authority (ICC). Model 1 and Model 1A, the baseline models, consist only of a constant and experience. In all the models, the dependent variables, Average Cost and Average Revenue, were calculated using miles in the numerator as a measure of firm size.

Table I. Coefficient Estimates

| | MODEL 1 (AC) | MODEL 2 (AC) | MODEL 1A (AR) | MODEL 2B (AR) |
|---|---|---|---|---|
| YEARS | -0.002339 | -0.004092 | -0.001036 | -0.001110 |
| | (0.014020) | (0.013995) | (0.002027) | (0.001923) |
| ICC | ---- | 0.599481* | ---- | 0.096520* |
| | | (0.346865) | | (0.047654) |
| ALH | ---- | -0.000522 | ---- | -0.000250* |
| | | (0.000503) | | (0.000069) |
| Std. Error | 1.646802 | 1.636017 | 0.238039 | 0.224763 |
| R Squared | 0.000275 | 0.032865 | 0.002579 | 0.128348 |
| R | 0.016597 | 0.181287 | 0.050780 | 0.358257 |
| F Ratio | 0.027828 | 1.121403 | 0.261117 | 4.859144 |

A. A * indicates signficance at 10% level

There is no evidence supporting Jovanovic's theory of industry evolution in the motor carrier industry, in either the baseline or augmented models. In all specifications, experience was shown to have no significance in determining either average cost or average revenue. This implies that in the motor carrier industry, experience is irrelevant in a firm discovering their relative efficiencies. Therefore, it can be hypothesized that the motor carrier industry is characterized by firms who are knowledgeable about their relative efficiencies, before they enter the market, and they make informed entry decisions. The implications to this are numerous. When tracking a number of firms over time, the amount of firms in the industry should not significantly decrease. Furthermore, one would not predict the industry's average cost curve to be decreasing at a decreasing rate over time, as young and new firms are operating at the same range of efficiencies. In the motor

carrier industry, a firm's costs and revenues are manifested in other variables, such as the included operating authority and average length of haul, and cannot be explained by experience.

Of significance in explaining average revenue is the inclusion of regulatory operating authority and the average length of haul. The sign and magnitude of operating authority on the intercept was positive, and consistent with prior expectations. The regulatory "rents" theory is supported here.[10] Firms with regulatory authority have a higher probability of obtaining a backhaul, thus increasing their average revenue.

The significant negative effect of average length of haul on average revenue supports the tapering principle.[11] Under this theory, rates increase with distance, but at a decreasing rate. Included in the explanation for this construction is the observation that initial costs are equal regardless of the length of the haul. Therefore, as the length increases, the rate per mile decreases. It is assumed if the tapering principle were not used, and rates increased in proportion to miles, the rates would become so high as to restrict movement of goods.[12]

While regulatory operating authority is of significance in explaining average costs, average length of haul is not. Different relevant specifications were attempted in estimating average costs, such as the inclusion of factor costs, but they proved to be statistically insignificant. Nevertheless, I cannot rule out possible specification error or omitted error bias, as theory supports the significance of factor costs and

average length of haul in determining average cost. On the other hand, there is enough evidence supporting regulatory operating authority as significant in increasing average costs.

## V. Summary and Conclusions

Jovanovic's theory of industry evolution has had considerable popularity among industrial organization economists. Under this theory, it is assumed firms are unknowledgeable about their relative costs and become informed through a sort of trial and error, where from they make educated decisions regarding continuing business activity or market exit.[13] The purpose of this paper was to test this hypothesis in the motor carrier industry.

The model estimated average cost and average revenue, with experience as the focal point. Prior expectations based on theory[14] supported the number of firms in the motor carrier industry to decrease, as years increased, illustrating the basic tenet that the less efficient firms, those characterized by high costs and low revenues, decline and fail. Furthermore, it was expected that over time, the industry's average cost curve would decrease, again illustrating the exit of firms with higher average costs, which would eventually approach the average cost curves of the most efficient firms.

However, there was no evidence to support this theory, as years was insignificant in the estimation of average cost and average revenue. This implies the motor carrier industry is characterized by new firms having some prior knowledge about their relative costs, such that they can

make informed entry decisions. Therefore, this fundamental relationship, where the number of firms, and the industry's average costs, decrease as experience increases, is not demonstrated in this industry.

The results did support two other theories. First, having regulatory operating authority increases a firms probability of obtaining backhaul loads, thus increasing revenue and decreasing cost. Additionally, the tapering principle was illustrated, where, as the distance traveled increases, the rate decreases, decreasing average revenue.

These results provide evidence that the motor carrier industry is one in which informed entry decisions can be made and young firms, as a group, are able to survive and compete. In explaining revenue and cost heterogeneity, obtaining ICC authority seems to increase the likelihood of obtaining backhauls, theoretically and empirically causing a positive effect on revenues. The demonstration of the tapering principle implies a rate structure that is prevalent in transportation industries.

Footnotes

1. See, for example, Audretsch and Acs [1], Audretsch and Mahmood [2] and Jovanovic [3].

2. See Jovanovic [3] for a more thorough examination on his theory of market selection and industry evolution.

3. See Jovanovic [3].

4. This data was provided to me by Wesley Wilson. For a more thorough explanation of it see [5].

5. See Wilson and Dooley [5], for an excellent empirical discussion on regulatory operating authority.

6. See Locklin [4].

7. See Locklin [4].

8. See Jovanovic [3].

9. Additional variables were originally specified, such as price of equipment, price of fuel, price of labor and number of trucks, but they were all statistically insignificant and had no effect on the estimations.

10. See Wilson and Dooley [5].

11. See Locklin [4].

12. See Locklin [4].

13. See Jovanovic [3].

14. See Jovanovic [3] and Audretsch and Mahmood [2].

References

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