Cable Company Case Study

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Abstract

This paper focuses on the exorbitant cost and lack of quality of broadband internet access in the United States relative to OECD countries and the inefficient competitive dynamics present in the Cable Industry. More specifically, it shows that Cable Companies will not be able to compete in perpetuity due to innovation, inflation, higher interest rates and an excessive debt load. By utilizing a continuous state model of industry entry and exit, this paper highlights the unlikelihood that US Cable Companies will continue to have strong performance. Moreover, rising inflation and higher interest rates will present even stronger headwinds for Cable Companies. These findings will demonstrate the high social costs created by the Cable Companies and present a call to action for entrepreneurs and regulatory authorities.

1 Introduction

The shift to remote work has increased the need for network connectivity and is beginning to commoditize network services. Consequently, federal and state agencies have taken an interest in the industry. Moreover, alternative conduits for broadband connection present a market ripe for disruption through innovation. For example, Elon Musk's company Starlink may be able to offer more affordable internet access to customers in rural areas. Starlink uses advanced satellites in a low orbit to provide low latency broadband internet access across the globe. The development and implementation of 5G may further dampen Cable Company profits, especially since 20% of Americans are smart phone only users. (Bandyopadhyay et al. 2020)

The looming threat of an economic downturn is yet another headwind for Cable Companies. The CPI was up 5.4% year over year in September and the threat of high long term inflation is very real. The COVID-19 pandemic and associated government support has created an extremely tight labor market. According to the NFIB, 51% of small business owners reported job openings they could not fill in September 2021. This is a record high and is up one point from the previous month. ("Jobs Report and Jobs Data from the NFIB Small

Business Research Center", n.d.) It seems likely that the FED's hand will be forced and interest rates will rise as a function of inflation.

The relative cost and quality of broadband internet access in the United States poses serious concerns about the efficacy of the industry model. The bar graph from the OECD Broadband Portal below indicates that the United States is behind many competitors regarding broadband internet penetration. This is surprising given the United States overall economic presence and brings to the light pressing need to increase penetration rates.

2 Literature Review

(**?**) This is a citation.

3 Data

Data is described in appendix **??**. *This is in italics* and **this is in bold**.

4 Models

4.1 Optimal Monetary Policy Model

Consider a monetary authority who wishes to control the nominal interest rate x to minimize the variation of the inflation rate s_1 + the GDP gap s_2 around specified targets $\mathrm{s}^*{}_1$ and $\mathrm{s}^*{}_1$.

$$L(s) = (s - s^*)^T \Omega (s - s^*) \tag{1}$$

The corresponding state transition function is:

$$g(s, x, \epsilon) = \alpha + \gamma x + \epsilon \tag{2}$$

$$s \subseteq \mathbb{R}^2 \quad x \subseteq [0, \infty)$$

Where s is a 2x1 vector containing the inflation rate and the GDP gap, s* is a 2x1 vector of targets, and Ω is a 2 x 2 constant positive definite matrix of preference weights.

$$\boldsymbol{s^*} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad \boldsymbol{\Omega} = \begin{bmatrix} 0.3 & 0.0 \\ 0.0 & 1.0 \end{bmatrix}$$

Assume that the inflation rate and the GDP gap are a joint controlled exogenous linear Markov process.

$$s_{t+1} = \alpha + \beta s_t + \gamma x_t + \epsilon_{t+1} \tag{3}$$

Where α and Γ are 2 × 1 constant vectors, β is a 2 × 2 constant matrix, and ε is a 2 × 1 random vector with zero mean.

$$\boldsymbol{\alpha} = \begin{bmatrix} 0.3 & 0.0 \\ 0.0 & 1.0 \end{bmatrix} \quad \boldsymbol{\beta} = \begin{bmatrix} 0.3 & 0.0 \\ 0.0 & 1.0 \end{bmatrix} \quad \boldsymbol{\Gamma} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad \boldsymbol{\epsilon} = \begin{bmatrix} 0.04 & 0.00 \\ 0.00 & 0.04 \end{bmatrix}$$

To formulate as a maximization problem, posit reward function equaling negative loss function

$$f(s, x) = -L(s)$$

The sum of current and expected future rewards satisfies the Bellman equation.

$$V(s) = \max_{0 \leq x} -L(s)(g(s, x, \epsilon)) \tag{4}$$

Given the model structure, one cannot omit the possibility that x ¡=0 will bind in certain states. Therefore, the shadow-price function λ(s) characterized by Euler conditions:

$$\delta\lambda^T E_\epsilon(g(s, x, \epsilon)) = \mu \tag{5}$$

$$\lambda(s) = -\Omega(s_t - s^*) + \delta\beta^T E_\epsilon \lambda(g(s, x, \epsilon)) \tag{6}$$

The Shadow price function represents the value of the Lagrange multiplier. Therefore, in the context of this problem, the shadow price function is the change in the optimal value per unit of infinitesimal change in the constraints (nominal interest rate and inflation variation).

It follows that along the optimal path

$$\delta\gamma T E_t \lambda_{t+1} = \mu_t \tag{7}$$

$$\lambda_t = -\omega(s_t - s^*) + \delta\beta^T E_t \lambda_t + 1 \tag{8}$$

$$x_t \geq 0 \mu_t \leq 0 x_t > 0 ==> u_t - 0$$

Thus, in any period, nominal interest rate x is reduced until either the long-run marginal reward µ or the nominal interest rate is driven to zero.

4.2 Entry Exit Model

Consider a market participant that operates in an uncertain profit environment. That market participant is a firm operating in the cable industry. The firm is either producing nothing or it is actively producing q units of a good per period at a cost of c. This is charaterized by the binary state δ(δ=0 for inactive, δ=1 for active), there is also an exogenous stochastic state representing the return per unit of output, P, which is described by the following equation:

$$P_t = \mu(P)dt + \sigma(P)dz \tag{9}$$

The firm faces fixed costs of activating and deactivating of I and E, with $I+E \geq 0$. The value function for any choice of a switching strategy is:

$$V(P_0) = E_0 \int_{\infty}^{0} [e^{-pt}\delta_t(P_t - c)\,dt \ - \sum_{i=1}^{\infty}(e^{-pt_i^a}I + e^{-pt_i^d}E)]$$

$t^a{}_i$ and $t^d{}_i$ are the times at which activation and deactivation occur. It is reasonable to assume that positive transition costs should be made infrequently. In addition, it is intuitively reasonable that the optimal strategy is to activate when P is sufficiently high, P = P_ah; otherwise, infinite transaction costs would be incurred. Therefore, the value function is thought of as a pair of functions where on represents an active firm V^a, and one for when it is inactive, V^i. The former is defined on the interval $[P_l, \infty)$, the latter on the interval $[0, P_h]$. On the interior of these regions, the value functions satisfy the Feynman-Kac equations:

$$pV^a = P - c + \mu(P)V_P^a + \sigma^2(P)V_{PP}^i \tag{11}$$

$$pV^i = \mu(P)V_P^i + \sigma^2(P)V_{PP}^i \tag{12}$$

At the upper boundary point P_h the firm will enter the market and become active at a cost of I. This is enforced by the value functions which require the switching cost to reach equality: $V^i(P_h)= V^a(P_h)$ - I. At the point P_l when the firm changes from an active to an inactive state, the value function requires: $V^a(P_l)= V^i(P_l)$ - E.

The value matching functions holds when considering arbitrary choices of P_l and P_h. However, optimal choices must satisfy the smooth-pasting conditions as follows:

$$V^i(P_l = V_P^a(P_l)) \tag{13}$$

$$V^i(P_h = V_P^a(P_h)) \tag{14}$$

Due to the nature of the cable industry and the necessity of connectivity, exit is irreversible and its cost is as expensive as the initial investment.

5 Results

6 Conclusion

Appendix A More on data