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Full Length Research Paper

Do supply curves for stocks slope up?

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The classical assumptions and standard models in finance assume a unit of fixed supply for an asset implying a flat supply curve. This paper empirically examines this claim and demonstrates that the supply curve for stocks slopes upward over the period from 1961 to 2008.

Key words: Supply curve slope, CAPM, Lucas exchange tree, JEL classification: G, M2.

INTRODUCTION

There is a common assumption that the supply of a stock is fixed and typically modeled as one unit of total supply. From a historical basis, a fixed supply of capital or stock was a known limitation to any model. Ricardo (1811) in his classic exposition of the quantity theory of money explicitly made his assumption of fixed supply an instant-taneous constraint at any time *t*. Marshall (1890) in his classic description of the basic principles of economics specifically distinguished between a short-term equili-brium in which capital or stock variables are to be considered fixed and a long-term equilibrium in which capital is able to adjust to the forces of supply and demand. These early great writers realized the limitations of any model that utilized the simplifying assumption of fixed supply of a stock variable.

In economics, there is a long tradition of capital growth due to the specific assumption of capital accumulation within many models. This is the standard in macro-growth models. In finance, however, the dependence on the one-period model framework, most notably the CAPM, eliminates capital accumulation. The rise to dominance of the CAPM, starting in the mid 1960's, helped to establish the one-period model as the standard in finance. Thus, by association, the assumption of fixed total supply of an asset became a standard in finance as well. Mossin (1969) was the first to carefully delineate this connection. The assumptions, either explicitly stated or implicitly assumed when using the one-period framework, naturally lead to a fixed supply of a financial asset. The first assumption is that there is only one-period in the model.

Thus, all production is consumed at the end of the period and firms cease to exist. As there is no interme-diate consumption and non-financial assets are assumed not to exist (only risky assets and a risk-free bond are the standard), the total demand for the assets must equal the total wealth endowed in the economy. Finally, market clearing in equilibrium forces the total supply of the asset to equal the total demand of the asset, which has already been assumed to equal the total wealth endowment. Thus, the total supply of the asset is fixed in this one-period setup.

Another classic paper with a flat supply curve is the Lucas (1978) pure exchange economy model. In this framework, production is assumed to be entirely exogenous and to result from a Markov process. Interestingly, Lucas explicitly makes a second assumption that each firm "...has outstanding one perfectly divisible equity share". In a Lucas economy, this assumption is acceptable. In fact, this assumption is redundant and only serves to normalize the fixed supply of the risky asset to one (This is the earliest reference that we have found for the normalization to one of the fixed supply of the risky asset). Production is exogenous and stochastic. Firms will thus not alter production by a change in the investment opportunity set. As such, when the price of a firm's share increases, that is, when its overall cost of capital decreases, the firm will not try to issue new shares to take advantage of newly profitable investment opportunities. Thus, given exogenous and stochastic production, a firm's outstanding equity will be of a fixed total supply.

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LITERATURE REVIEW OF DOWNWARD SLOPING DEMAND

There is an extant empirical literature on the downward sloping demand debate. Work by Harris and Gurel (1986) and Blouin, Raedy and Shackelford (2000) indicate that stocks have a short-term downward sloping demand curve, that is, the price should be momentarily affected by a demand shock due to indexing, but that effect should dissipate once the excess demand is satisfied. That stocks have a long-term downward sloping demand curve with the excess returns permanent is supported by research by Shleifer (1986), Beneish and Whaley (1996), Lynch and Mendenhall (1997), Kaul, Mehrotra and Morck (2000) and Blume and Edelen (2001). These studies utilize major stock index additions and deletions to study this effect. Cha and Lee (2001) and Denis et al. (2003) question the index change study results due to the fact that such price moves could be due to informational effects associated with being included in an index. However, Loderer, Cooney and Van Drunen (1991) and Wurgler and Zhuravskaya (2002) control for information effects and still find downward sloping demand. Probably one of the most interesting results in Wurgler and Zhuravskaya is that they find a surprising lack of substitutability between various assets. For their median stock, they were not able to find "...substitutes that could hedge away even a quarter of the stock's daily return variance."

The claim for downward sloping demand is strengthened as the results are robust across several different methodologies. Mikkelson and Partch (2002) utilize secondary offering and conclude that a large number of shares cannot be sold at the prevailing market price or at a small cost. Asquith and Mullins (1986) study seasoned equity offerings and find support for the hypothesis that there is a downward sloping demand for a firm's shares. Shleifer and Vishny (1997) and Baker and Savasoglu (2002) find empirical support for risk-arbitrage. As pure arbitrage is required in order to maintain flat demand curves for stocks, their results support downward sloping demand. Field and Hanka (2001) study IPO lockup expirations, which are a known event, and find statistically prominent abnormal returns and partial support for downward sloping demand.

There is also the theoretical support for downward sloping demand. If the conditions for perfect markets are not satisfied, e.g.,there is significant imperfect knowledge of future events, then it is possible for the demand curve to slope down under heterogeneous beliefs. Miller (1977) has a two-period model with *N* investors. Differing opinions over the uncertainty leads to a downward sloping demand curve for the risky asset. Vives (1987) formalizes Marshall's (1890) idea that when the proportion of income spent on any commodity is small, then the income effects are small. This leads to a downward sloping demand curve given the number of assets is large. Merton (1987) in an incomplete markets framework with heterogeneous agents finds that securities can have significant downward sloping demand curves.

DATA ANALYSIS

In the modern financial literature, the one-period restriction is usually made for purposes of tractability and to better obtain closed form solutions. However, outside a one-period model, fixed asset supply is far from reality. The supply of assets changes over time and the available supply responds to the current market price. Interestingly, we could find few papers that addressed the slope of the supply curve for financial assets. The one exception, Bagwell (1992) supports this claim; however, Bagwell studies the supply curve faced by firms buying their own shares (Three papers provide indirect support for upward sloping supply curves. Bagwell (1991), Bradley, Desai and Kim (1988) and Brown and Ryngaert (1992) empirically measure the heterogeneity among shareholders for a firm's value. The difference is large and violates the assumptions of perfect markets, which is one of the main assumptions that lead to flat supply curves). This is different than the supply curve in our model in which firms are the supply curve.

We collect data for the S&P500 index stocks, which constitutes approximately 70% of the total traded stocks in the US market. In order to capture the trading activity of firms in their own stock, we use the firm's current number of treasury stock. Treasury stock is reported on the equity section of the firm's balance sheet. By buying and selling from its supply of stock in its treasury, a firm can influence the overall supply of stock to investors on a more short-term basis. Dittmar (2000) studies the reasons why firms trade in their own securities. Nohel and Tarhan (1998) conclude that repurchases are not meant to change the firm's capital structure. Rather they are meant to shrink the current assets of the firm. In the long-term there are many ways for a firm to influence the total supply of its stock. There are warrants, convertible bonds, secondary issues, IPO's and employee stock options, to name a few. To capture this ability of firms to change the total supply of assets to the market, we use two measures. The first is the number of common shares outstanding. This captures the current stock that is actually made available to investors. We also consider the number of common shares used to calculate diluted earnings per share. The difference between shares outstanding and shares diluted is a rough measure of the potential of new shares to enter trading dependent on market conditions (Both measures lead to the same qualitative results. Thus, we report only one set in order to conserve space). Figure 1 demonstrates the empirical evidence in graphical format that the total supply of financial assets is very much not fixed.

METHODOLOGY

Demand is not observable. Thus, the downward sloping demand

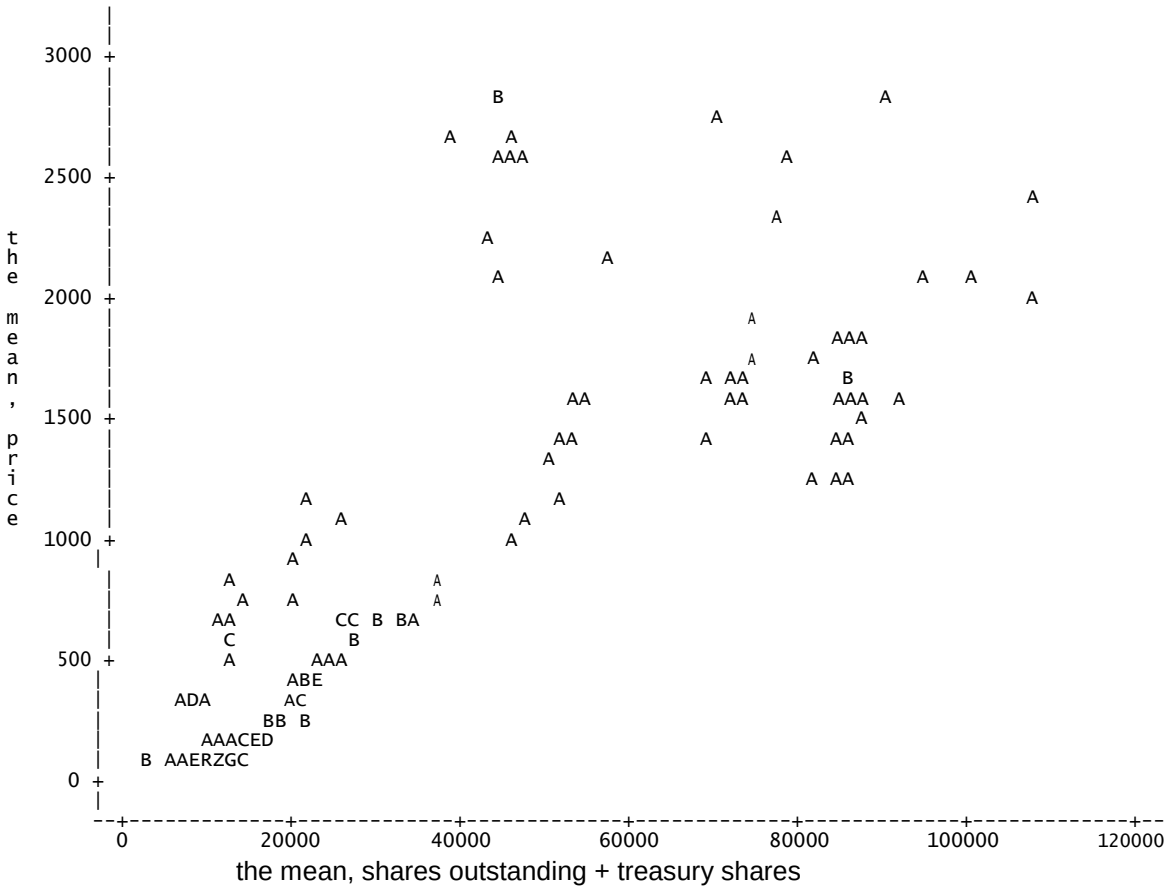

Figure 1. Plot of adjusted price verse adjusted total shares

Quarterly data from 1961 to 2008 for S&P 500 constituent firms.
Legend: A = 1 obs, B = 2 obs, etc.

Note: Short term fluctuations are captured by the firm's current number of treasury stock. Treasury stock is reported on the equity section of the firm's balance sheet. Long-term fluctuations are captured by two measures. The first is the number of common shares outstanding. This captures the current stock that is actually made available to investors. We also consider the number of common shares used to calculate diluted earnings per share. The difference between shares outstanding and shares diluted is a rough measure of the potential of new shares to enter trading dependent on market conditions.

literature attempts to measure the effect of events on the demand curve and measures the impact via market price movements. For example, when a stock is added (subtracted) from an index, an assumption is made that the demand for this stock increases (decreases). Given this assumption, assuming a fixed supply, the price should rise (fall). There is some debate over the validity of this approach (see Cha and Lee, 2001 and Denis et al., 2003).

Supply on the other hand is observable. Each quarter all listed firms file statements that include their activity in the market in their own shares (treasury shares). While demand can come from any agent in the market and the majority of market participants are not under government control and do not have to file quarterly reports, supply of a firm's share can only come from a firm. Thus, all agents that affect the supply curve must file quarterly statements with the SEC. This is the main difference between supply and demand that we exploit in this paper.

We collect raw stock market data from CRSP and accounting/filing data from Compustat. We collect data from January 1961 to December 2008. We link and merge the data sets. Raw data on shares outstanding and price cannot be used. Firms adjust both over time in ways that do not reflect true change. For example, firms may have a target price for their shares. If a share price is too low then bid-ask spread and other market microstructure affects can induce high idiosyncratic volatility. On the other hand, a firm may have a desire to have broad ownership. A low stock price encourages this goal. Thus, a firm must balance the benefits of a low price and the costs of higher volatility leading to an optimal price range. In order to maintain a target price range, firms utilize stock splits. Stock splits are "illusionary" changes in supply, nor do they represent real changes to price. Table 1 gives a simple example of a stock that splits over time, *t*. Note that both price and shares outstanding change over time, yet true ownership rights to

Table 1. Simple example of split adjustment to shares outstanding and price.

T	p	Shrout	Split	Cumulative factor (CS)	p*	Shrout*
1	100	1		100	$p_1(cs_1/cs_1)$	$Shrout_1(cs_1/cs_1)$
2	50	2	2/1	50	$P_2(cs_1/cs_2)$	$Shrout_2(cs_2/cs_1)$
3	10	10	5/1	10	$P_3(cs_1/cs_3)$	$Shrout_3(cs_3/cs_1)$
4	5	20	2/1	5	$P_4(cs_1/cs_4)$	$Shrout_4(cs_4/cs_1)$
5	1	100	5/1	1	$P_5(cs_1/cs_5)$	$Shrout_5(cs_5/cs_1)$

Note: t = Time period.
P = Observed price.
CS = Cumulative adjustment factor for share splits.
Shrout = Actual number of shares owned.
p* = Price adjusted for firm market operations.
Shrout* = Shares owned adjusted for firm market operations.

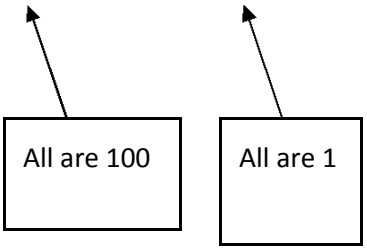

Table 2. Regression result for Q = a + b*Price + e and Q = a + b*Price + c*PPE + e.

	All data		1961 - 1984		1985 - 2008	
a	9688.06***	555.689	9493.008***	8791.582***	14678.000***	-7858.276
Price	28.617***	8.789***	18.447***	-0.808	25.778***	7.237*
PPE		4.667***		1.673**		5.870***

Note: Significance is indicated at the 1% level (***), 5% level (**), and 10% level (*).
Q = Quantity adjusted for firm market operations.
Price = Price adjusted for firm market operations.
PPE = Property, Plant and Equipment (Gross Total)
e = Error term.

firm cash flows are unaffected. The Table demonstrates the correct procedure in order to adjust both shares outstanding and price to account for the illusionary affect induced from stock splits.

Stock splits are not the only adjustments that create illusionary changes to price and shares outstanding. Dividend payments, spin offs, one-time cash distributions, among others create such affects. In order to control for all illusionary affects, we utilize the CRSP cumulative adjustment factors. CRSP maintains a time series of adjustments on a time series basis for both shares outstanding and for price. We implement this cumulative adjustment factor in a manner similar to that portrayed in Table 1. Unlike our example, the cumulative factors differ for shares outstanding and for price. For example, dividends affect price, but not shares outstanding. CRSP provides the appropriate adjustment factor for each variable.

After calculating the adjusted shares outstanding (adj_shr) and the adjusted price (adj_pr), we then aggregate for each date across all firms the average shares outstanding and the average price. Since the number of firms is fixed (500), the average is proportional to the total supply. For each date we utilize the list of firms that belonged to the S&P500 at that specific time (We also ran our tests for a fixed set of firms by choosing the list of firms belonging to the Russell 1000 at a specific date. The firms in this list accounted for about 94% of the market cap. We found similar results with this methodology. A potential drawback to this approach is that the Russell index level does not perfectly reflect the price level of the sample of firms used to collect share information. Our results are robust to either approach). Thus, we construct a time series of adj_shr and adj_pr on a quarterly basis. We run our regressions on this constructed date series. Table 2 contains the regression results. Firm shares are the dependent variable. Quantity may grow for reasons other than increase in price (lower cost of capital). For example, if a firm expands, then it may need to issue more shares to fund this expansion and to maintain a target debt/equity ratio. We use gross total property, plant and equipment (PPE) as a control for this affect. In the most reliable tests, that is, using all the available data, our results hold up to the inclusion of *PPE*. The coefficient on adj_pr is positive and significant at the 1% level. We then conduct a subperiod analysis as a robustness test to ensure that our results are not period specific. We divide the sample into two equal periods each of 23 years. Our results are robust to the subperiod analysis in that price still has a positive and significant coefficient in the second subperiod (1985 - 2008). However, in the first subperiod (1961 - 1984), the coefficient is insignificant. Overall, in 5 out of 6 specifications the coefficient on adj_pr is significant and positive.

Conclusion

It is common in finance to assume a flat demand curve and a unit of fixed supply for a stock. This can be forced by the assumptions of the underlying model, e.g., exogenous supply, or this can be a necessity to make computations tractable. However, in the real world, production is not exogenous, nor is it random. Firms do observe and react to the current market price of their

traded shares. IPO's, secondary issues, stock options and treasury stock all exist and affect the current supply of stock in the market that is available to investors.

REFERENCES

Asquith P, Mullins Jr. DW (1986). "Equity issues and offering dilution", J. Finan. Econo. 15(1-2): 61-89.

Baker M, Savasoglu S (2002). "Limited arbitrage in mergers and acquisitions", J. Fin. Econ. 64(1):91-115.

Bagwell LS (1991). "Shareholder heterogeneity: Evidence and implications", Am. Econ. Rev. 81(2): 218-221.

Bagwell LS (1992). "Dutch auction repurchases: An analysis of shareholder heterogeneity", J. Finan. 47(1): 71-105.

Beneish MD, Whaley RE (1996). "An anatomy of the S&P 500 Game: The effects of changing the rules", J. Finan. 51(5): 1909-1930.

Blouin J, Ready J, Shackelford D (2000). "The impact of capital gains taxes on stock price reactions to S&P 500 inclusion", NBER Working paper, No. 8011.

Blume M, Edelen R (2001). "On S&P 500 index replication strategies", University of Pennsylvania Working paper.

Bradley M, Desai A, Kim EH (1988). "Synergistic gains from corporate acquisitions and their division between the stockholders of target and acquiring firms", J. Finan. Econ. 21(1), 3-40.

Brown DT, Ryngaert MD (1992). "The determinants of tendering rates in interfirm and self-tender offers", J. Bus. 65 (4): 529-556.

Cha HJ, Lee BS (2001). "The market demand curve for common stocks: evidence from equity mutual fund flows", J. Finan. Quant. Anal. 36 (2): 195-220.

Denis DK, McConnell JJ, Ovtchinnikov AV, Yu Y (2003). "S&P 500 index additions and earnings expectations", J. Finan. 58 (5): 1821-1840.

Dittmar AK (2000). "Why do firms repurchase stock?". J. Bus. 73(3): 331-355.

Field LC, Hanka G (2001). "The expiration of IPO share lockups", J. Finan. 56 (2): 471-500.

Harris L, Gurel E (1986), "Price and volume effects associated with changes in the S&P 500: New evidence for the existence of price pressures", J. Finan. 41 (4): 815-830.

Kaul A, Mehrotra V, Morck R (2000). "Demand curves for stocks do slope down: New evidence from an index weights adjustment", J. Finan. 55(2): 893-912.

Loderer C, Cooney JC, Van Drunen LD (1991). "The price elasticity of demand for common stock", J. Finan. 46 (2): 621-651.

Lucas RE, Jr (1978). "Asset prices in an exchange economy", Econometrica 46(6): 1429-1445.

Lynch AW, Mendenhall RR (1997). "New evidence on stock price effects associated with changes in the S&P 500 index", J. Bus. 70 (3): 351-383.

Marshall A (1890). Principles of Economics, Macmillan and Co., NY, NY.

Merton RC (1987). "A simple model of capital market equilibrium with incomplete information", J. Fin. 42(3): 483-510.

Mikkelson WH, Partch MM (2002). "Stock price effects and costs of secondary distributions", J. Finan. Econ. 14 (2): 165-194.

Miller EM (1977). "Risk, uncertainty, and divergence of opinion", J. Fin. 32(4): 1151-1168.

Mossin J (1969). "Equilibrium in a capital asset market", Econometrica 34(4): 768-783.

Nohel T, Tarhan V (1998), "Share repurchases and firm performance: new evidence on the agency costs of free cash flow", J. Finan. Econ. 49(2): 187-222.

Ricardo D (1811). Reply to Mr. Bosanquet's practical observations on the report of the bullion committee.

Shleifer A (1986), "Do demand curves for stocks slope down?", J. Finan. 4 (3): 579-590.

Shleifer A, Vishny R (1997). "The limits to arbitrage", J. Fin. 52(1): 35-55.

Vives X (1987). "Small income effects: A Marshallian theory of consumer surplus and downward sloping demand", Rev. Econ. Stud. 54(177): 87-103.

Wurgler J, Zhuravskaya E (2002). "Does arbitrage flatten demand curves for stocks?" J. Bus. 75(4): 583-608.