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Demand Curves for European Stocks Slope Down Too

Evidence from Float-Capitalization Index Weights In Dow Jones STOXX 50

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Abstract. The 2000 implementation of float-capitalization index weights in the Dow Jones STOXX^{SM} indices changed the demand for large European stocks. In this paper, we test for imperfect-substitution and price-pressure effects due to the change in the demand for stocks. Our results show that we cannot reject complete reversal after eight weeks of abnormal trading volume for companies with both decreased or increased index weights. This result is consistent with the existence of downward sloping demand curves for stocks. Contrary to the fundamental assumption of perfectly elastic demand curves in asset pricing theories, our findings suggest that a price pressure effect is not a plausible explanation.

Key words: downward sloping demand curves, float capitalization, imperfect substitution, index weights, liquidity effects, price pressure

JEL classification codes: G11; G14

1. Introduction

On July 3, 2000, the Dow Jones STOXX^{SM} announced a change from using market capitalization (market weights) to float-capitalization index weights (float weights).[1] The change went into effect on Monday September 18, 2000. The

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[1] The Dow Jones STOXX^{SM} Limited is a joint venture of Deutsche Börse AG, Dow Jones and Company, ParisBounce^{SBF} SA, and Swiss Exchange SWX. The Dow Jones STOXX^{SM} indexes were launched on February 26, 1998, and they were created in anticipation of the European Monetary

decision to use float weights marked the beginning of a large-scale portfolio rebalancing, which affected a wide range of large European blue chip stocks. The implementation of float weights was fully anticipated by the marketplace. Thus, STOXX's decision provides a "natural laboratory" to investigate the price elasticity of the demand curves for stocks. This paper examines the implementation of float weights in Dow Jones Europe STOXX 50 (STOXX 50), using a similar method as applied in Harris and Gurel (1986) and Kaul et al. (2000).

The change in the calculation method of the index weights should not affect stock prices if stocks have perfect substitutes as assumed by APT and other asset pricing theories. However, the portfolio rebalancing gave rise to significant abnormal returns and volumes. The September 2000 implementation is associated with a drop of 0.59 percent for low-float companies in mean index weight while high-float companies experienced a 0.30 percent increase in mean index weight. The abnormal returns around the implementation of float weights are negative 1.33 percent for low-float companies and positive 0.50 percent for high-float companies. More importantly, high-float companies experienced a run-up in prices and the price level did not seem to adjust to the pre-event level. Price-reversal is not supported by a test that regresses post-event period cumulative abnormal returns on long-event period cumulative abnormal returns. Cross-sectional tests show that both abnormal returns and abnormal volume are positively related to changes in the demand for stocks. Taken together, these findings are difficult to reconcile with the assumption that any stock has an infinite number of perfect substitutes. Instead, our findings suggest that demand curves slope down for European blue chip stocks.

The paper is organized as follows: Section 2 presents the background on STOXX's decision to implement float weights; Section 3 discusses the hypotheses and the prior literature; Section 4 describes the data and the methodology; Section 5 presents the empirical findings; and Section 6 concludes.

2. Float Capitalization Index Weights

During the second half of 1999 and the first half of 2000, a number of European companies (particularly in the telecommunications and the media sector) decided to spin off parts of their organization and privatize them with a relatively low float. Portfolio managers and index trackers became forced buyers of these newly spun-off companies. Therefore, indices had to consider whether or not the equity index components should represent stocks that are easily traded. Several other national

Union in 1999. The European Monetary Union introduced a number of transition effects such as removing legal restraints on European institutions making investments in non-domestic markets, accelerated cross-border consolidation, and increased the integration of the European equity markets. For institutional investors and pension funds, the Dow Jones STOXX^{SM} indexes provide tradable and OTC index-based products that accurately track European equity index performances. OTC index-based products include derivatives, exchange traded funds, and index certification.

European indexes simultaneously implemented float weights.[2] Moreover, MSCI, which dominates the benchmarking industry in Europe, also decided to switch to float weights.

The concept of float weights is not new: the Salomon Smith Barney Global Equity Index was the first index to implement it in 1989. The primary reason for implementing float weights is that the shares of some companies in market-weighted indices are significantly overstated. The argument is that if an index is not adjusted for block holdings or cross-holdings, companies with low actual floats are over-weighted at the expense of companies with high public floats. Michael Schanz, managing director of the Dow Jones STOXX^{SM}, argued that the implementation of the float weights would enable investors to compare the performance of different European equity markets including relevant sub-regions and market sectors. The implementation of float weights also meets the objective of the Dow Jones STOXX^{SM} to provide a measure for comparing the performance of European stock markets.

The Dow Jones STOXX^{SM} defines float capitalization as the number of shares that are not held in block ownership. Holdings that exceed five percent of the total number of outstanding shares are considered block ownership. The majority of block ownership holdings are stocks held by governments, cross holdings between companies, and private ownership. Stock holdings by investors that are assumed to take part in active trading, including institutional investors, investment companies, and custodian holdings, are excluded. Based on this definition of float capitalization, the market weights of several companies equal their float weights.

The change to float weights matters particularly to traders, portfolio managers, investment managers, and hedge funds. Traders and portfolio managers who actively trade securities in the index need to anticipate buying and selling pressure. Investment managers and hedge funds may attempt to profit from price and volume effects around the implementation of float weights. The implementation of float weights changes the demand and the trading volume for affected stocks for several reasons. First, index funds and index trackers invest in the index stocks proportional to their index weights. A change to float capitalization means that index funds must sell low-float companies and purchase high-float companies. Second, the Dow Jones STOXX^{SM} is used as a benchmark for active portfolio managers. This provides investors with the incentive to directly replicate the index weights in the index stocks. Third, the stocks in the STOXX 50 are the most liquid and actively traded in their sectors. This may induce foreign investors to follow the index and thereby change the demand for the stocks. Fourth, futures and options are traded on the STOXX 50. Hedging these derivative instruments leads to an increase in the

[2] For example, on April 18, 2000, Sociedad de Bolsas in Madrid, which compiles the Spanish IBEX index, announced a rule that limits the weighting to 60 percent if a company's free float is less than 40 percent. FTSE International applied a system with multiples of 25 percent starting in January 2000.

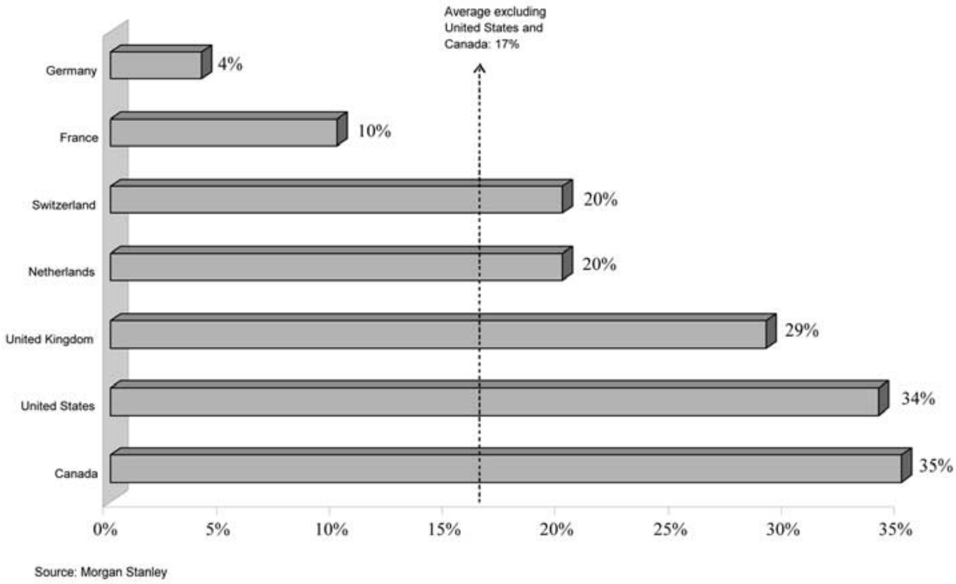

Figure 1. Proportion of Equity Assets Managed Passively as of December 31, 2000.

trading activities in the stocks (Bechmann, 2001). If the change in demand causes a permanent price effect, it follows that the demand curve for stocks slopes down.

Shleifer (1986) and Kaul et al. (2000) found that the price effect is permanent in the United States and Canada, which can be partially explained because of an active market for index funds and index trackers. However, our results are interesting because indexing appears to be less important in the European indices compared to the United States indices.

Figure 1 shows the proportion of passively managed equity assets in selected European countries, the United States, and Canada as of December 31, 2000. The figure suggests that indexing is more common among Anglo-Saxon countries than elsewhere. As of December 31, 2000, index funds in the United Kingdom, the United States, and Canada held 29%, 34%, and 35% of equity assets, respectively, whereas index funds in continental European countries held between 4% (Germany) and 20% (The Netherlands). On average, 19% of the STOXX 50 index is held by index funds compared with 17% for all the European countries.

3. Prior Research

The efficient market hypothesis states that current stock prices reflect all publicly available information and implies that stock prices are perfectly elastic and unrelated to the supply of stocks as long as some investors do not have superior or private information. Scholes (1972) argues that the market prices of stocks are based on their risks such that the expected risk-adjusted rates of return are equal.

The equilibrium prices are achieved, for example, through risk-averse arbitrage by buying (selling) the under priced (overpriced) stock and simultaneously shorting a perfect substitute. This strategy keeps individual stocks' demand curves flat and shields prices from any uninformed shifts in demand. However, most individual stocks do not have perfect substitutes. Empirical evidence is more consistent with alternative hypotheses that attempt to explain price effects such as (1) the price-pressure effect or (2) the imperfect-substitution effect, (3) information effect, and (4) selection bias. Since no new information is revealed and we excluded additions and deletions, we can disregard any information effects and the certification effects. Consequently, our analysis is focused on the price-pressure and imperfect-substitution effects.

The price-pressure models suggest that transitory order imbalances associated with a change to float weights would be the primary source of price movements. The price pressure is temporary due to the price premium dealers and market makers charge to accommodate a large imbalance from their own inventory. Market makers supplying stocks to accommodate the change in demand are compensated for the transaction costs and portfolio risk in the form of temporary price changes for the affected stocks. The equilibrium value of stocks quickly reverts to normal levels. Imperfect-substitution models assume a permanent downward sloping demand curve for stocks because securities are not perfect substitutes for each other. An increase (decrease) in demand (supply) drives the prices of stock up given the supply for any particular security.

Empirical findings document significant positive stock price reactions in response to additions, and negative stock price reactions in response to deletions, from major indexes. Harris and Gurel (1986) and Shleifer (1986) provide two of the first studies of price effects analyzing the S&P 500 index. Harris and Gurel (1986) find temporary price pressure and full reversion to normal levels within two weeks. Shleifer (1986) finds a permanent increase in the prices of stocks that are added to the S&P. Beneish and Whaley (1996) and Lynch and Mendenhall (1997) examine the price effects surrounding the announcement instead of the implementation of changes to the S&P 500. They show that price effects take place between the announcement date and the implementation date. However, they find no evidence of a permanent increase in stock prices. Pruitt and Wei (1989) find that institutional investors rebalance their portfolios around changes to the S&P 500. Their results suggest that institutional investors' trading volume is a potential source of the price pressure. Other studies conclude that excess returns exist due to favorable information because major index providers such as S&P serve a certification role. Dhillon and Johnson (1991) show that the addition of a company's stock to the S&P 500 index generates a permanent stock price effect and volume effect to both the company's equity and its debt. This result is difficult to reconcile with price-pressure effects. They also find that the prices of call options on a stock that gets added to the S&P 500 increase while the prices of put options decrease. This suggests that an increasing liquidity and/or decreasing information cost cause the price effects. Similarly, Jain (1987) reports a positive abnormal return related to inclusion in a supplementary index that is distinct from the S&P 500. The magnitude of the impact is similar to the magnitude of the excess returns for stocks added to the S&P 500. Jain's results suggest that temporary price pressure does not explain return anomalies. Therefore, imperfect-substitution effects are left as the only possible explanation for downward sloping demand curves for stocks. Despite the fact that Brealey (2000) finds little evidence of permanent price effects in the FTSE All-Share Index.

4. Data and Methodology

4.1. DATA

On July 3, 2000, Dow Jones STOXX^{SM} announced its decision to implement float weights for its benchmark indices effective September 18, 2000. The decision marked the beginning of a large-scale portfolio rebalancing effort, which affected a wide range of large European stocks. Since the STOXX 50 consists of large European blue chip stocks, it appears possible that they are perfect substitutes and therefore the implementation should have no permanent impact on stock prices. However, the rebalancing will affect the allocation of portfolios between sectors and countries. For example, some countries like Finland (Nokia), Sweden (Ericsson), United Kingdom (Shell), and Switzerland (Nestle) will gain as a result of increased demand due to the increase in index weights. While France (France Telecom), Germany (Deutsche Telecom), and Italy (Telecom Italia) will be hurt because of decreased demand due to the decrease in index weights (see appendix A).

Table I provides summary statistics on the change to float weights for the companies in the STOXX 50. The change in index weights increases the demand for the stocks of high-float companies and decreases the demand for the stocks of companies whose index weights are lowered. We exclude three stocks from the STOXX 50 due to the revisions announced on August 15, 2000.[3] The three stocks are excluded from the analysis in order to avoid certification effects related to the revision decision. Daily security prices and daily volume are gathered from Datastream.

We expect that the demand for stocks will decrease (increase) for low-float (high-float) companies. This decrease (increase) in demand is caused by index funds rebalancing their portfolios, which leads to an increase in trading activities surrounding the change to float capitalization. For the low-float companies, the mean public float decreases to 62.02 percent while the median float decreases to 63.00 percent. The public floats for large telecommunications companies are, for

[3] On August 15, 2000, the following companies were added to STOXX 50: AstraZeneca (Great Britain), BNP (France) and CGNU (Great Britain) while the following companies were deleted: Enel (Italy), KPN (Netherlands) and Unilever (Netherlands).

Table I. Float and index weight changes in Dow Jones Europe STOXX 50. On September 18, 2000, the Dow Jones STOXXSM implemented float weights. Float denotes the number of shares not held by block ownership. Pre-float and post-float index weights measure the weight in Dow Jones STOXXSM. The low-float group represents the firms that experienced a reduction in index weight. The high-float group consists of the firms that experienced an increase in index weight. p-values for change in pre-float capitalization to post-float capitalization are in parentheses

	Mean	First quartile	Median	Third quartile
Low float (N = 13)				
Pre-float firm size	74,118	54,934	58,333	85,018
(Million Euro)				
Post-float firm size	42,523	34,623b	45,333	51,939
(Million Euro)				
Float	62.02%	44.98%	63.00%	80.66%
Pre-float index weights	1.74%	1.31%	1.39%	1.78%
Post-float index weights	1.15%	0.94%	1.23%	1.41%
Change	−0.59%	−0.37%	−0.16%	−0.37%
	(0.0063)***		(0.0870)*	
High float (N = 34)				
Pre-float firm size	94,266	54,907	75,832	113,553
(Million Euro)				
Post-float firm size	92,316	54,592	75,832	112,829
Float	97.44%	93.89%	100.00%	100.00%
Pre-float index weights	2.20%	1.24%	1.69%	2.70%
Post-float index weights	2.50%	1.48%	2.05%	3.06%
Change	0.30%	0.24%	0.37%	0.35%
	(0.0000)***		(0.0000)***	
All firms (N = 47)				
Pre-float firm size	88,693	54,832	68,602	104,485
(Million Euro)				
Post-float firm size	78,543	41,061	56,444	94,475
(Million Euro)				
Float	87.64%	83.73%	100.00%	100.00%
Pre-float index weights	2.07%	1.28%	1.63%	2.47%
Post-float index weights	2.13%	1.11%	1.53%	2.56%
Change	0.06%	−0.17%	−0.10%	0.09%
	(0.5007)		(0.4037)	

**, * denotes significance at the 1 percent and 10 percent level, respectively.

example: 41 percent (Deutsche Telecom), 34 percent (France Telecom), and 45 percent (Telecom Italia). This change in public float translates into large decreases (increases) in the individual index weights.

Table I shows that the mean index weight decreased on average by negative 0.59 percent for low-float companies. On the other hand, high-float companies experienced a mean index weight increase of 0.30 percent. Using a test for mean differences between pre- and post-index weights, we show in Table I that both low-float and high-float companies experienced a significant change in index weights. Also, note that the mean size of the low-float companies decreased from 74 billion to 42 billion Euro. Therefore, we expect stock prices to have decreased (increased) for low-float (high-float) companies. A decrease (increase) in demand by index funds for low-float (high-float) companies makes it possible to measure price pressure effects. Moreover, because the change to float weights was announced three months prior to the implementation, it is the absence of new information that makes it possible to test whether or not the demand curve for stocks in reality slopes down.

4.2. METHODOLOGY

To estimate the price effect, we calculate abnormal returns using the market model (Brown and Warner, 1985). The market model makes use of security-specific information to estimate the expected event-period return. However, because there may be cross-correlation between companies, we apply the methodology suggested by Campbell et al. (1997). In the market model, the return on stock i at day τ is:

$$R_{i\tau} = \alpha_i + \beta_i \cdot R_{m\tau} + \epsilon_{i\tau}, \tag{1}$$

where $R_{m\tau}$ is the return of an appropriate market index on day τ. The respective national (country) market index for each individual security i is used as a benchmark to estimate the market model parameters for most companies. However, Nokia and Ericsson dominated their national market indices at the time. To overcome this problem, we estimate β_i using Bloomberg's sub-sector indices to capture the cross-sectional variation in the major pan-European sectors. Assuming that $E(\epsilon_{i\tau} \mid R_{m\tau}) = 0$, the abnormal return ($\mathrm{AR}_{i\tau}$) for security i at day τ is estimated as:

$$\mathrm{AR}_{i\tau} = R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i \cdot R_{m\tau}, \tag{2}$$

where α and β are the ordinary least squares regression estimates of the market model parameters for security i over the 200 day trading period starting 220 days before the implementation. Then, we calculate the average abnormal return (AAR) at time τ and the average cumulative abnormal return from τ_1 to τ_2.

Figure 2 shows the market adjusted cumulative average abnormal return from June 2, 2000 to December 8, 2000. Between the announcement date and the implementation date, high-float companies' cumulative average abnormal return is higher than that for low-float companies. The figure indicates a run-up for high-float firms, suggesting a permanent shift in the price level rather than a price-pressure effect.

We estimate abnormal returns over two event windows to test for price-pressure effects and imperfect-substitution effects. First, we calculate abnormal returns over a short-event window around the implementation date. The advantage of a short-event window is that we are able to detect the existence of a price-pressure reversal. Such an effect should occur within days of the implementation date – as soon as the volume returns to normal. The disadvantage of this short-event window is that we are not able to identify whether the reversal is complete. We therefore also estimate abnormal returns over a long-event window, stretching from the announcement date to the implementation date. Using this longer event window allows us to test whether any reversal is complete. However, extending the length of the event window leads to a diminishing statistical power. Sections 5.1 and 5.2 present the results using, respectively, the short-event window and the long-event window.

To examine the trading activity in index funds around the implementation of float weights, we apply the methodology proposed in Harris and Gurel (1986). The mean cross-sectional trading volume (in million Euro) is adjusted for market volume and calculated as follows:

$$\mathrm{MVR}_\tau = \frac{1}{N} \cdot \sum_{i=1}^{N} \mathrm{VR}_{i\tau}, \tag{3}$$

where

$$\mathrm{VR}_{i\tau} = \frac{V_{i\tau}}{V_{m\tau}} \cdot \frac{V_m}{V_i}, \tag{4}$$

where $V_{i\tau}$ is the trading volume of security i on day τ as a fraction of its shares outstanding on the same day, and $V_{m\tau}$ is the trading volume of the STOXX 50 index on day τ. V_i and V_m are the average "normal" trading volumes of the security and the STOXX 50 index during April, May, and June 2000. This period is chosen because it precedes the surfacing of the first rumors of the change to float weights. The market adjusted mean volume ratio, $\mathrm{MVR}_{i\tau}$, is a standardized measure of event-period trading volume adjusted for variation in both shares outstanding and the market. If the implementation of float weights has no impact on volume, the expected level of the volume ratio, $\mathrm{VR}_{i\tau}$, is equal to one.

5. Empirical Results

5.1. ABNORMAL RETURN AND MEAN VOLUME RATIO

Table II summarizes the abnormal returns and the mean volume ratio around the implementation of float weights for both low-float and high-float companies. The

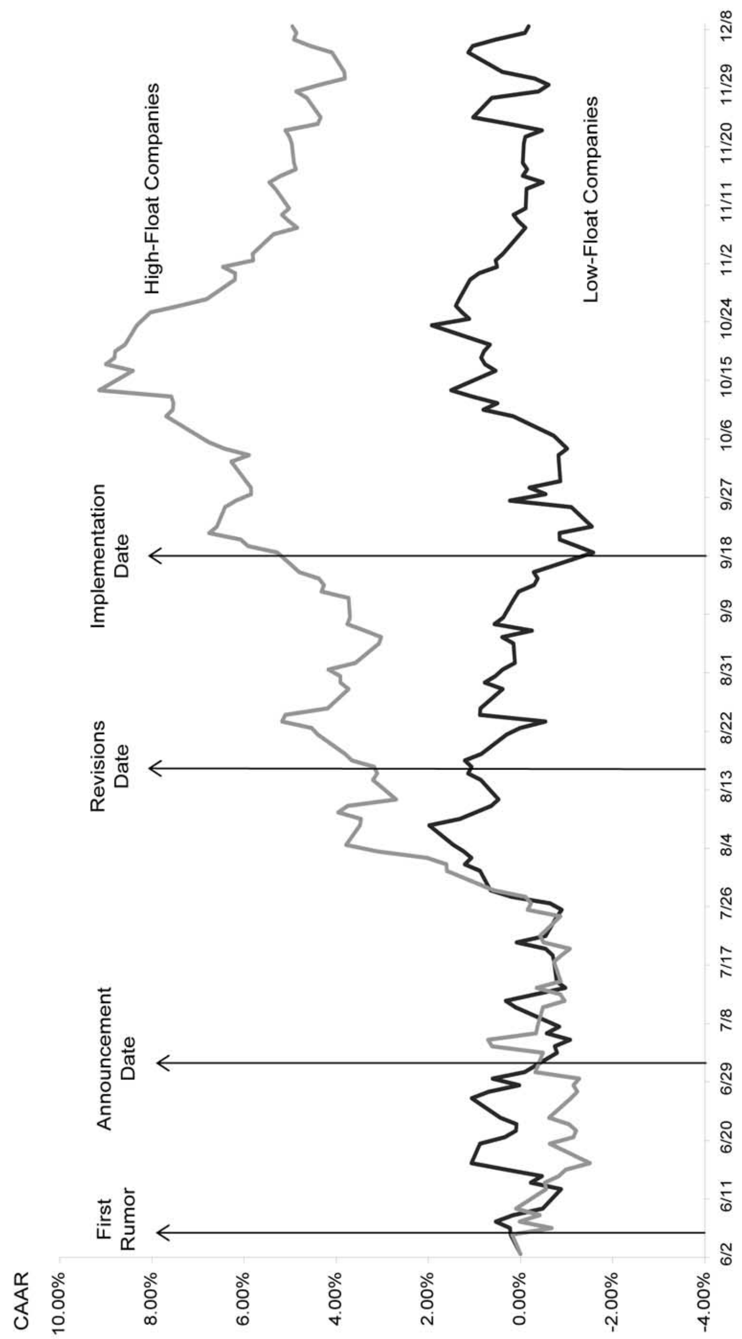

Figure 2. Cumulative average abnormal return for low-float and high-float companies between June 2, 2000 and December 8, 2000.

abnormal return on September 15, 2000, the day before the implementation, is negative 1.23 percent for low-float companies and positive 0.28 percent for high-float companies. The negative (positive) abnormal return for low-float (high-float) companies is consistent with the expectation of the decrease (increase) in demand for stocks. However, interestingly, it is only the decrease in demand for stocks of low-float companies that is statistically significant. Another observation is that the cumulative abnormal return is negative (positive) a few days around the implementation and positive (negative) a few days after the implementation. The cumulative abnormal return between 10 days before to 10 days after the implementation of float weights is negative 1.88 percent and positive 0.76 percent, respectively, for low-float and high-float companies. The results in Table II suggest that stock prices decrease when index weights decrease in the STOXX 50. Similarly, stock prices increase when index weights increase. The results using a short-event window are consistent with price-pressure effects, although whether price-pressure effects offer a full explanation remains to be checked.

Table II also summarizes the market adjusted mean volume ratio, $MVR_{i\tau}$.[4] If the implementation of float market capitalization index weights does not affect volume, the volume ratio, $VR_{i\tau}$, will equal one. For low-float (high-float) companies, the mean volume ratio is 124 percent (119 percent) higher than normal the day prior to the implementation. The mean volume ratio indicates that the daily volume returns to normal levels within the event week. This suggests that the stock prices of low-float companies and high-float companies should make a complete reversal to normal levels within the same time period. To determine if this is the case, the next section examines price reversals.

5.2. TESTING FOR PRICE REVERSALS

Price-pressure effects imply that positive (negative) abnormal returns over the rebalancing period should be offset by subsequent negative (positive) abnormal returns of equal magnitude. This is because suppliers of liquidity can demand higher prices during temporary surges in demand by index funds following the implementation of float weights. However, as soon as rebalancing is completed, the stock prices should return to normal levels. To detect whether a reversal is complete, we use the long-event window of abnormal returns.

Table III summarizes the market adjusted mean volume ratio for low-float companies and high-float companies between July 3, 2000 and November 24, 2000. We calculate each company's abnormal volume by adjusting for the mean market volume. For low-float companies abnormal volume is 15.07 percent above normal during the event week, while for high-float companies, abnormal volume is 18.70 percent above normal. Interestingly, during the week before the event week, low-float companies experience a 5.36 percent higher volume. However, the

[4] Note, we show the raw volume ratio, and not the natural log, because the fifty STOXX 50 companies are rather homogenous in terms of size and trading volumes.

Table II. Price and volume effects around the implementation of float weights. On September 18, 2000, the Dow Jones STOXX^{SM} implemented float weights. The low-float group represents the companies that experienced a reduction in index weight. The high-float group consists of the companies that experienced an increase in index weight. The parameter estimates from the market model are used to calculate the abnormal returns for each day in the event period 10 before to 10 after the implementation of public float. The market adjusted mean volume ratio is calculated using the methodology proposed in Harris and Gurel (1986). The trading volume in Euro is used to calculate the mean volume ratio

	Price effect				Mean volume ratio			
Event period	Low-float companies		High-float companies		Low-float companies		High-float companies	
Days	AR	t-value	AR	t-value	MVR	t-value	MVR	t-value
−10	0.27%	0.48	0.09%	0.25	1.96	1.47	1.57	0.80
−9	−0.65%	−1.17	0.15%	0.42	1.38	0.59	1.67	0.94
−8	0.76%	1.36	0.29%	0.84	1.49	0.75	2.14	1.60
−7	−0.23%	−0.40	0.01%	0.04	1.56	0.87	1.49	0.69
−6	−0.26%	−0.46	−0.22%	−0.62	1.53	0.82	1.75	1.05
−5	−0.11%	−0.19	0.57%	1.66*	1.05	0.08	0.98	−0.03
−4	−0.49%	−0.87	−0.14%	−0.39	1.68	1.05	1.64	0.90
−3	−0.08%	−0.14	−0.10%	−0.28	1.24	0.36	1.46	0.63
−2	0.02%	0.04	0.47%	1.34	1.51	0.78	1.51	0.71
−1	−1.23%	−2.20**	0.28%	0.80	2.24	1.90**	2.19	1.66*
0	−0.49%	−0.87	0.16%	0.47	1.66	1.01	1.50	0.69
1	0.38%	0.68	0.06%	0.17	1.68	1.05	1.73	1.01
2	0.07%	0.12	0.33%	0.97	1.47	0.73	1.47	0.66
3	−0.67%	−1.20	−0.45%	−1.30	1.69	1.07	1.33	0.46
4	0.39%	0.69	−0.12%	−0.35	1.58	0.89	1.74	1.04
5	1.35%	2.43**	−0.16%	−0.48	1.28	0.43	1.22	0.31
6	−0.81%	−1.45	−0.44%	−1.28	1.64	0.99	1.42	0.59
7	0.39%	0.69	0.02%	0.07	1.52	0.79	1.56	0.78

Table II. Continued

Event period	Price effect				Mean volume ratio			
	Low-float companies		High-float companies		Low-float companies		High-float companies	
Days	AR	t-value	AR	t-value	MVR	t-value	MVR	t-value
8	−0.58%	−1.04	0.00%	0.00	1.76	1.16	1.30	0.41
9	0.07%	0.13	0.28%	0.81	1.64	0.99	1.83	1.16
10	0.01%	0.01	−0.32%	−0.93	1.43	0.67	1.98	1.37
(−1:+1)	−1.33%	−1.38	0.50%	0.83	1.32	0.48	1.32	0.50
(−5:+5)	−0.84%	−0.46	0.90%	0.78	1.09	0.06	1.00	0.02
(−10:+10)	−1.88%	−0.73	0.78%	0.48	1.10	0.19	1.04	0.04

**,* denotes significance at the 5-percent and 10-percent levels, respectively.

Table III. Mean volume ratio around the implementation of float capitalization. On September 18, 2000, the Dow Jones STOXX^{SM} implemented float weights. Pre-float and post-float index weights measures the weights in Dow Jones STOXX^{SM}. The low-float group represents the companies that experienced a reduction in index weight. The high-float group consists of the companies that experienced an increase in index weight. The week ending September 15, 2000 is designated week 0. The market adjusted mean volume ratio is calculated using the methodology proposed in Harris and Gurel (1986). The trading volume in Euro is used to calculate the mean volume ratio

Week	Mean volume ratio				
	Period	High-float companies	Low-float companies	Difference	t-test
Week −10	3/7/00–7/7/00	1.0779	0.8367	−0.2412	1.7870*
Week −9	10/7/00–14/7/00	1.1591	0.9008	−0.2583	1.2934
Week −8	17/7/00–21/7/00	1.0416	1.0480	0.0064	0.0430
Week −7	24/7/00–28/7/00	1.1236	1.3160	0.1923	0.6650
Week −6	31/7/00–4/8/00	1.1398	1.1221	−0.0177	0.0878
Week −5	7/8/00–11/8/00	0.9987	0.8916	−0.1071	0.7489
Week −4	14/8/00–18/8/00	0.9819	0.8125	−0.1694	1.2535
Week −3	21/8/00–25/8/00	0.9534	1.0591	0.1057	0.7736
Week −2	28/8/00–1/9/00	1.0049	0.9914	−0.0135	0.0847
Week −1	4/9/00–8/9/00	0.9053	0.9589	0.0536	0.4352
Week 0	11/9/00–15/9/00	1.1870	1.1507	−0.0363	0.2152
Week +1	18/9/00–22/9/00	1.2268	1.0863	−0.1405	0.9615
Week +2	25/9/00–29/9/00	1.1982	1.0684	−0.1297	0.9342
Week +3	2/10/00–6/10/00	1.2148	1.0586	−0.1562	1.1221
Week +4	9/10/00–13/10/00	1.2640	1.0731	−0.1909	1.2933
Week +5	16/10/00–20/10/00	1.2508	1.0579	−0.1930	1.3033
Week +6	23/10/00–27/10/00	1.1916	1.0507	−0.1409	1.1147
Week +7	30/10/00–3/11/00	1.1885	1.1421	−0.0465	0.3382
Week +8	6/11/00–10/11/00	1.1806	1.1476	−0.0330	0.2234
Week +9	13/11/00–17/11/00	1.2348	1.1101	−0.1247	0.8516
Week +10	20/11/00–24/11/00	1.3277	1.1014	−0.2263	1.1925

* denotes significance at the 10-percent level.

mean difference between abnormal return for low-float companies and high-float companies is not significant at any level.

The high abnormal volume after week −1 is consistent with fund managers spreading their trades over a number of trading days to reduce the possibility that the decreasing (increasing) demand for low-float (high-float) companies will affect stock prices. The decrease in index weights for low-float companies would explain the lower abnormal volume compared to high-float companies that experienced a positive increase in index weights. Since the positive abnormal volume in week

Table IV. Price pressure test of return reversal
The following regression is estimated for varying post-implementation of public float weights.

$$\mathrm{CAR}_{i,1-\tau} = \alpha + \beta \cdot \mathrm{CAR}_{i,0} + \epsilon_{i,1-\tau}.$$

The dependent variable, $\mathrm{CAR}_{i,1-\tau}$ is the cumulative abnormal stock return beginning in week 1 through week $+\tau$ inclusive. The independent variable, $\mathrm{CAR}_{i,0}$, is the cumulative abnormal return between the announcement date (July 3, 2000) and the implementation date (September 18, 2000). The week ending on September 15, 2000, is designated week 0. The implementation of float weights in the Dow Jones STOXX$^{\mathrm{SM}}$ became effective on September 18, 2000. The coefficient on $\mathrm{CAR}_{i,0}$ equals negative one for high-float companies under the price pressure prediction of complete reversals. The coefficient on $\mathrm{CAR}_{i,0}$ equals zero under the hypothesis of no reversals

Dependent variable	Coefficient and standard deviation			Coefficient tests		
	α	β	σ	$\beta = 0$	$\beta = -1$	R^2
$\mathrm{CAR}_{i,1-1}$	0.003	−0.090	0.052	0.187	0.000***	0.038
$\mathrm{CAR}_{i,1-2}$	0.004	−0.131	0.040	0.013**	0.000***	0.129
$\mathrm{CAR}_{i,1-3}$	0.014	−0.128	0.050	0.055	0.000***	0.080
$\mathrm{CAR}_{i,1-4}$	0.020	−0.249	0.072	0.010***	0.000***	0.139
$\mathrm{CAR}_{i,1-5}$	0.027	−0.287	0.068	0.002***	0.000***	0.193
$\mathrm{CAR}_{i,1-6}$	0.023	−0.566	0.081	0.000***	0.000***	0.394
$\mathrm{CAR}_{i,1-7}$	0.013	−0.526	0.086	0.000***	0.000***	0.331
$\mathrm{CAR}_{i,1-8}$	0.016	−0.707	0.107	0.000***	0.039**	0.371
$\mathrm{CAR}_{i,1-9}$	0.019	−0.861	0.116	0.000***	0.358	0.425
$\mathrm{CAR}_{i,1-10}$	0.021	−0.996	0.114	0.000***	0.977	0.504
$\mathrm{CAR}_{i,1-11}$	0.017	−1.063	0.124	0.000***	0.695	0.497

***, ** denotes significance at the 1-percent and 5-percent, respectively.

zero is not significant and the abnormal returns in Table III are not significant after the implementation date, there is no strong support for price reversals. Therefore, we apply a test proposed in Kaul et al. (2000) that provides a more powerful prediction of price-pressure effects. Price-pressure effects imply that the event period cumulative abnormal return between the announcement and the implementation is reversed completely over subsequent weeks. If price-pressure effects are in fact causing an increasing demand for stocks, we should find an intercept of zero and a slope of -1 when we regress cumulative abnormal return from the event week through week 11 against the long-event window cumulative abnormal return.

Table IV summarizes the results of the regression. The beta coefficient is significantly different from -1 only for eight weeks following the implementation. We can therefore not reject complete reversal after eight weeks. This result suggests that the demand curves for stocks do slope down. Similarly, Kaul et al. (2000) find that it takes index funds nine weeks to complete the rebalancing caused by an increase in float capitalization. The increasing standard deviation of coefficient estimates indicates that the power of the test to reject the hypothesis of complete reversal is diminishing as the length of the event window is extended. Coefficient estimates on beta equal to zero suggest the possibility of a reversal of the event period cumulative abnormal return. Overall, we interpret these results as consistent with imperfect-substitution effects.

5.3. CROSS-SECTIONAL TESTS

To further explore the possibility of downward sloping demand curves for stocks, we estimate cross-sectional regressions that relate the long-event window cumulative abnormal return and the abnormal volume to the change in demand and the elasticity of supply for stocks. To measure the change in demand, we use Δfloat, the change in stock i's public float, and Δweight, the change in stock i's weight in the STOXX 50 as a result of the implementation of float weights. Since the implementation increases the demand for stocks, we expect a positive coefficient on Δfloat and Δweight. Positive coefficients are also consistent with both price-pressure effects and downward sloping demand curves. $\delta_{\text{run-up}}$ is a proxy for the elasticity of supply that is based on the run-up in the price of stock i over the previous 12 months. If the run-up is greater than 50 percent, the $\delta_{\text{run-up}}$ is equal to one. Otherwise it is equal to zero. Kaul et al. (2000) purports that this proxy is a reflection of shareholders' reluctance to sell stocks with large accumulated capital gains, indicating that the supply is less elastic for stocks with large run-up prices. MV is the company's market value. It is used to control for cross-sectional variation due to firm size. We do not expect any influence due to size because the companies in the STOXX 50 are all fairly large companies.

Table V displays the coefficients of the regression of the long-event window cumulative abnormal returns and abnormal volume against changes in demand for stocks caused by the rebalancing activities of index funds. The coefficients on Δfloat and Δweight are positive, but only the coefficient on Δfloat is significant. The positive coefficient suggests that larger demand for stocks in companies with a high floats is associated with a larger price impact. The coefficient on $\delta_{\text{run-up}}$ and the coefficient on MV are not statistically significant.[5] This may be because the stocks of low-float companies and the stocks of high-float companies are perfect substitutes. If the demand for high-float companies (low-float companies) increases (decreases) because investment managers rebalance their portfolios around the implementation of float weights, the stock prices for high-float companies (low-float companies) should increase (decrease). Accordingly, if the supply of stocks

[5] We use market capitalization directly without any transformation. However, using the natural log of companies' market capitalization does not produce significant results.

of high-float companies (low-float companies) declines (rises) the stock price, on average, should go up (down).

Shleifer (1986) tests for downward sloping demand curve effects by regressing event-period cumulative abnormal returns against the volume ratio as a proxy for the demand increase. This regression provides the following results in our case:

$$\begin{aligned}
\text{High-float companies:}\quad & \text{CAR} = 0.0372 + \underset{(0.92)}{0.0300} \cdot \text{VR} \\
& N = 34,\ \text{Adj. } R^2 = 3.5\% \\
\text{Low-float companies:}\quad & \text{CAR} = 0.1615 - \underset{(-2.63)^*}{0.1519} \cdot \text{VR} \\
& N = 13,\ \text{Adj. } R^2 = 33.2\%
\end{aligned}$$

The t-statistics are in the parentheses. In both regressions, we use the volume ratio adjusted for normal market and company volume, $\text{VR}_{i\tau}$, instead of the market adjusted mean volume ratio. The positive (negative) sign of the volume ratio is consistent with a downward sloping demand curve effect. For low-float companies, the coefficient on the volume ratio is significant providing further evidence that the demand curve for stocks slopes down. Shleifer (1986) reports an R^2 of 4% for a similar regression for stock additions and deletions to the S&P 500. In our regression, the adjusted R^2 is 3.5% and 33.2%, respectively, for high-float companies and low-float companies. Overall, these regression results and the results in Table II through V are consistent with downward sloping demand curves for stocks.

6. Conclusions

On September 18, 2000, the European Dow Jones STOXX$^{\text{SM}}$ indexes implemented float weights that excluded all shares held in block ownership. The implementation of float weights marked an empirical opportunity to study the slope of the demand curve for European stocks. The implementation is an information-free event since all market participants had full knowledge of the new index calculation in advance. In addition, we avoid certification effects due to the selection process because our sample excludes new additions and deletions. Consequently, the implementation allows us to study the extent to which stocks have perfect substitutes as implied by asset pricing theories.

Our findings display temporary effects surrounding the implementation consistent with, although poorly measured, price pressures. However, the cumulative abnormal return indicates that the price run-up for high float companies is permanent. Although, we cannot reject complete reversal by the end of the abnormal trading volume period, as one would expect, the demand curves for large European stocks appears to be downward sloping.

For practitioners, our study suggests that suppliers that provide liquidity capitalize on substantial rewards. Also, our findings suggest that passive index funds pay a high price for minimizing tracking error on the date of the implementation of

Table V. Regression-based tests for price and volume effects

Regressions are applied to test for price and volume effects using a seemingly unrelated regression estimation procedure. The dependent variables are the cumulative abnormal return between the announcement date, July 3, 2000, and the implementation date, September 18, 2000:

$$\mathrm{CAR}_{i,0} = \alpha + \beta \cdot \Delta\mathrm{float}_i + \beta \cdot \Delta\mathrm{weight}_i + \beta \cdot \delta_{\mathrm{run-up},i} + \beta \cdot \mathrm{MV}_i + \epsilon_i$$

and the abnormal volume between the announcement date and the implementation date:

$$\mathrm{VR}_{i,0} = \alpha + \beta \cdot |\Delta\mathrm{float}_i| + \beta \cdot |\Delta\mathrm{weight}_i| + \beta \cdot \delta_{\mathrm{run-up},i} + \beta \cdot \mathrm{MV}_i + \epsilon_i .$$

Δfloat and Δweight measure the percentage change in public float and index weights. In the second model with mean volume, absolute value is used for the Δfloat and Δweight measure. $\delta_{\mathrm{run-up}}$ is a zero-one dummy variable that measures the 50 percent appreciation of a stock during previous twelve months. MV is the firm's market value. t-statistics are given in parentheses

Panel A: Price effect regressions				
Variables:	1	2	3	4
Intercept	0.0771	0.0368	0.0879	0.0371
	(4.41)***	(2.19)***	(2.98)***	(1.13)
Δfloat	0.3039		0.3191	
	(3.90)***		(4.05)***	
Δweight		0.0267		0.0278
		(1.05)		(1.02)
$\delta_{\mathrm{run-up}}$			0.0437	0.0278
			(1.23)	(0.68)
MV			−0.0000	−0.0000
			(−0.82)	(−0.25)
Panel B: Mean volume regressions				
Variables:				
Intercept	0.9825	1.0558	1.0375	1.1103
	(16.75)***	(18.81)***	(10.33)***	(11.43)***
$\|\Delta$float$\|$	0.3409		0.3167	
	(1.30)		(1.18)	
$\|\Delta$weight$\|$		−0.1074		−0.1058
		(−1.27)		(−1.28)
$\delta_{\mathrm{run-up}}$			0.0463	0.0650
			(0.38)	(0.54)
MV			−0.0000	−0.0000
			(0.78)	(-0.83)
System weighted R^2	0.1557	0.0267	0.1804	0.0432

*** denotes significance at the 1-percent level.

float weights. The findings further suggest that future work on asset pricing should focus on understanding the relationship between liquidity and stock prices.

Appendix A. Companies in the Dow Jones Europe STOXX 50

Company	Ticker	Country	Free float factor	Market cap float adjusted Euro million	Market weight	Float adjusted weight
ABN Amro Holding	AA	NA	0.89	35,106	0.93%	0.95%
Aegon	AEGN	NA	0.63	34,795	1.31%	0.94%
Alcatel	CGE	FP	1.00	102,986	2.42%	2.79%
Allianz	ALV	GY	0.58	53,530	2.19%	1.45%
Assicurazioni Generali	G	IM	0.89	39,946	1.07%	1.08%
Axa	CS	FP	0.80	51,939	1.52%	1.41%
Banco Bilbao Vizcaya Argentaria	BBVA	SM	1.00	54,731	1.30%	1.48%
Barclays	BARC	LN	1.00	42,177	1.01%	1.14%
Bayer	BAY	GY	0.95	30,872	0.77%	0.84%
BP Amoco	BP/	LN	1.00	233,144	5.56%	6.32%
British Telecom	BT/A	LN	1.00	87,545	2.07%	2.37%
BSCH	SCH	SM	1.00	56,444	1.22%	1.53%
Carrefour	CA	FP	0.83	48,212	1.39%	1.31%
Credit Suisse	CSGN	SW	0.90	59,488	1.58%	1.61%
DaimlerChrysler	DCX	GY	0.81	45,333	1.35%	1.23%
Deutsche Bank	DBK	GY	1.00	58,916	1.40%	1.60%
Deutsche Telekom	DTE	GY	0.41	53,312	3.11%	1.44%
Diageo	DGE	LN	1.00	32,572	0.77%	0.88%
E.ON	EOA	GY	0.85	34,623	0.96%	0.94%
Eni	ENI	IM	0.63	32,320	1.22%	0.88%
Ericsson	LMEB	SS	1.00	175,679	3.79%	4.76%
France Telecom	FTE	FP	0.34	51,202	3.54%	1.39%
GlaxoWellcome	GLXO	LN	1.00	116,110	2.76%	3.15%
HSBC Holdings	HSBA	LN	0.92	139,856	3.32%	3.79%
ING	INTNC	NA	0.82	60,141	1.78%	1.63%
Phillips Electronics	PHIL	NA	1.00	70,476	1.68%	1.91%
Lloyds TSB	LLOY	LN	1.00	57,059	1.33%	1.55%
L'oreal	OR	FP	0.46	24,478	1.25%	0.66%
Marconi	MNI	LN	1.00	51,321	1.21%	1.39%
Muenchener Rueck	MUV2	GY	0.45	24,665	1.33%	0.67%
Nestle	NESN	SW	1.00	94,300	2.24%	2.55%
Nokia	NOK1V	FH	1.00	243,406	5.78%	6.59%
Novartis	NOVN	SW	1.00	122,580	2.91%	3.32%

Company	Ticker	Country	Free float factor	Market cap float adjusted Euro million	Market weight	Float adjusted weight
Prudential	PRU	LN	1.00	29,619	0.70%	0.80%
Roche Holding	ROG	SW	1.00	86,011	1.63%	2.33%
Royal Bank of Scotland	RBOS	LN	0.91	54,546	1.36%	1.48%
Royal Dutch Petroleum	RD	NA	0.93	141,787	3.62%	3.84%
Shell Transport	SHEL	LN	1.00	94,650	2.25%	2.56%
Siemens	SIE	GY	0.94	99,021	2.52%	2.68%
SmithKline Beecham	SB/	LN	1.00	81,189	1.93%	2.20%
Swiss Re	RUKN	SW	0.92	29,107	0.77%	0.79%
Telecom Italia	TI	IM	0.45	38,241	1.68%	1.04%
Telefonica	TEF	SM	0.90	92,595	2.28%	2.51%
Total Fina	FP	FP	1.00	127,311	3.03%	3.45%
UBS	UBSN	SW	1.00	68,602	1.70%	1.86%
Vivendi Universal	EX	FP	1.00	55,436	1.31%	1.50%
Vodafone Group	VOD	LN	1.00	274,166	6.53%	7.43%

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