Are ETFs Bad for Financial Health?

Some Counterintuitive Examples

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Abstract

Exchange-traded Funds (ETFs) are easy to understand, cost-efficient, and liquid investment vehicles based on market indices that have become very popular for both institutional and retail investors. The dynamics of the index and its underlying assets are closely interlinked based on the rebalancing effect and depend among others on the different types of traders in the market, price trends in individual stocks and the overall market, as well as over- or undervaluation of individual stocks and the index. Investing in an index of assets via an ETF can generate quite complex and sometimes counterintuitive investment behaviors on the level of individual assets. Seemingly stabilizing investment strategies, such as a fundamentalist approach, on the level of the ETF might actually lead to destabilizing effects on the level of individual stocks.

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1 Introduction

Exchange-traded Funds (ETFs) are easy to understand, cost-efficient, and liquid investment vehicles that have become very popular for both institutional and retail investors (Gastineau, 2010; Oura et al., 2015; Wiandt and McClatchy, 2002). Originally, the typical ETF tracked the performance of an underlying stock index. In recent years, ETFs have grown substantially in assets, diversity, and market significance, and are available, e.g., for bonds and for alternative investment strategies (see Martin et al., 2017; Lettau and Madhavan, 2018). In September 2017, Exchange-traded Funds globally managed $4.3 trillion in around 6,300 investment vehicles, thus exceeding the hedge fund industry. However, investments in index funds still account for less than 20% of global equities (for recent surveys see Lettau and Madhavan, 2018; BlackRock, 2017).

As volume and diversity of ETFs have expanded greatly, regulators and researchers have increasingly asked how these developments might affect market quality, financial market governance, and financial stability (see, e.g., Fichtner et al., 2017; Ivanov and Lenkey, 2014; Pan and Zeng, 2017; Anadu et al., 2018). However, there is still only limited understanding of the longer term effects of ETFs' dramatic growth.

A first analytical step could be to compare a market situation without any indexing with the other extreme of asset markets in which all traders invest in an index only. Without indexing all stock prices would reflect the idiosyncratic volatility of the underlying companies; in a situation with index trading only (and no one investing directly in the underlying stocks), the indexed stock prices would be perfectly correlated and lose all the idiosyncratic volatility. Via the index channel, shocks would be transmitted to

all indexed assets.

Empirical research indicates that ETFs have sizeable effects on asset prices, giving rise to phenomena such as index and asset class effects. In a first step ETFs' growth can be seen as part of a more general trend in the asset management industry to move from active to passive investment strategies (cf. Liu et al., 2014). A lot can be learned from work that tries to explain this trend and to explore the implications for market quality (see, e.g., Ben-David et al., 2017). On the one hand the spread of passive investment is seen as evidence of improved market efficiency as arbitrage opportunities have disappeared (Stambaugh, 2014). On the other hand Baker and Wurgler (2011) point to a number of potential adverse effects of increased indexation as it might create distortions in securities' valuation, such as inclusion and deletion effects (see, e.g., Shleifer, 1986; Wurgler and Zhuravskaya, 2002; Kaul et al., 2000; Greenwood, 2005), comovement of the stock with the index (see, e.g., Greenwood and Sosner, 2007; Da and Shive, 2017), and higher sensitivity to bubbles and subsequent crashes. As it is difficult to explain such phenomena within standard representative-agent asset pricing models, Basak and Pavlova (2013) allow for heterogeneity in investors in their theoretical analysis. They show that institutional investors not only amplify index stock volatilities and aggregate stock market volatility by demanding a higher fraction of risky stocks than retail investors, but also induce excess correlations among stocks that belong to their benchmark index, the well-known asset class effect.

More specifically Ben-David et al. (2014) find that ETF ownership of stocks typically increases volatility and turnover. Glosten et al. (2016) find that stocks incorporate information more quickly once they are included in ETF portfolios. Da and Shive (2017) document an increased comovement in returns of stocks that are part of the same index. When investors trade on news related to the index, the mechanical basket trading of the underlying securities tied to the ETF through arbitrage exhibits higher return comovements and causes basket stocks to lose part of their idiosyncratic volatility. At

the same time individual stocks are likely to respond less sensitively and timely to idiosyncratic earnings news (see also Sullivan and Xiong, 2012; Israeli et al., 2017).

Possible negative effects of ETFs on informational efficiency are related among others to lower analyst coverage (e.g., Israeli et al., 2017), slower price discovery (Bradley and Litan, 2011, 2010), impact of retail investor sentiments (Da et al., 2015), and increased attractiveness of ETFs for short-horizon noise traders with correlated demand across investment styles (Broman, 2016). In related research a number of studies analyze how ETFs might transmit noise to the underlying assets. ETFs have seen high turnover and are traded by traders who tend to make directional bets with short time horizon implying low informational efficiency, deterring long-term investors and exacerbating price drops in times of market turmoil (e.g., Stratmann and Welborn, 2012; Cella et al., 2013; Ben-David et al., 2014). Chinco and Fos (2016) analyze how ETFs' rebalancing needs in case of price changes are likely to trigger large rebalancing cascades that exacerbate the original price shock. In a broad analysis of the asset management industry Oura et al. (2015) raise the issue of systemic risks and identify risk-creating mechanisms even for seemingly simple financial products such as ETFs. They conclude that it is not so much the size of ETFs per se that is relevant for systemic risk but rather the investment strategies that appear to be more important.

Taken together, ETFs might play a crucial role in amplifying shocks and destabilizing price dynamics when compared to a situation in which investors invest directly in individually selected securities. These risks are likely to have risen not only due to the increased weight of such products, but also as banks have tended to backtrack as market makers, possibly contributing to lower market liquidity. Still, the implications of ETFs on financial stability remain an open question (Sushko and Turner, 2018).

This study takes up this important policy issue and examines the transmission channels from ETF investments to price behavior of individual stocks. In particular it asks whether ETFs' dramatic growth could imperil financial stability. It contributes to the

literature by systematically bringing together important aspects that have so far not received the necessary scrutiny, namely on the one hand the specific relation between ETFs and the underlying assets, the so-called rebalancing effect, and on the other hand the specific trading strategies ETFs are used for. While ETFs are a passive investment instrument by construction, institutional investor use them mainly to implement various active trading strategies (see Stacey and Narine, 2018; Vlastelica, 2017; Rennison, 2017; Schatzker, 2017).

Take, e.g., a market with four types of traders: chartists and fundamentalists investing either in all stocks individually or in the index ETF only. All chartists are assumed to be trend followers, i.e., they buy when a stock or the index is rising and sell when a stock or the index is falling. Furthermore, fundamentalists buy when a stock or the index is undervalued and sell when a stock or the index is overvalued. Consider, for example, a situation in which stock 1 is overvalued and rising, while all other stocks are undervalued and falling so that the index is also decreasing and undervalued. The typical chartist would buy stock 1 and sell all other stocks. Since the index falls, an ETF chartist would sell ETF shares and so indirectly all underlying stocks, including stock 1. So while trend following investment strategies are typically associated with destabilizing asset prices, the ETF chartist would stabilize the price of asset 1 by implicitly selling the rising and overvalued asset 1. In an analogous way a fundamentalist investment strategy, typically associated with stabilizing asset prices, can implicitly destabilize individual stock prices. As stock 1 is assumed to be overvalued, a fundamentalist would sell this stock, and as all remaining stocks are undervalued, a fundamentalist would buy these stocks. However, as the the market index is also assumed to be undervalued, the ETF fundamentalist would buy ETF shares and so indirectly buy the overvalued stock 1 as well with an obviously destabilizing price effect. To sum up, in case of ETF traders, the conventional assessment that fundamentalists tend to stabilize, while chartists tend to destabilize price dynamics does not necessarily hold anymore.

We can generalize this insight if we account for rebalancing effects as they are implied by the use of index-based investment strategies. Therefore we do not use trading rules based on selling and buying signals only. Instead we use rules in which investors adjust their net asset positions in individual stocks as asset prices change. Chartists are assumed to increase (decrease) their net asset position if a price is rising (falling) and fundamentalists are assumed to increase (decrease) their net asset position if an asset or index is under-(over-)valued. Note that the net asset position is affected not only by buying or selling decisions, but also by any change in asset prices. In this setting counterintuitive trading behavior is not only observed in specific cases (as, e.g., the one explained above), but also in much more market situations, caused by rebalancing effects. The analysis focuses on index ETFs as the most common type of ETFs.

We analyze how the interaction between the rebalancing effect and the specific trading strategies ETFs are used for can imply very complex, seemingly counterintuitive trading strategies on the level of the individual stocks depending on, among others,

- the strategy of ETF investors, e.g., fundamentalist or chartist,
- the price dynamics of the individual stocks, i.e., increasing or decreasing, and
- the prices of the individual stocks relative to their fundamental values, i.e., situation of over- or undervaluation.

Section 2 presents some analytical findings on the effects of index based investment strategies. Section 3 discusses some counterintuitive price effects for individual stocks that can result from strategies of fundamentalists and chartists, in particular trend followers, based on index funds. Section 4 generalizes this analysis and examines how investment strategies affect market stability depending on alternative market settings. Section 5 concludes.

2 Investment Strategies and Price Dynamics of Indices and their Underlying Assets

As a passive investment vehicle a typical ETF replicates a specific asset index, e.g., the Dow Jones Industrial Average. We define as *index* both a publicly known set of N assets that are considered to be representative for a market as well as the price of that basket of assets which is defined as the sum of the (weighted) asset prices. To simplify our analysis, we assume that the price of the index is available to all market participants at any time at no costs.

The implicit net asset position $I_i^\ell(t)$ of ETF trader ℓ in stock i at time t is given by

$$\begin{aligned} I_i^\ell(t) &= I^\ell(t) \cdot \pi_i(t) \\ &= I^\ell(t) \cdot p_i(t)/p(t) \end{aligned} \tag{1}$$

where $I^\ell(t)$ denotes trader ℓ's net asset position in the ETF with price $p(t) = \sum_{j=1}^{N} p_j(t)$. With market price $p_i(t)$, stock i's relative weight in the index is $\pi_i(t)$. Note that all ETF investors resemble chartists, especially trend followers, since the ETF is investing in rising stocks and disinvesting from falling ones by construction.

Investments on the level of the ETF imply specific trades on the level of the individual stocks depending on two determinants, namely the net asset position $I^\ell(t)$ (*level* or *quantity effect*) and the stocks's relative weight $\pi_i(t)$ (*rebalancing*, *price*, or *composition effect*). Note that a trader's gain is independent of trading in ETF shares or in the underlying stocks according to Equation (1).[1]

To better understand how ETF investments implicitly affect investments in the underlying stocks we analyze the quantity and price dimensions of these investments in greater detail. Given the past net asset position $I^\ell(t-1)$, the current investment in the

[1]Complete formal proofs are available from the authors upon request.

index $\Delta I^\ell(t)$, as well as the index's rebalancing dynamics $\Delta\pi_i(t) = \pi_i(t) - \pi_i(t-1)$, we derive an ETF trader's investment in individual stocks $\Delta I_i^\ell(t) = I_i^\ell(t) - I_i^\ell(t-1)$.

Proposition 1. The investment in stock i of an ETF trader ℓ with net asset position I^ℓ in period t is given by

$$\Delta I_i^\ell(t) = \Delta I^\ell(t)\pi_i(t) + I^\ell(t-1)\Delta\pi_i(t). \tag{2}$$

Proof. It holds:

$$\begin{aligned}
\Delta I_i^\ell(t) &= I_i^\ell(t) - I_i^\ell(t-1) \\
&= I^\ell(t)\pi_i(t) - I^\ell(t-1)\pi_i(t-1) \\
&= I^\ell(t)\pi_i(t) - I^\ell(t-1)\pi_i(t) + I^\ell(t-1)\pi_i(t) - I^\ell(t-1)\pi_i(t-1) \\
&= \Delta I^\ell(t)\pi_i(t) + I^\ell(t-1)\Delta\pi_i(t)
\end{aligned}$$

□

As Equation (2) indicates, firstly the investment in an individual stock i depends on the investment in the index given the relative weight of the stock in the index, i.e., $\Delta I^\ell(t)\pi_i(t)$ (*level effect*). Secondly, the investment in individual stocks also depends on how the fund reallocates the overall investment in the index due to changes in the relative weight of the individual stocks, i.e., $\Delta\pi_i(t)$ (*rebalancing effect*). The level effect, i.e., the first summand of Equation (2), depends on the trader's strategy, i.e., on his or her investment $\Delta I^\ell(t)$, whereas the rebalancing effect, the second summand, depends on the change of the relative price of the stock, i.e., on market dynamics that traders take as given. Thus, an ETF trader actively controls his or her investment only on the level of the index, while passively tolerating the implied investments on the level of the individual

assets. As the two effects can work in the same direction or in opposite directions, the net effect of index trading on individual stocks is a priori indeterminate and depends on the relative size of the level and the rebalancing effects. The interactions of these two effects can have complex and sometimes counterintuitive effects of ETF investments on the underlying stocks, as we illustrate further below.

Equation (2) further indicates that shocks might not only be spread out over whole markets but might also be amplified. Idiosyncratic shocks to an asset price are passed on to the other assets incorporated in the index as the weights of all assets $\Delta\pi_j$ change. The rebalancing effect becomes more important relative to the level effect which implies counterintuitive investment behavior, amplified shocks, and increased uncertainty. When denoting the demand (i.e., the amount of stocks to be bought or sold) with $D^{\ell}_{(i)}(t) = I^{\ell}_{(i)}(t) - I^{\ell}_{(i)}(t-1) \cdot p_{(i)}(t)/p_{(i)}(t-1)$, it holds $D^{\ell}_{i}(t) = D^{\ell}(t)\pi_i(t)\ \forall t \Rightarrow I^{\ell}_{i}(t) = I^{\ell}(t)\pi_i(t)\ \forall t$. From this fact it follows that for buy-and-hold strategies there is no difference between investing in the ETF or investing in the underlying assets according to Equation (1). Another finding that can be learned is that an ETF does not have to pay transaction costs for rebalancing, only for buying or selling assets when traders buy or sell ETF shares. However, these transaction costs are passed to the traders via so-called privileged agents or authorized participants (Lettau and Madhavan, 2018).

3 Level vs. Rebalancing Effect —A Counterintuitive Example

We conduct a simple simulation to illustrate how investment strategies on the level of an index can imply quite different investment behavior on the level of the underlying individual stocks due to changes in the relative prices of individual stocks and the subsequent rebalancing. In particular, we specify simple trading strategies for chartists as trend followers and fundamentalists. We differentiate between traders who invest in individual

stocks or ETF stock indices giving rise to four distinct types of traders, namely chartists investing in individual stocks (C) or ETFs (E-C) as well as fundamentalists investing in individual stocks (F) or ETFs (E-F). To keep our analysis simple, we assume that traders can only change their net asset position by a constant amount c^* per individual stock or by Nc^* for ETF shares per period. Price dynamics are given, i.e., traders are price takers as their investments are too small to affect market prices. Trend followers invest c^* (Nc^*) in stock i (the index) if stock i (the index) rises, disinvest from stock i (the index) if it is falling, and stay neutral if the price stays constant. Analogously, fundamentalists invest c^* (Nc^*) in stock i (the index) if it is undervalued and disinvest if it is overvalued.

Chartists in individual stocks invest the amount c^* according to

$$\Delta I_i^C(t) = c^* \cdot sgn(p_i(t) - p_i(t-1)) \cdot 1_{\{t>0\}} \qquad \forall i \in \{1, \ldots, N\},$$

while ETF chartists invest according to

$$\Delta I^{E-C}(t) = Nc^* \cdot sgn(p(t) - p(t-1)) \cdot 1_{\{t>0\}}$$

where N denotes the number of stocks that comprise the index. Note that the investment of an ETF trader is spread across the individual stocks according to Equation (1).

Analogously, fundamentalists who invest in individual stocks follow

$$\Delta I_i^F(t) = c^* \cdot sgn(f_i(t+1) - p_i(t)) \qquad \forall i \in \{1, \ldots, N\},$$

while ETF fundamentalists invest according to

$$\Delta I^{E-F}(t) = Nc^* \cdot sgn(f(t+1) - p(t))$$

for given expected fundamental values $f_i(t+1)$ for all stocks i and respective a fundamental value of the index $f = \sum_{i=1}^{N} f_i$. To simplify the discussion the market environment is assumed to be non-stochastic, i.e., there is no noise in the fundamentals.

In the subsequent scenario analysis, we assume an index with $N = 30$ stocks with initial price $p_{1-30}(0) = 1$ on the time grid $T = \{0, 1, \ldots, t^*\}$. The price of stock 1 follows $p_1(t+1) = p_1(t)e^{\mu_1/250}$ and the index develops according to $p(t+1) = p(t)e^{\mu/250}$ where $\mu_1 > -1$ and $\mu > -1$ are fixed and $p_i(t) = p_j(t)\ \forall t\ \forall i, j \in \{2, \ldots, N\}$. The trends μ_1 and μ are chosen so that $p_i(t) > 0$ is fulfilled for all $t \in T$ and all $i \in \{1, \ldots, N\}$. Additionally, we set $0 < f_i = f^*$ as constant for all i and so $f = Nf^*$ is constant as well. (Dis)Investment per period is $c^* = 1$. The parameters under investigation are μ_1, μ, and f^*. Given this simple framework, we identify and discuss a scenario in which ETF investments have interesting, seemingly counterintuitive effects on the level of individual stocks due to the complex interactions of level and rebalancing effects.

Scenario: Modestly Rising Stock in a Bull Market We assume the price of stock 1 to rise with trend $\mu_1 = 0.1$ and the price of the index to increase with trend $\mu = 2$, i.e., π_1, the relative price of stock 1, falls. All stocks are assumed to be overvalued relative to their fundamental values f_i that are set to unity, i.e., $p_i > f_i = 1$ and $p > f = 30$ holds ($t > 0$) (see Figures 1 and 2). Prices of stock 1 and the other stocks increase over the $t^* = 250$ trading days and are above their respective fundamental values (see Figure 1). However, stock 1 differs from the other stocks as its relative price π_1 declines (see Figure 2). Based on our pricing assumptions the market price of the index p rises while its fundamental value f stays constant (see Figure 3).

Given these price dynamics, how do the different traders allocate their investments? As the prices of all stocks rise, chartists that trade in individual stocks or the index invest in their respective target asset. In contrast, individual stock and index fundamentalists disinvest from their respective target assets as the individual stocks and the index are

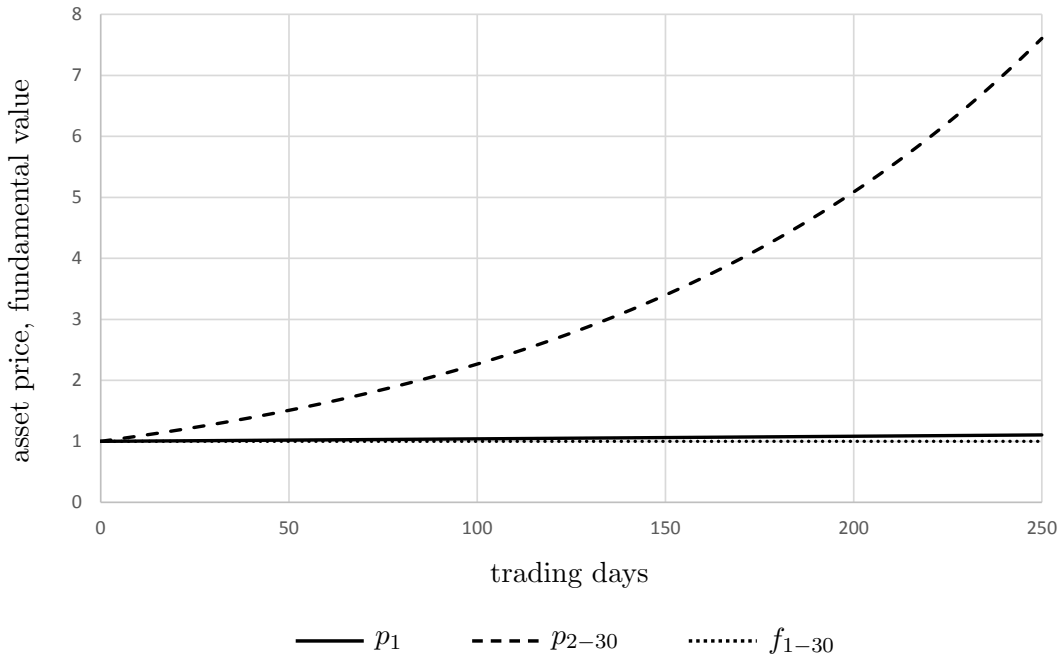

Figure 1: Price paths p_1 of stock 1 and p_{2-30} of stocks 2-30.

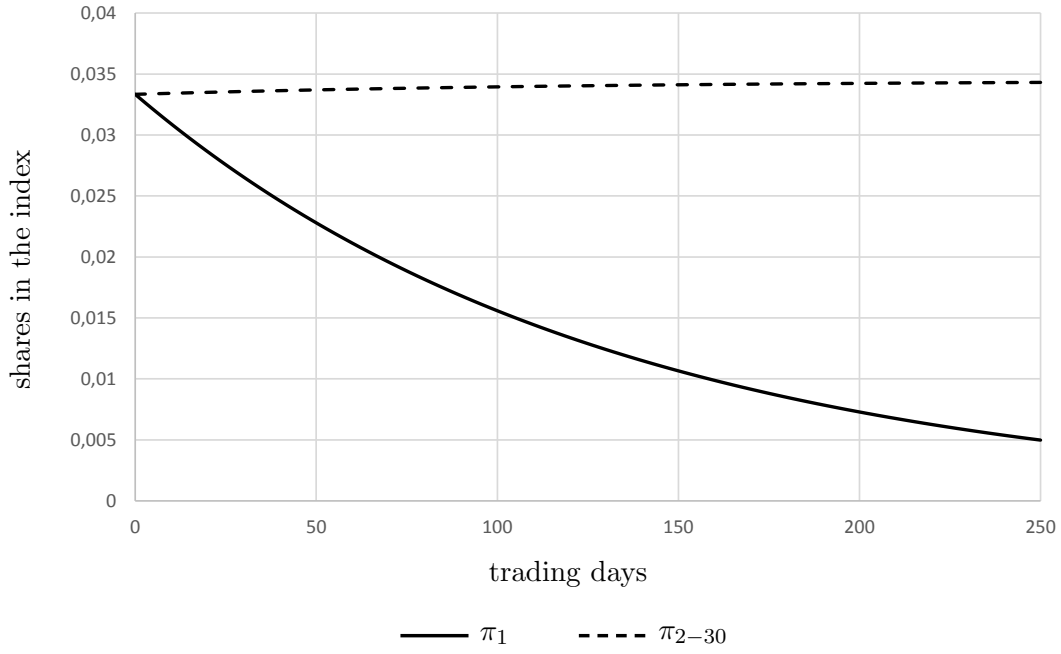

Figure 2: Change of the ratio π_1 and π_{2-30} of stock 1 and stocks 2-30, respectively.

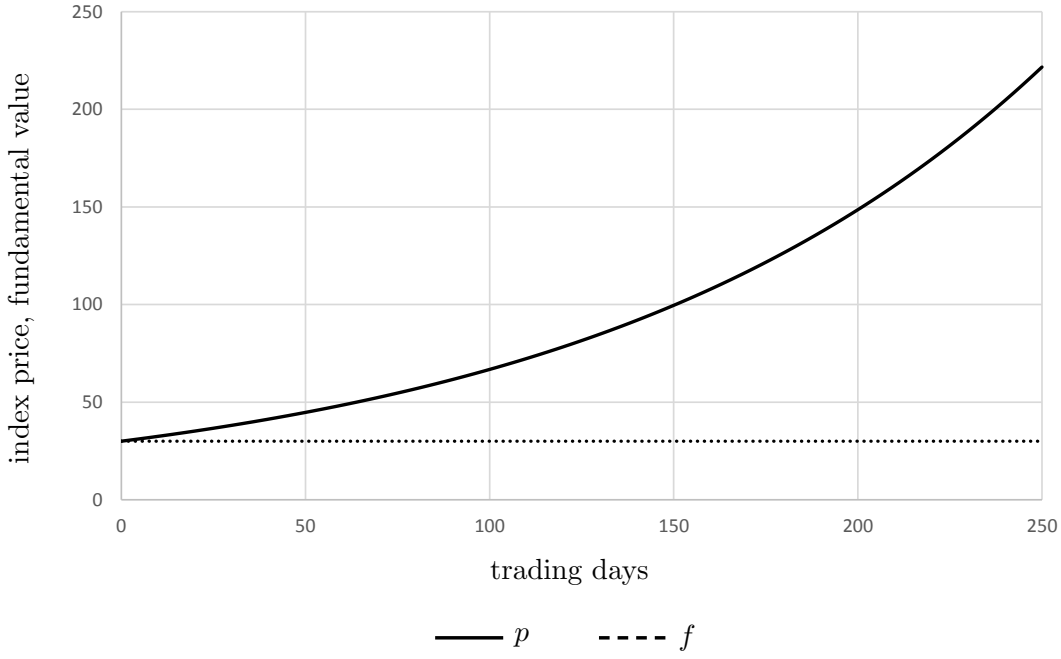

Figure 3: Market price p and fundamental price f of the index.

overvalued.

Investments of individual stock investors are straight forward and serve as benchmark to evaluate ETFs implied investments in individual stocks. In the case of stock 1 individual stock chartists C invest in every period as the price rises, while fundamentalists F disinvest as the stock is overvalued (see Figure 4).

In contrast, investments by ETF traders might result in rather complex price effects on the level of individual stocks with seemingly counterintuitive investment dynamics in the case of stock 1. As the relative price of stock 1, π_1, and thus its relative weight in the index declines (see Figure 2), ETF chartists implicitly invest less and less in stock 1, i.e., the level effect of their additional investment over time decreases as less funds $\Delta I^{E-C}\pi_i(t)$ are allocated to stock 1 (see Equation (2)). At the same time the rebalancing effect, the second part of Equation (2), calls for disinvesting from stock 1 to account for its reduced weight in net asset position I^{E-C}. Eventually, the rebalancing

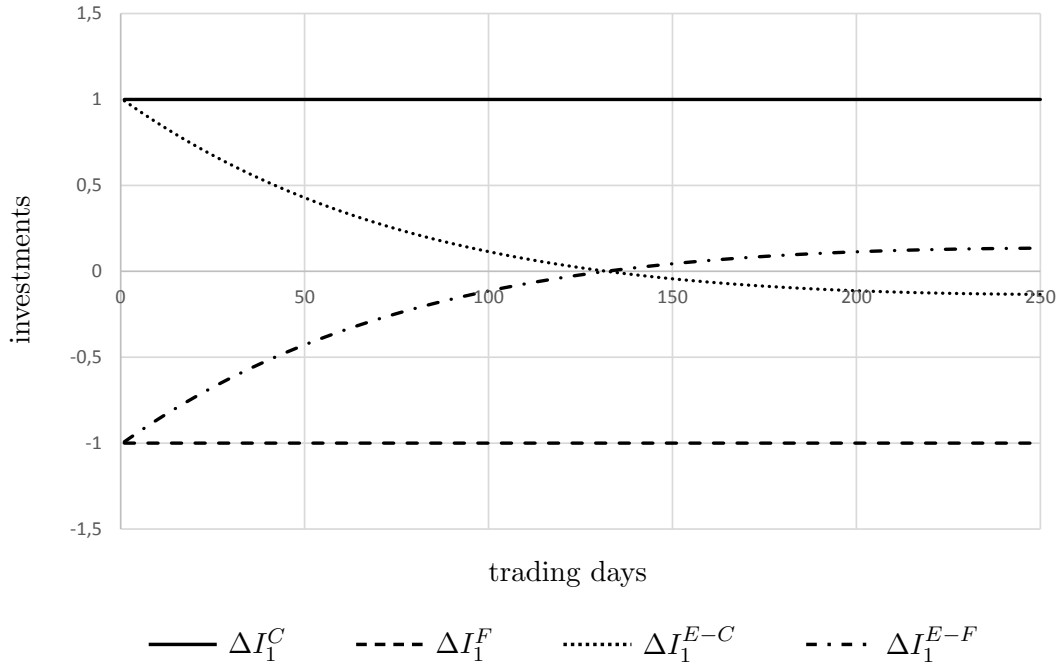

Figure 4: Investment ΔI_1^ℓ in stock 1 if the stock price rises more slowly than the index price.

effect dominates the level effect, so that the net investment turns negative and the ETF chartists disinvest from the rising stock 1 (see Figure 4).

In contrast, ETF fundamentalists start off disinvesting from the overvalued index and thus implicitly from stock 1. Over time they disinvest less and less from this stock (see Figure 4) as its relative price and relative weight in the index decreases. While they disinvest from ETF shares due to the overvaluation of the index (level effect), they implicitly invest in stock 1 to assure the appropriate portfolio allocation (rebalancing effect). Without the required rebalancing they would disinvest too much from stock 1 and therefore have to implicitly invest in this stock to compensate for its decreasing weight in the index. As the relative price of stock 1 continues to fall, the positive rebalancing effect eventually dominates the level effect and ETF fundamentalists become de facto net investors in an overvalued stock.

Taken together and somewhat counterintuitively, ETF chartists end up disinvesting from a rising stock, while ETF fundamentalists invest in an overvalued stock. Obviously, ETF traders do not intentionally invest in this counterintuitive way, they are simply not aware of these effects. From the perspective of financial stability and contrary to the conventional perception, ETF chartists tend to stabilize, while ETF fundamentalists tend to destabilize the price of this specific stock. Ultimately, these investment dynamics are driven by the complex interactions of investment strategies, fundamental and market price dynamics of individual stocks and the index, as well as the net asset positions of the investors. Section 4 analyzes in greater detail how these interrelations work to affect stock prices. Obviously, these counterintuitive effects only hold for the "outlier" stock 1, while for stocks 2-30 the effects of chartists and fundamentalists are as conventionally expected (see Figure 5). The strategies of the traders are the same for stock 1 and stocks 2-30. However, there is a difference in the effects caused by the outlying dynamics of stock 1.

4 What do ETF Investment Strategies Imply for Trading of Individual Assets?

In a next step, we generalize and summarize how ETF traders' investment strategies affect the dynamics of an individual asset i. We discuss three investment drivers that differ between ETF fundamentalists and ETF chartists and the one factor that is independent of the traders' investment strategies (see also Equation (2)).

Specific to ETF fundamentalists is their past net asset position, the ratio of (expected) fundamental index price and market price, as well as the price p_i of asset i relative to its fundamental value f_i, which is used as a benchmark:

- In the past, the index has been under- or overvalued, implying a positive net asset position $\left(I^{E-F}(t-1) > 0\right)$ of the ETF fundamentalist or a negative one

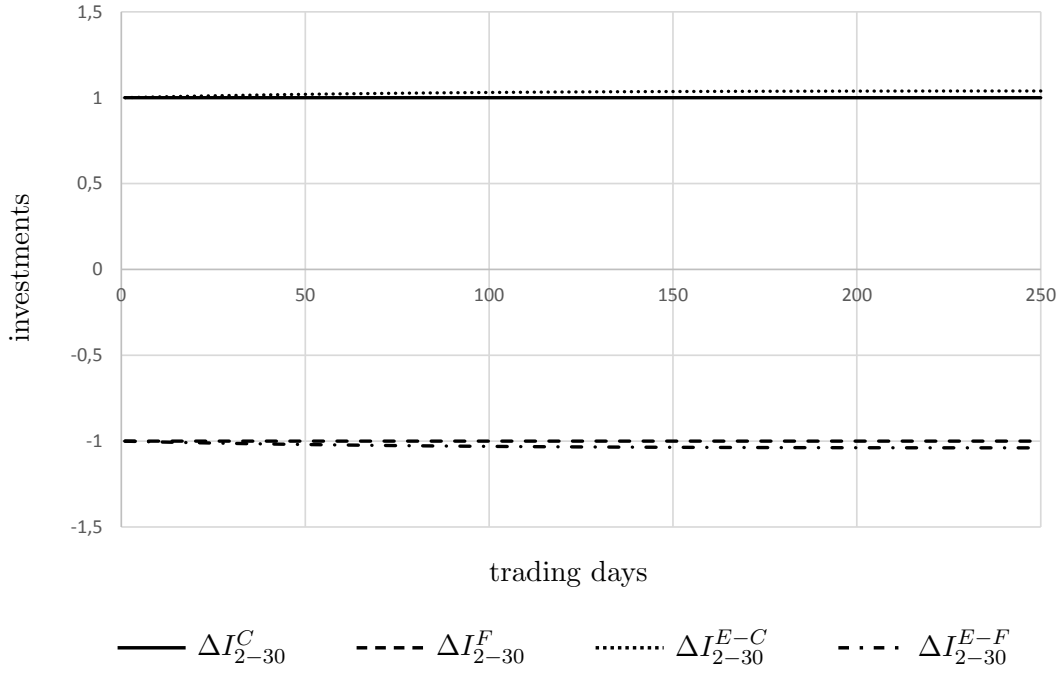

Figure 5: Traders' investment ΔI^{ℓ}_{2-30} in stocks 2-30.

$\big(I^{E-F}(t-1) < 0\big)$.

- The index is currently undervalued $(f(t+1)/p(t) > 1)$ or overvalued $(f(t+1)/p(t) < 1)$.

- The i^{th} asset is currently undervalued $(f_i(t+1)/p_i(t) > 1)$ or overvalued $(f_i(t+1)/p_i(t) < 1)$. This variable helps classify the investment behavior of an ETF fundamentalist relative to a fundamentalist investor in individual stocks, i.e., to evaluate whether the behavior of the ETF fundamentalist is in line with conventional intuition (int.) or should be considered counterintuitive (count.).

Analogously, the relevant factors in case of ETF chartists are their past net asset positions and the market price dynamics of the index and individual asset i:

- In the past, the index has been increasing or decreasing, implying a positive net asset position $\big(I^{E-C}(t-1) > 0\big)$ of the ETF chartist or a negative one

$\big(I^{E-C}(t-1) < 0\big)$.

- The price of the index is currently increasing $(p(t)/p(t-1) > 1)$ or decreasing $(p(t)/p(t-1) < 1)$.
- The price of asset i is currently increasing $(p_i(t)/p_i(t-1) > 1)$ or decreasing $(p_i(t)/p_i(t-1) < 1)$. This variable is needed as a benchmark, too.

A factor independent of the ETF traders' specific trading strategies is the change of the relative weight of asset i in the index (see Equation (2)):

- The relative share of asset i in the index can be either increasing $(\Delta\pi_i(t) > 0)$ or decreasing $(\Delta\pi_i(t) < 0)$.

ETF fundamentalists		$f_i(t+1)/p_i(t) > 1$		$f_i(t+1)/p_i(t) < 1$	
		$\Delta\pi_i(t) > 0$	$\Delta\pi_i(t) < 0$	$\Delta\pi_i(t) > 0$	$\Delta\pi_i(t) < 0$
$I^{E-F}(t-1) > 0$	$f(t+1)/p(t) > 1$	int.	?	count.	?
	$f(t+1)/p(t) < 1$	?	count.	?	int.
$I^{E-F}(t-1) < 0$	$f(t+1)/p(t) > 1$	?	int.	?	count.
	$f(t+1)/p(t) < 1$	count.	?	int.	?

Table 1: Price dynamics and (counter)intuitive behavior of ETF fundamentalists implied by the past net asset position, over- or undervaluation of index or individual asset, as well as increasing or decreasing relative share of the individual asset in the index.

Combining these effects, we determine the sign of the investment decision for the i^{th} asset and relate it to the underlying ETF investment strategy. We characterize market constellations as intuitive (*int.*) if the investment strategy on the level of the ETF implies a similar investment on the level of the individual asset i. More specifically in the case of trend followers a constellation is labeled intuitive if the ETF trend followers not only invest in a rising index and disinvest from a falling index but also (implicitly) invest on the level of individual assets in rising stocks and disinvest from falling stocks. In contrast,

ETF		$p_i(t)/p_i(t-1) > 1$		$p_i(t)/p_i(t-1) < 1$	
chartists		$\Delta\pi_i(t) > 0$	$\Delta\pi_i(t) < 0$	$\Delta\pi_i(t) > 0$	$\Delta\pi_i(t) < 0$
$I^{E-C}(t-1) > 0$	$p(t)/p(t-1) > 1$	int.	?	count.	?
	$p(t)/p(t-1) < 1$	?	count.	?	int.
$I^{E-C}(t-1) < 0$	$p(t)/p(t-1) > 1$	?	int.	?	count.
	$p(t)/p(t-1) < 1$	count.	?	int.	?

Table 2: Price dynamics and (counter)intuitive behavior of ETF chartists implied by the past net asset position, increasing or decreasing price of index and individual asset, as well as increasing or decreasing relative share of the individual asset in the index.

situations in which ETF trend followers (implicitly) invest on the level of individual assets in falling stocks and disinvest from rising stocks are characterized as counterintuitive (*count.*), respectively inconsistent. Analogously, a market situation is considered as intuitive/counterintuitive when ETF fundamentalists who invest in undervalued indices and disinvest from overvalued indices implicitly disinvest/invest on the level of individual asset from/in overvalued stocks and invest/disinvest in/from undervalued stocks.

In half of the set-ups summarized in Tables 1 and 2, level and rebalancing effect work in the same direction and the net effect can be determined. In the other half the net investment effect cannot be determined in general without knowing the specific parameter values as indicated by ?. This is the case if one summand is positive and the other one is negative in Equation (2), e.g., if the level effect is positive and the rebalancing effect is negative or vice versa.

Consider, for example, the scenario presented in the cell of the first row and the first column of Table 1. According to Equation (2), a positive net asset position together with a rising ratio of asset i $\left(\text{i.e., } I^{E-F}(t-1)\Delta\pi_i(t) > 0\right)$ plus an undervalued index price resulting in a positive overall investment $\left(\text{i.e., } \Delta I^{E-F}(t)\pi_i(t) > 0 \text{ where } \pi_i(t) > 0 \text{ for all } t\right)$ and a positive investment in asset i $\left(\text{i.e., } \Delta I_i^{E-F}(t) > 0\right)$. Together with the condition of undervaluation of asset i ($f_i(t+1)/p_i(t) > 1$), the ETF fundamentalist's investment in

asset i is in line with the investment of an investor in individual assets in such a situation, i.e., the ETF fundamentalists' investment is considered to be intuitive. In contrast, if asset i is overvalued (first row, third column of Table 1), his or her investment in asset i is opposite to the investment of an investor in individual assets, i.e., it is considered counterintuitive. Please note that the 16 cases in the two tables differ between ETF fundamentalists and chartists. For ETF fundamentalists, the ratio between fundamental value of tomorrow and price of today is important whereas for ETF chartists the ratio of today's price and yesterday's price is of interest.

5 Conclusion

Exchange-traded Funds are easy to understand, cost-efficient ways of investing in stock market indices that have become very popular for both retail and institutional investors. The discussion of the wider repercussions of ETFs have just begun and are motivated by the rapid growth of these financial products. In our study we focus on alternative investment strategies implemented with ETFs and how they affect the markets of underlying individual assets. Under the complex interactions between index investments and the price dynamics of individual stocks, we find that the conventional assessment that fundamentalists tend to stabilize, while chartists tend to destabilize price dynamics does not necessarily hold.

Exchange-traded Funds might play a crucial role in amplifying shocks and destabilizing price dynamics when compared to a situation in which investors invest directly in individually selected securities. The importance of such risks is likely to have risen due to structural changes in the financial systems of advanced economies. Not only has the relative weight of such products increased considerably, but also banks have tended to backtrack as market makers, possibly contributing to lower market liquidity. The effects of large-scale funds, respectively large-scale investment strategies, might thus be more

far-reaching than in the past.

This analysis suggests to refocus financial market regulation. New financial products such as ETFs are not (de)stabilizing per se and regulation should not (only) concentrate on their sheer size and rate of growth. Rather it is the specific use of these products that is of interest and should be at the focus of financial market regulators, an idea also suggested from the perspective of market governance, see, e.g., Ockenfels and Schmalz (2016); Röper (2016). More generally, even simple and seemingly innocuous products like ETFs might have substantial side effects and deserve close scrutiny in particular with respect to alternative market situations and trading strategies. An important lesson learned from financial history is that even seemingly innocuous algorithmic trading might lead to serious asset price bubbles and financial crises. Subsequent research which particularly looks into the various dynamic interactions between market dynamics of indices and their underlying individual assets is called for to better understand the wider implications of the rapid spread of ETFs, which can essentially be considered algorithmic trading vehicles.

List of Abbreviations and Symbols

abbreviations:

C	chartist/trend follower
count.	counterintuitive behavior
E	ETF; Exchange-traded Fund
E-C	ETF chartist/ETF trend follower
E-F	ETF fundamentalist
ETF	Exchange-traded Fund
F	fundamentalist
int.	intuitive behavior
?	unknown behavior

parameters and variables:

c^*	fixed investment parameter
D, D^ℓ	demand function for the index (of trader ℓ)
D_i, D_i^ℓ	demand function for asset i (of trader ℓ)
f, f_i	fundamental value of the index, fundamental value of asset i
I, I^ℓ	net asset position of the index (of trader ℓ)
I_i, I_i^ℓ	net asset position of asset i (of trader ℓ)
N	number of assets in the index
μ, μ_i	trend of the index, trend of asset i
p, p_i	price of the index, price of asset i
t, t^*, T	time, termination time, time grid

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