

TRACKING THE EURO STOXX 50

by

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Tracking the Euro Stoxx 50

MOTIVATION

- To develop a completely **new class of indexes** based on the (unobserved) market value of *assets*.

RELEVANCE

- At the end of April 2021, €32.3 billion in assets under management (AuM) were pegged to the Euro Stoxx 50 index, making it the **most important European equity benchmark** measured by assets.

GOAL

- The Euro Stoxx 50 should be **easy to replicate**. We show that this is **not** the case, because one has to cope with the changes of the constituent stocks (*reshuffling*) and the weights (*rebalancing*).

Motivation

- In another paper (“Deleveraging CAPM: Asset Betas vs. Equity Betas”), we assume that the instability of the estimates of “classical” *equity betas* is mainly due to the firms’ leverage, which stochastically changes over time.
- To overcome the instability’s problem, we proposed a three-step approach:
 1. To estimate the (unobserved) market value of firm’s assets, V , by assuming a Perpetual-Debt Structural Model (PDSM).
 2. To build an index that tracks the (unobserved) market value of firm’s assets.
 3. To estimate the *asset betas* of the linear relationships between the asset returns and the market returns.
- This paper “paves the road” to the 2nd step of the above approach.

Constituent Stocks and Method of Construction

The stock market indices differ *primarily* by the particular universe from which they are constructed and, *secondarily*, by their method of construction.

Constituent
Stocks

Method of
Construction

Constituent Stocks

- Broadening the underlying portfolio can generate pitfalls:

There is an econometric tradeoff as the index is broadened from the largest capitalization stocks to include ever smaller ones. The more inclusive is the index, the closer it is to the ideal of an index that includes all wealth. The cost of completing the index, however, is the lowered continuity and reliability of the prices of smaller stocks. [Ross (1992)]

Method of Construction

- *Value-weighted* $I_{0,1} = \frac{\sum p_1 q_0}{\sum p_0 q_0} = \frac{\sum \frac{p_1}{p_0} p_0 q_0}{\sum p_0 q_0} = \sum \frac{p_1}{p_0} w_0$ where $w_0 = \frac{p_0 q_0}{\sum p_0 q_0}$

- *Equally-weighted* $I_{0,1} = \frac{\sum \frac{p_1}{p_0}}{m} = \sum \frac{p_1}{p_0} \frac{1}{m} = \sum \frac{p_1}{p_0} w_0$ where $w_0 = \frac{1}{m}$

- *Price-weighted* $I_{0,1} = \frac{\sum p_1}{\sum p_0} = \frac{\sum \frac{p_1}{p_0} p_0}{\sum p_0} = \sum \frac{p_1}{p_0} w_0$ where $w_0 = \frac{p_0}{\sum p_0}$

Chain Indices

- Whatever their method of construction, stock indices are *chain indices*: They link together the returns measured in homogeneous periods, when the components of the underlying portfolio or the number of their shares do not change.
- In other terms, when the underlying portfolio is revised at time $t = t_1$, the time $t = t_2$ index, I_2 , is equal to

$$I_2 = \text{base} \cdot I_{0,1} \cdot I_{1,2}$$

where the base is an arbitrary number (“100”, “1,000” or “10,000”).

- More generally, when we have k review dates, the time $t = t_n$ index is equal to

$$I_n = \text{base} \cdot I_{0,1} \cdot I_{1,2} \cdots I_{k-1,k} \cdot I_{k,n}$$

Market Capitalization and Divisor

- Specifically, for what concerns *value-weighted indexes*, the index level is calculated as the ratio between the *market capitalization* of the underlying portfolio and a *divisor*.

$$I_n = \text{base} \cdot \frac{\sum p_1 q_0}{\sum p_0 q_0} \cdot \frac{\sum p_2 q_1}{\sum p_1 q_1} \cdot \dots \cdot \frac{\sum p_k q_{k-1}}{\sum p_{k-1} q_{k-1}} \cdot \frac{\sum p_n q_k}{\sum p_k q_k} = \frac{\sum p_n q_k}{\text{divisor}}$$

where

$$\text{market capitalization} = \sum p_n q_k$$

and

$$\text{divisor} = \frac{\sum p_0 q_0}{\text{base}} \cdot \frac{\sum p_1 q_1}{\sum p_1 q_0} \cdot \dots \cdot \frac{\sum p_{k-1} q_{k-1}}{\sum p_{k-1} q_{k-2}} \cdot \frac{\sum p_k q_k}{\sum p_k q_{k-1}}$$

Divisor

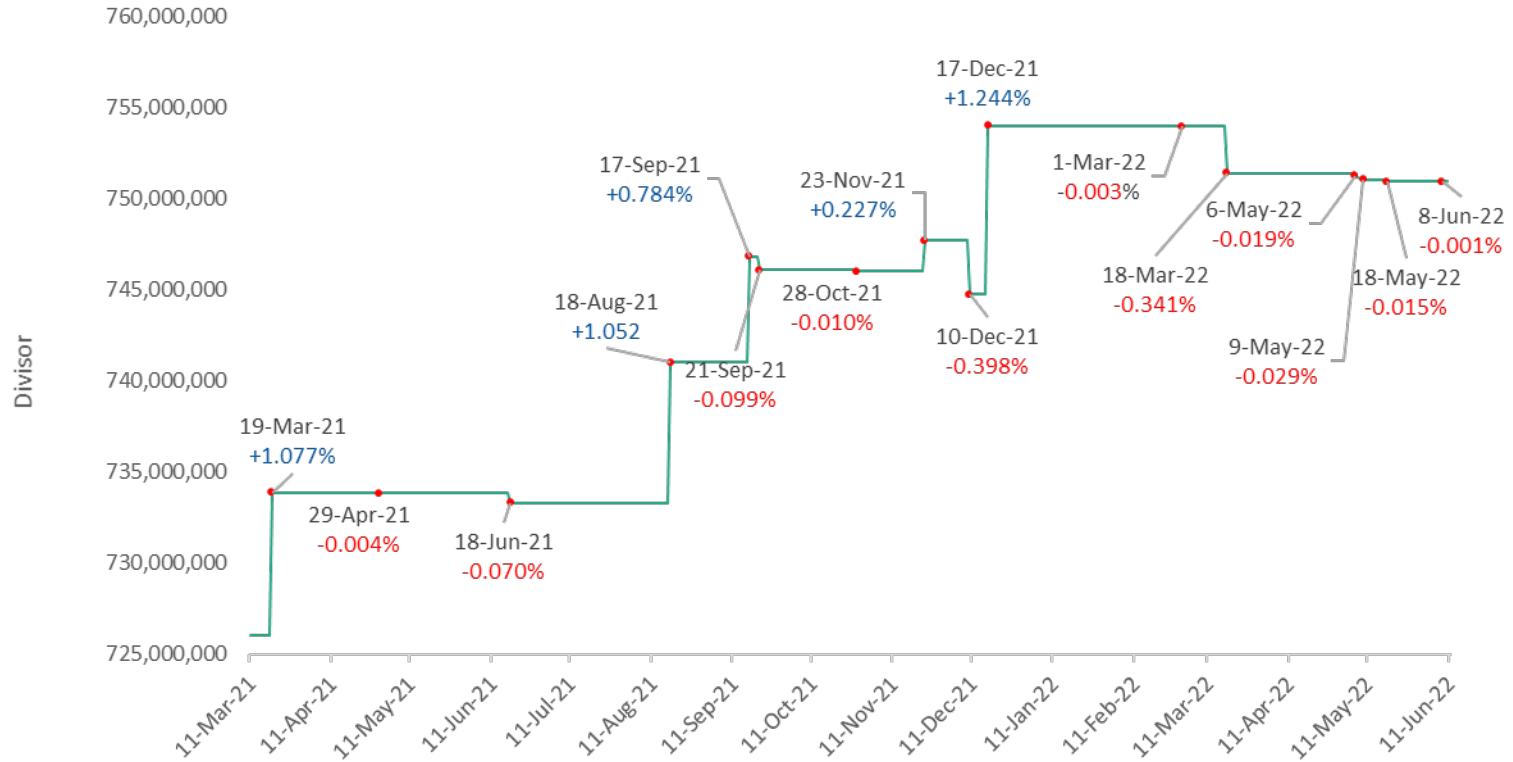
- Therefore, the divisor

$$divisor = \frac{\sum p_0 q_0}{base} \cdot \frac{\sum p_1 q_1}{\sum p_1 q_0} \cdot \dots \cdot \frac{\sum p_{k-1} q_{k-1}}{\sum p_{k-1} q_{k-2}} \cdot \frac{\sum p_k q_k}{\sum p_k q_{k-1}}$$

is the product of $(1 + k)$ terms, where the first one is the ratio between the value of the original portfolio and the base chosen (“100”, “1,000” or “10,000”) while the following ones are the ratios between the value of the new portfolio and the value of the old portfolio at each of the k review dates.

- As a consequence, in order to *sterilize* the effects of the revision, the divisor increases (decreases), at a review date, if the value of the new portfolio is higher (lower) than the value of the old portfolio.

EURO STOXX 50[®] Index: Divisor



Divisor's Changes: Reshuffling and/or Rebalancing

The Divisor's changes shown in the previous slide may be due to the changes of i) the constituent stocks (*reshuffling*) or ii) the weights (*rebalancing*).

Reshuffling

Rebalancing

Reshuffling

- The portfolio underlying the EURO STOXX 50 is highly “dynamic”: During our observation period (February 26th, 1998 to December 31st, 2021) **only 11 (out of 50) stocks have not been removed from the original portfolio.**
- In our observation period (24 years), the underlying portfolio has been **reshuffled 50 times.**
- **The number of companies** that, at least once, have been included in the portfolio underlying the EURO STOXX 50 is equal to **108.**

Rebalancing

- Originally, the EURO STOXX 50[®] Index was based on the total number of *shares outstanding* for each class of stock.
- Now, the company's *outstanding shares* are *adjusted by free float* “to reflect only truly tradable and investable shares”.
- On July 6th 2000, STOXX announced that (effective September 18th, 2000):
For each of the component stocks, the weighting will be based on the number of free float shares outstanding; i.e. those shares that are not held in block ownership.
- The rules for free float adjustment have made *tracking of the EURO STOXX 50[®] Index much more difficult.*

Tracking the EURO STOXX 50

- In order to be readily aware of changes in the underlying portfolio, we started to collect the Refinitiv daily data on the capitalization and the divisor of the index.
- During the period from December 17th, 2021, to February 28th, 2022, [the divisor did not change](#), remaining stable at the level of 753,992,857.
- This made it possible to [estimate the free-float shares on the basis of the first 50 observations](#) (December 17th, 2021 to February 24th, 2022) and to measure our tracking errors by using the last two observations (February 25th and February 28th, 2022).
- To estimate the free-float shares, we set up a system of 50 equations in 50 unknowns.
- Our *tracking errors*, defined as log differences between actual and theoretical indices, are both equal to 2 basis points.

Conclusions (I)

- The EURO STOXX 50[®] Index is one of the most important benchmarks for the asset management industry.
- Even if its underlying portfolio is made up by only 50 stocks, its **tracking is not easy** because of *reshuffling* (additions and deletions of constituent stocks) and *rebalancing* (review of free-float shares).
- The portfolio underlying the EURO STOXX 50 is highly “**dynamic**”: During our 24-year observation period the underlying portfolio has been reshuffled 50 times, and only 11 (out of 50) stocks have not been removed from the original portfolio.
- Besides, we showed that, in a 15-month period, the index’s divisor has been changed 16 times, roughly once per month.

Conclusions (II)

- Should the **reference portfolio** be **dynamic** or **static**?
- Consistently with the two criteria of *parsimony* and *transparency*, benchmarks should be as **static** as possible and track the performance of a *buy-and-hold investor*.
- Additions to and deletions from the EURO STOXX 50 have a strong **impact on quotes**
- As shown from Fernández *et al.* (2006): *A portfolio long in the companies that entered the index and short in the companies that abandoned the index had on average a 6.85% return in the 20 days prior to the index recomposition and a 0.97% return in the 20 days after the index recomposition.*

Conclusions (III)

- Should prices be weighted by **outstanding shares** or **free-float shares**?
- Quoted prices only measure what investors want to pay or receive for a **marginal number** of traded shares.
- Therefore, they are **marginal prices**. They do **not** measure the **average** value of a single share.
- Therefore, theoretically, prices should be weighted by **traded quantities**.
- Take the case of hostile takeovers. In a battle where a **marginal** percentage of the outstanding shares is sufficient to gain the firm's control, quoted prices include a **control premium** that cannot be extended to the whole universe of outstanding or free-floating shares. As stated by Alan Greenspan, control premiums can be as high as 100%.

Conclusions (III)

- Theoretically, the weights of value-weighted indices should be based on the number of **traded shares** rather than on the number of outstanding or free-floating shares.
- However, such indices would be “**informationally demanding**” and difficult to be tracked. Full replication of the index would be difficult to achieve and would involve **significant rebalancing transaction costs**.
- Besides, these indices would **not** measure the performance of any **real portfolio** and could be invalidated by **chumming** practices.

Conclusions (IV)

- An easy alternative to the EURO STOXX 50[®] is the **EURO STOXX 50[®] Equal Weight Index**, which better fits the needs for *parsimony* and *transparency*.
- The EURO STOXX 50[®] Equal Weight Index follows the same methodology as the EURO STOXX 50[®] Index except for the weighting process: All components are given an equal weight.
- In the period 1999-2021, the EURO STOXX 50[®] Equal Weight Index **overperformed** the EURO STOXX 50[®] Index by 24,74%, while their daily volatilities are almost equal.
- This evidence seems to confirm that **it is easy to beat a value-weighted market index**.

EURO STOXX 50[®] and EURO STOXX 50 Equal Weight[®]



Final Remarks

- So, what should be the **ideal index**?
- Do we need a **stock** price index or an **asset** price index?
- The **Market Portfolio** should be made up by all the *assets* in the economy, not by all the *stocks* in the economy. *Stocks* are only one of many contracts whose value depends on the firm's *assets*.
- The **Equity Betas** are notoriously unstable. We assume that their instability is not only due the continuous index reshuffling and rebalancing, but also to leverage, which stochastically changes over time. In fact equity is a levered portfolio: long on assets and short on bonds.
- The construction of a ***static index of asset values*** and the estimation of ***asset betas*** will be the subject of our future research.