Gain–loss asymmetry for emerging stock markets

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Abstract

Stock indexes for some European emerging markets are analyzed using an investment-horizon approach. Austrian ATX index and Dow Jones have been studied and compared with several emerging European markets. The optimal investment horizons are plotted as a function of an absolute return value. Gain–loss asymmetry, originally found for American DJIA index, is observed for all analyzed data. It is shown, that this asymmetry has different character for emerging and for established markets. For established markets, gain curve lies typically above loss curve, whereas in the case of emerging markets the situation is just the opposite. We propose a measure quantifying the gain–loss asymmetry that clearly exhibits a difference between emerging and established markets.

Keywords: Stock; Indices; Investment horizon approach; Inverse time distribution

Tools and approaches worked out to describe physical phenomena often become a source of new methods used in analysis of economical data. A list of analogies between statistics of physical and economical systems is already quite impressive [1–3]. In this work an analysis of stock index data for several European markets follows recently proposed method called investment horizon approach [4–8]. Investment horizon approach is an adaptation of the concept of inverse statistics. It gives new, time dependent, measure of asset performance, an alternative to the classical approach. In the traditional statistics distributions of returns for a given time window are analyzed. In the inverse statistics we analyze distributions of time periods that one has to wait before getting assumed return value for the first time. This waiting time is our investment horizon at a given return level \( \rho \). It has previously been shown that such a distribution may be described by a universal curve [4–7], with power decay law for large times, given by the universal exponent \( \alpha \approx 1.5 \). For each return value the maximum of the distribution \( t_{\text{max}} \), called optimal investment time, can be found. It appears that \( t_{\text{max}} \) increases as a power of return values. The value of the exponent \( \gamma \) of this power growth has been shown to be \( \approx 1.8 \) for Dow Jones industrial average (DJIA) [6,7]. This value is smaller than an analogical parameter for the random-walk first-passage-time behavior \( \gamma_0 = 2 \).

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Similar analysis performed in Ref. [9] resulted in even smaller value of this exponent for DIJA $\gamma \approx 1.6$. The authors of Ref. [9] studied many emerging and established markets, and calculated parameter $\gamma$ for all analyzed data. They conclude that this parameter can measure maturity of a given market. In general, values of $\gamma$ are much lower for emerging markets than those found for developed markets. In the present paper we show, that investment horizon approach provides even more evident measure of the market maturity. For DIJA loss and gain curves are not symmetric with respect to the change of a sign of a return value [7]. We compared behavior of such curves for emerging and for developed markets. It appears that the difference is not only quantitative, but also qualitative. Gain and loss curves, when plotted as a function of the absolute return value lay one above the other in the order that depends on the character of the market. Exponent $\gamma'$, that describes power-like dependence of the optimal investment time for loss as a function of $|\rho|$ is much higher than $\gamma$ of the optimal investment time for gain in the case of emerging markets, and this relation is just opposite for developed markets. Below, we shortly characterize the method used, discuss distribution and parameters of the fit, and then we show results of our analysis. Finally a parameter that can be used as a practical and sensitive market maturity measure is defined.

Let $S(t)$ denotes the asset price. Returns are defined as the difference of logarithms of successive asset prices:
$$s(t) = \frac{\ln S(t) - \ln S(t-\Delta t)}{\ln S(t)/\ln S(t-\Delta t)}.$$ In our case $\Delta t = 1$ day. The input data for further study are obtained by subtracting mean time trend of returns. The mean trend of data is evaluated by moving average over 100 points. In this method local trend value for a given time point is an average, linear trend of successive 50 points prior to given point and 50 following it. The trend value at the next moment of time is calculated after moving forward such a time window by one data point. First 50 data points and last 50 data points are, obviously, ignored. Results of this procedure are shown in Fig. 1. The number of data to calculate an average has been chosen after many trials, and number 100 was found to be the best choice for emerging markets. All European emerging markets exist for quite a short time. Because of this it was not possible to take 1000 points to the average, like it has been done in the previous analysis of DJIA [7]. The currently invested capital in such emerging markets is relatively small thus they are more susceptible on influences of global economic situation and the mean trend of data shall be evaluated taking into account less number of points. We checked, however, that the main results for DJIA do not change much when an average over 100 samples is taken.

Period of time that goes by until we get a given return value depends on the moment, when we invest our money. When we repeat our procedure starting at distinct moments, we end up with a distribution of possible investment horizons for a given $\rho$. If the investigated process is completely random and uncorrelated, like the Brownian motion, the distribution of such periods of time, often called a first passage time, is given by
$$p(t) = a \frac{\exp(-a^2/t)}{\sqrt{\pi}t^{3/2}},$$ (1)
where $a$ is a variable being an analogue of our return value and $t$ is time. This distribution for large values of $t$ scales as
$$p(t) \approx t^{-3/2}.$$ (2)
It has been shown [6,7] that distribution of investment horizons for DJIA has well defined maximum, called optimal investment time, followed by power-like tail scaling as $\approx t^{-3/2}$. Formula (1) can be (poorly) fitted to the obtained distributions, but to reach better agreement, the modified version of the above formula can be used

$$p(t) = \frac{\nu}{\Gamma(\alpha - 1/\nu)} t^{-\alpha} \exp\left\{ -\left( \frac{\beta^2}{t - t_0} \right)^\nu \right\},$$

where $\nu$, $\beta$, $\alpha$ and $t_0$ are fitting parameters. The function above has been postulated in Ref. [7], and it describes very well the shape of the obtained distribution.

Note, that position of the maximum of (3) is given by

$$t_{\text{max}} = t_0 + \frac{\beta^2}{\alpha} \left( \frac{v}{\alpha} \right)^{1/\nu},$$

and is not equal to $t_0$. For our distributions $t_{\text{max}}$ value is far from the value $t_0$, differently than in the case of DJIA, hence we use rather $t_{\text{max}}$ as a fitting parameter.

Applying this method we have reproduced results from Ref. [7] for DJIA. Then we started analysis of some emerging market indexes: Slovak SAX, Hungarian BUX, Polish WIG, and Czech PX50. As it is shown below, the obtained results are essentially different from those for DJIA. To check whether this difference is not just a scale effect, we have chosen Austrian ATX as an example of a relatively small but established European market. It happens that gain–loss curves for ATX resemble DJIA data. In general, distributions for emerging markets, when compared with those for established ones, are shifted towards zero; their optimal investment horizons are lower. This is a sign of a rather large volatility of the data, what is typically a characteristic feature of emerging markets. Such behavior suggests that the optimal investment horizon is located within a small time window, dominated by short-time volatile processes. Volatility, measured by mean standard deviation $\sigma$ of the return value, is larger for emerging markets. However, our main results do not scale with $\sigma$, which means that $t_{\text{max}}/\sigma$ data are still smaller for emerging than for established markets. Formula (3) has four different fitting parameters. All of them are necessary to describe properly the shape of a given investment horizon distribution. However, we are interested only in two of them, having some direct interpretation. Parameter $\alpha$ describes power-like decay of long time tails of distributions. In all studied data this parameter is about 1.5, like for the Brownian motion. Next parameter discussed here is $t_{\text{max}}$, which gives a position of optimal investment horizon for a given return value. Its behavior as a function of a return level for its positive and negative values will be discussed below. Additional two parameters $\nu$ and $\beta$ (or $t_0$ via Eq. (4)) have no simple interpretation, and their values vary from one distribution to another. Values of $\nu$ change from 0.06 to 0.4, and $t_0$ changes between $-1$ to 1. When we compare distributions for the same absolute values of return values, but with negative and positive sign, it is obvious that they differ in an essential way (Fig. 2).

In all examined cases gain–loss asymmetry is evident. It can be already seen comparing the shape of distributions plotted for $\rho$ and $-\rho$. When we plot $t_{\text{max}}$ as a function of the absolute value of returns, curves plotted for positive and negative returns are separated. In the case of DJIA loss curve lies below gain curve; this reflects situation where usually (on average) you wait longer for gain than for loss of the same return value. In the case of emerging markets this is no longer true. It can be seen, that the ordering of curves depends on the character of the market. In Fig. 3 gain–loss curves for several East-European markets are plotted in double logarithmic scale. In all these plots optimal investment time changes within the range of 1 up to 20 days, and not up to 100 days as in the DJIA, or 40 days for ATX. As mentioned above, this reflects volatile character of these markets. In the case of Polish WIG and Slovak SAX, loss and gain curves clearly separate, but loss curve is located above gain curve, which suggests that, contrary to the American market, waiting time for loss is longer than for gain at the same absolute return value.

The distance between two curves depends on the data. For Czech PX50 and Hungarian BUX both curves are very close together but with some tendency of the loss curve to be above gain curve, which can be observed by comparing their slopes. The situation is different for Austrian ATX, presented in Fig. 4. Here loss curve is the lower one, like for DJIA. All discussed plots have characteristic shape: they stay close to the value of one day up to some return value, and then start to grow as $\rho^\gamma$ with different values of the coefficient $\gamma$. 
Fig. 2. WIG investment horizon distribution calculated for return values $\rho = 0.06$ (closed squares) and $\rho = -0.06$ (open triangles).

Fig. 3. Optimal investment horizon plotted as a function of absolute return value for: (a) SAX; (b) BUX; (c) WIG and (d) PX50. Data for $\rho > 0$ are marked by squares, and for $\rho < 0$ by triangles. Dashed lines show average slope of gain and loss curves.
To characterize a difference between curves more precisely, we analyzed values of $g$ for gain curve and of $g^0$ for loss curve given by mean slope of the plotted curves. Lines with fitted slopes are shown in presented figures. For Slovak SAX $g = 1.27$ (gain curve) and $g^0 = 1.67$ (loss curve). For Hungarian BUX $g = 1.44$ and $g^0 = 1.81$. For Polish WIG $g = 1.11$ and $g^0 = 1.42$. And finally for Czech PX50 $g = 1.48$ and $g^0 = 1.65$. Behavior of the all above mentioned markets can be compared with Austrian ATX, where $g = 1.54$ and $g^0 = 1.44$.

Now we are ready to define a quantity $\kappa$ that is a measure of the market “maturity”. Let $\kappa = g - g^0$. Then for corresponding markets (in the same order as above) we have: $\kappa = -0.40$, $-0.37$, $-0.31$, $-0.17$, and $0.10$.

We can see, that the value of $\kappa$ is negative for emerging and positive for developed markets. This property systematically divides markets into two groups according to sign of $\kappa$.

For the first type of the market, the established one, you wait shorter time (on average) for loss of a given value than for gain of the same amount. Investing in markets of the second type, the emerging ones, you wait shorter time for gain. Thus, in general, they seem to be more promising markets to invest.

We did not find that individual stocks behave essentially in a different way than the index of a market. There were some differences in behavior, but we observed the same gain–loss asymmetry for most of them. This means that hypothesis that the asymmetry is caused by some correlation between different objects (stocks) is not true for emerging markets. It is rather simple sum of the behavior of individual stocks.

In summary, we have found that gain–loss asymmetry, previously found for DJIA, is also present for emerging markets, but it is inverted as compared to developed markets. We have proposed a simple and useful measure of the observed asymmetry, defined as a difference between the exponents $g$ and $g^0$. Such a parameter has negative values for emerging markets and stays positive for developed ones.

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References