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THE TREND AND DYNAMICS DISTRIBUTION OF THE JAKARTA STOCK EXCHANGE (JSX) COMPOSITE

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─Abstract ─
In this paper we discuss the dynamics of the Jakarta Stock Exchange (JSX) Composite. The dynamics indicates performance indicator of several industries in Indonesia. The data is presented as time series. To predict the dynamics from the data, however, is still difficult. In general, it is almost impossible to predict such dynamics for the case of high frequency data. Hence, we do not predict the dynamics. Rather, we seek the trend and the probability density function (pdf).

For a 'small' period of time, the pdf is based on the assumption that the dynamics is normally distributed. Mathematically speaking, this is a time averaging of data, and in some cases the data is presented in the form of candle sticks. The trend will be approximated by a higher order polynomial function which is sought by applying a least square methods. On the other hand, the probability density function of the data within each candle stick is obtained by computing standard deviation of the data with respect to the trend in the candle stick.

Key Words: *Jakarta Stock Exchange, JSX Composite, Dynamics, Trend Curve*
JEL Classification: C02, C15, C32, C53, G17

1. INTRODUCTION

1.1. Jakarta Composite Index (JSX)

Jakarta Stock Exchange (JSX) Composite is an index of all stocks that trade on Indonesia Stock Exchange (ISX). ISX si formerly known JSX. The dynamics of JSX Composite indicates performance indicators of industries selling their stocks on Indonesia Stock Exchange. Hence, understanding the dynamics 'behaviors' is a need from practical point of view. From theoretical point of view, on the other hand, such dynamics is still hardly to predict. This motivates for further study, partly reported in this paper.

JSX Composite was introduced on April 1983. As on August 10, 1982 the base index is 100. Recently, as the industries grow and more industries sell their stocks on ISX, the index reaches almost 4000. The data of JSX Composite is presented as time series. Most studies are intended to predict the dynamics based on the time series data.

1.2. Previous study on the dynamics of index, commodity and currencies

So far, research on the dynamics of index, commodity, and currencies are not intended to predict them directly. Rather, the research focuses on the related aspects. Bekiros & Diks (2008) conducted study on causal linkages of six currencies; i.e. Euro (EUR), Great Britain Pound (GBP), Japanese Yen (JPY), Swiss Frank (CHF), Australian Dollar (AUD) and Canadian Dollar (CAD) relative to United States dollar (USD). The results indicate that currency returns may exhibit asymmetries and statistically significant higher-order moments. Such asymmetries are also found on Emekter, Jirasakuldech & Snaith (2009) for the case of Singaporean dollar (SUD) and South African rand (SAR).

Gadea, Kaabia & Sabaté (2009) studied the relationship among Italian, Spanish and United Kingdom prices over the period 1874–1998. They found that the price differential dynamics captured by deterministic trends in the period 1940–1998. Krylova, Nikkinen & Vähämaä (2009) examined the cross-dynamics of volatility term structure slopes implied by foreign exchange options. Their empirical findings demonstrate that a few principal components can explain a vast proportion of the variation in volatility term structure slopes across the major exchange rates. Muchnic, Bunde & Havlin (2009) also study volatility, but focusing on the return of an investment on shares and exchange rates. Béreau, Villavicencio & Mignon (2010) studied the nonlinear dynamics of the real exchange rate towards its behavioral equilibrium value. They obtain that the real exchange rate convergence process in the long-run is characterized by nonlinearities for emerging economies, whereas industrialized countries exhibit a linear pattern.

The study on the dynamics (i.e. the ups and downs) of exchange rates has also attracted research in physics which then introduced the so-called econophysics. In econophysics, asset dynamics is often modeled by continuous time random walk (CTRW). In physics, CTRW is used to model anomalous diffusion, where a cloud of particles spread at a rate different than the classical Brownian motion. A rather comprehensive review of the CTRW for asset dynamics can be found in (Meerschaert & Scalas, 2006).

In econophysics, the CTRW model has been applied for the movement of asset log-prices, see among others Gorenflo etal (2001), Mainardi etal (2000) and Roberto etal (2002). Especially, Roberto etal (2002) conducted an empirical study of tick-by-tick trading data for General Electric (GE) stock during October 1999. They use a Chi-square test to show that the waiting times and the subsequent log returns are not independent. The data show that long waiting times are followed small returns, while large returns follow very short waiting times.

For the case of the dynamics of asset value in general, Cahyono, Juliana & Raya (2009) show that the trend and the probability density (pdf) function of the dynamics are related to the fundamental solution of a type of diffusion equation. They follow Evans (2000) for the derivation of the solution. In this paper, however, we study the trend and the pdf of the dynamics of USD relative to Indonesian rupiah (IDR).

2. DATA, METHODS, RESULTS AND ANALYSIS

2.1. Data and Methods

The data of JSX Composite for this study are recorded monthly in the period of January 1995 to December 2010 provided by Indonesia Central Bank (Bank Indonesia). Mathematically, the data can be represented in the form of a set of m-ordered pairs $D = \{(t_i,x_i) \mid 1 \le i \le m\}$, a discrete relation between time t_i and the index x_i. The trend which is a continuous function in the form $y = f(t)$ will be obtained by applying a Least Square Method.

Note that this is a mathematical analysis approach. For practical or technical point of view can be found in many standard textbooks, such as Neter, William & Michael (1990). Moreover, the trend to be sought is choosen in the form of polynomial function. It is because, mathematically, every continuous function can be expressed in a polynomial function. The mathematical proof can be found in many standard (classical) books on analysis, including the introduction one such as Barttle & Sherbert (1994). The method is to seek the coefficient of the polynomial function by minimizing its distance to the data.

On the other hand, the data distribution relative to the trend is treated as below. For the fixed time, the data is assumed normally distributed centered at the trend. Hence, we seek the normal probability distribution function which is determined by the center (on the trend) and the standard deviation. To compute the standard deviation, the adjacent data is grouped of five, suppose x_{t1}, x_{t2}, x_{t3}, x_{t4}, and x_{t5}. The trend at t_3 is $\bar{x}$. Grouping the data means that each data no longer depend on time. Such treatment to the data often occures on the presenting in the candle stick form. Hence, the standard deviation is computed by the formula

$$s = \frac{1}{4}\sum_{n=1}^{5}\left(x_{tn} - \bar{x}\right). \qquad (1)$$

2.2. Results and discussion

The dynamics of JSX is represented by the trend and the data distribution relative to the trend. The trend is obtained by applying a least square method which is implemented in software Maple. Applying a 28th order polynomial, the trend is given in the form of

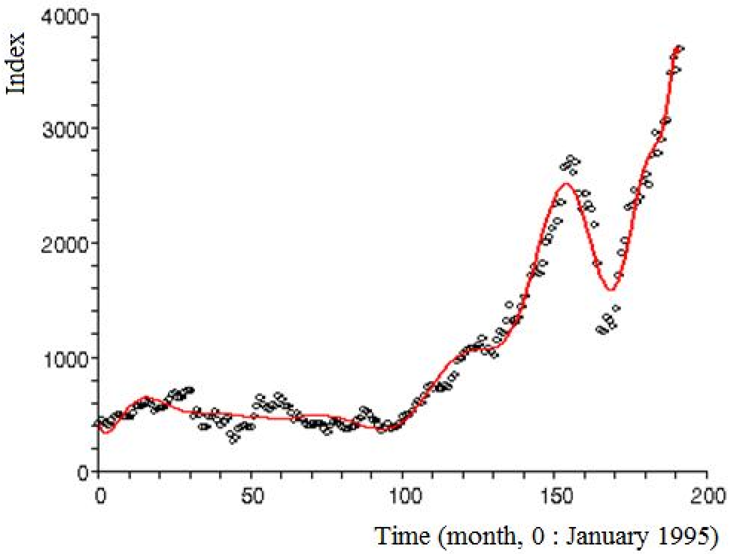
$$f(t) = \sum_{n=0}^{28} a_n t^n \ , \qquad (2)$$

where

a_0	$= 433.831$	a_1	$= -84.706237$
a_2	$= 24.068514$	a_3	$= -2.197367$
a_4	$= 0.099477$	a_5	$= -0.002529$
a_6	$= 0.000037$	a_7	$= -2.693534 \text{ X } 10^{-7}$
a_8	$= 4.350202 \text{ X } 10^{-10}$	a_9	$= 5.752319 \text{ X } 10^{-12}$
a_{10}	$= -2.661567 \text{ X } 10^{-14}$	a_{11}	$= 2.124948 \text{ X } 10^{-16}$
a_{12}	$= -3.382219 \text{ X } 10^{-18}$	a_{13}	$= 1.351667 \text{ X } 10^{-20}$
a_{14}	$= 1.811358 \text{ X } 10^{-23}$	a_{15}	$= -3.119745 \text{ X } 10^{-28}$
a_{16}	$= 0$	a_{17}	$= -4.994935 \text{ X } 10^{-30}$
a_{18}	$= -2.701217 \text{ X } 10^{-32}$	a_{19}	$= -1.890559 \text{ X } 10^{-35}$
a_{20}	$= 1.276546 \text{ X } 10^{-36}$	a_{21}	$= 7.969189 \text{ X } 10^{-39}$
a_{22}	$= -2.647231 \text{ X } 10^{-41}$	a_{23}	$= -2.326265 \text{ X } 10^{-43}$
a_{24}	$= 5.556006 \text{ X } 10^{-47}$	a_{25}	$= 1.964410 \text{ X } 10^{-48}$
a_{26}	$= 2.100884 \text{ X } 10^{-50}$	a_{27}	$= -9.489044 \text{ X } 10^{-53}$
a_{28}	$= 8.056877 \text{ X } 10^{-56}$		

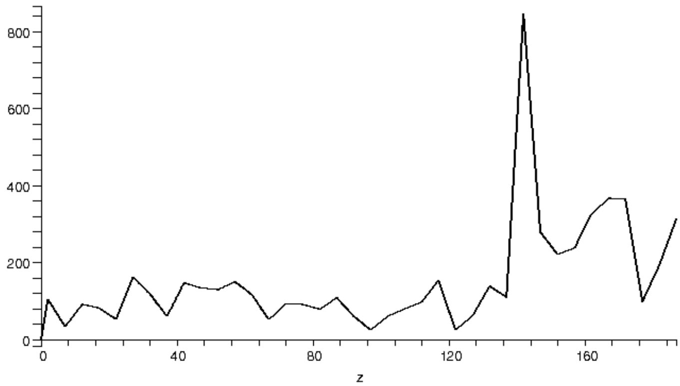
Graphical representation of (2) is given in Figure 1. The dots are the data, while red curve is the trend (2). The coefficient of correlation (*R*) is 0.986, and the coefficient of determination (*R*2) is 0.973 meaning that the trend is a good approximation to the data, as can be observed on the Figure 1. Observe that there are time intervals where the data close to the trend and others which are not. In the interval of [25,60] or in the years 1997 to 2000 data are not close to the trend. This is related to the Asia economic crisis in 1997/98 and the time for recovery afterwards. The large distribution also appears in the interval [150,170] or in 2008 to 2009 which is related to the global financial crisis.

Figure-1: The trend curve of JSX



The standard deviation of each group of five data is computed by applying formula (1). This give several standard deviations that depend on time, the so-called temporal standard deviation. Graphically, the temporal standard deviation is presented in Figure 2. Note that the temporal standard deviation is linear interpolation of the computed standard deviation. The trend and the data distribution all together yield the so-called a temporal probability density function (t-pdf). For the case of 'linear' standard deviation, t-pdf is fundamental solution of a diffusion equation, Cahyono etal (2009). There have been tremendous mathematical results on the fundamental solutions of several types of diffusion equations including for the applications in heat and mass transfer. Rosner (1963), Belolipetski & Ter-Krikirov (1984), Mainardi (1996), Evans (2000), Balakrishnan & Ramachandran (2000), Guevara-Jordan & Rojas (2003) and Cahyono & Soeharyadi (2010) are among others. These studies are expected to be applicable on such dynamics in the near future.

Figure-2: Standard deviation of the data from the trend



3. CONCLUSION

We have presented the dynamics of the Jakarta Stock Exchange (JSX) Composite. The focus is on the trend and the data distribution from the trend. The trend is approximated by a higher order polynomial function of order 28th. The data distribution is indicated by the standard deviation of their temporal normal probability density function (t-pdf).

On the study of the family of diffusion equations, t-pdf is fundamental solution of a diffusion equation. Tremendouse results on diffusion equation are expected to be applicable to explain the dynamics of JSX Composite.

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BIBLIOGRAPHY

Balakrishnan, K. and Ramachandran, P. A. (2000), “The method of fundamental solutions for linear reaction-diffusion equation”, *Methematuics and Computer Modelling*, Vol. 31, No. 2-3, pp.221-237.

Bekiros, S. D. and Diks C. G. H. (2008), “The nonlinear relationship of exchange rates: Parametric and nonparametric causality testing”, *Journal of Macroeconomics,* Vol. 30, No. 4, pp.1641-1650.

Belolipetskii, A. A. and Ter-Krikorov, A. M. (1984), “Fundamental solutions of the non-linear equation of heat conduction”, *USSR Computational Mathematics and Mathematical Physics*, Vol. 24, No. 3, pp.141-149.

Béreau, S., Villavicencio A. L. and Mignon, V. (2010), “Nonlinear adjustment of the real exchange rate towards its equillibrium value: A panel smooth transition error correction modeling”, *Economic Modelling,* Vol. 27, No.1, pp.404-416.

Cahyono, E., Juliana, J.R. and Raya, R. (2009), “Asset value dynamics and the fundamental solution of a modified heat equation”, (in the 4th International Conference on Mathemetics and Stattistics), Bandar Lampung, Indonesia, pp.312-318.

Cahyono, E. and Soeharyadi, Y. (2010), “On the interaction of Barenblatt’s solution to the porous medium equation”, *International Journal of Mathematical Sciences and Engineering Applications*, Vol. 4, No. 2, pp.187-198.

Evans, M. D. D. and Lyons, R. K. (2008), “How is macro news tranmitted to exchange rates?”, *Journal of Financial Economics,* Vol. 88, No. 1, pp.26-50.

Emekter, R., Jirasakuldech, B. and Snaith, S. M. (2009), “Nonlinear dynamics in foreign exchange excess returns: Tests of asymmetry”, *Journal of Multinational Financial Management,* Vol. 19, No. 3, pp.179-192.

Gadea, M. D., Kaabia, M. B. and Sabaté, M. (2009), “Exchange rate regimes and prices: The cases of Italy, Spain and the United Kingdom (187-1998)”, *Journal of International Financial Markets, Institutions and Money,* Vol. 19, No. 3, pp.477-489.

Guevara-Jordan, J. M. and Rojas, S. (2003), “A method of fundamental solutions for modelling porous media advective fluid flow”, *Applied Numerical Mathematics*, Vol. 47, No. 3-4, pp.449-465.

Huang, Y., Neftci, S. N. and Guo, F. (2008), “Swap curve dynamics across markets: Case of US dollar versus HK dollar”, *Journal of International Financial Markets, Institutions and Money,* Vol. 18, No. 1, pp.79-93.

Ito, T. and Sato, K. (2008), “Exchange rate change and inflation in post-crisis Asian economies: Vector autoregression analysis of exchange rate pass-through”, *Journal of Money, Credit and Banking*, Vol. 40, No. 7, pp.1407-1437.

Krylova, E., Nikkinen, J. and Vähämaä, S. (2009), “Cross-dynamics of votality term structures implied by foreign exchange options”, *Journal of Economics and Business,* Vol. 61, No. 5, pp.355-375.

Mainardi, F. (1996), “The fundamental solutions for the fractional diffusion-wave equation”, *Applied Mathematics Letter,* Vol. 9, No. 6, pp.23-28.

Mainardi, F., Roberto, M., Gorenflo, R., and Scalas, E. (2000), “Fractional calculus and continuous time finance. II the waiting time distribution”, *Physica A: Statistical Mechanics and its Applications,* Vol. 287, pp.468-481.

Meerschaert, M.M. & Scalas, E. (2006) Couple continuous random walks in finance. *Physica A: Statistical Mechanics and its Applications,* Vol. 370, pp.114-118.

Melvin, M. and Taylor, M. P. (2009), “The crisis in foreign exchange market”, *Journal of International Money and Finance,* Vol 28, No 8*,* pp.1317-1330.

Muchnik, L., Bunde, A. and Havlin, S. (2009), “Long term memory in extreme returns of financial time series”, *Physica A: Statistical Mechanics and its Applications,* Vol. 388, Issue 19*,* pp.4145-4150.

Neter, J., William, W. dan Micheal, H. K. (1990) *Applied linear statistical models: regression, analysis of variance, and experimental design.* Third edition. Irwin, Boston.

Resende, M. and Zeidan, R. M. (2008), “Expectation and chaotic dynamics: Empirical evindence on exchange rates”, *Economics Letters,* Vol. 99, No. 1, pp.33-35.

Roberto, M., Scalas, E., & Mainardi, F. (2002), “Waiting-times and returns in high-frequency financial data: an empirical study”, *Physica A: Statistical Mechanics and its Applications,* Vol. 314, pp.749-755.

Rosner, D. E. (1963), “Fundamental solutions to the diffusion boundary layer equation for seperated flow over solid surfaces at very large prandtl numbers”, *International Journal of Heat and Mass Transfer*, Vol 6, No. 9, pp.793-804.