



## INVESTIGATION OF CONVERGENCE OF RETURNS ON STOCK MARKETS IN IRAN

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### ABSTRACT

#### PURPOSE

Due to the nature of the assets in Iran, markets such as stock markets are options facing investors as asset portfolio, with different returns. Usually, investors are looking for higher returns. By accumulation of investors on markets with higher returns, it is expected that the long-run returns of such markets be decreased, which leads to the induction of difference between these markets' returns with other markets. This can be named as returns convergence of different asset markets.

#### METHODOLOGY

This study aims to also examine the returns convergence of stock markets in Iran over the period 2009:05- 2016:02, using Nahar and Inder method. This method examines the returns convergence of each of these markets to the average returns of them.

#### MAIN FINDINGS

Based on the results, the returns of banks and credit institutions, industrial companies, mining of metal ores, chemical products, refined petroleum and nuclear fuel, cement are converged to the average returns. All coefficients are statistically significant at a confidence level of ten percent. But basic metals, telecommunications, multidisciplinary, automobile and parts, engineering services, materials and Manufacture of coke, lime and plaster, materials and pharmaceutical products, transport, storage and communications, computer and related activities, mass product, real estate and food products and Beverage except sugar's returns has not converged to the average returns.

#### IMPLICATIONS

This study can be called as the convergence of diverse market. Namely, returns of different investment markets will be converged on each other in the long term.

#### NOVELTY/ ORIGINALITY

The present study, when focusing on the examination the returns convergence of stock markets in Iran, differs from the previous researches.

**KEYWORDS:** *Convergence, Returns, Stock Markets, Nahar and Inder Method, Iran.*

**JEL Classification:** c22, c51, g21.

#### INTRODUCTION

Along with the end of World War II, undeveloped countries were looking for higher economic growth rates to reach economic development. Given the Solow- Swan theory, the developing countries have a higher economic growth compared to rich ones. This means that economic growth rates in poor and wealthy countries will be converged in the long term towards the same destination. This caused to launch convergence issue which was later developed to such additional areas as convergence in the price indices and returns.

Convergence of returns in diverse markets can be implicated in such a way that the investors are dealt with different markets for investment while each market has diverse returns. Such markets as currency, housing, stock, and gold are of those with returns in Iran. Such markets are so sensitive to the events occurred in other markets and any



considerable events influence prices of these markets. Such effects lead to varied returns of mentioned markets. The investors pay the returns into attention to select a market for investment. The investment is typically conducted in a market with higher returns. The influx of investors towards the markets with higher returns gives rise to lower returns of these markets in the long term due to congested investment. This causes to eliminate return difference of such markets with other ones, as well. This also can be called as the convergence of diverse market. Namely, returns of different investment markets will be converged on each other in the long term. The present work aims to investigate the convergence of returns in stock markets within the period 2009:05- 2016:02.

## RESEARCH HISTORY

Plenty of studies have been conducted regarding convergence most of which focus on beta, sigma and stochastic convergences and a low number of studies are carried out using Nahar and Inder method which will be reviewed here.

[Barro\(1991\)](#) studied the convergence of economic growth as beta convergence among 20 member countries in Organization for Economic Co-operation and Development (OECD) over the years 1840-1963 using difference convergence. The results approved beta convergence hypothesis.

[Nahar and Inder \(2002\)](#) studied the convergence of per capita income among 22 member countries in OECD over the years 1950-1998 using the new convergence method. Their results indicated that most countries move towards a certain level in the long term.

Using beta and sigma convergence methods, [Murinde et al. \(2002\)](#) concluded that financial rights of shareholders in new investments among 7 selected countries of Europe Union are convergent over the years 1972-1996.

[Iskenderoglu et al. \(2009\)](#) investigated the convergence of returns rate among 8 Turkish banks over the years 1998-2009 using the root test. Their results indicate no convergence in banking system due to high competitive conditions.

[Caporale et al.](#) studied the convergence of returns in the stock market with 5 EU countries and the US over the years 1973-2008 using Philips and Sul's nonlinear convergence method. Their results indicated that convergence exists in the stock of some markets and does not exist in that of some other ones.

[Srivasta \(2010\)](#) studied housing market of EU over the years 1982-2009 using the beta and sigma convergence approaches. Their results indicate presence and absence of sigma convergence and beta convergence, respectively.

[Anand and Madhogaria \(2012\)](#) investigated the relationship between gold price and stock market among 6 countries. Using Granger causality testing and vector error correction model, they calculated the relationship between gold price and stock over the years 2002-2011 based on t-test and correlation coefficient and concluded that price of gold and stock is varying from positive to negative.

[Bruno et al. \(2012\)](#) investigated the convergence of financial assets in OECD countries using beta and sigma convergence methods, indicating approved beta-convergence in financial assets.

[Apergis et al. \(2012\)](#) studied returns of stock markets among 42 countries over the years before 2008 using Philips and Sul's convergence approach. Their results indicated no convergence in the stock market.

Using Beta convergence method, [Kaijage and Nzioka \(2012\)](#) investigated the monthly convergence of stock returns in Eastern African countries over the years 2007-2012. The results suggested the presence of convergence with a speed of 0.61.

[Bulut et al. \(2015\)](#) investigated the monthly convergence of interest rate returns among Turkish banks over the years 2003-2014 using Nahar and Inder's convergence method. The results indicated convergence of returns in two of ten studied banks.

[Shahbazi et al., \(2012\)](#) investigated the convergence of price indices in Iranian provinces over the years 2002-2010 using stochastic convergence. Their results indicated that the convergence is different depending on consideration of the base province.

Using Beta convergence, [Fallahi et al., \(2012\)](#) studied the convergence of per capita income in Iran and selected Islamic countries. Their results indicate that convergence moves towards average in most of the countries.

By different approaches such as Sigma convergence, tile testing and root testes, [DaeiKarimzadeh \(2013\)](#) investigated the convergence of an income defined as per capita income gap between business partners over the years 1965-2009

among Developing-8 (D8) countries. The results approved the divergence among studied countries by diverse convergence methods.

[Pourrostami et al., \(2013\)](#) investigated economic convergence among 29 selected countries in Latin America and the Caribbean over the years 1980-2009 by beta convergence (sectional model) and sigma convergence (distributed model). The results do not approve beta convergence while sigma convergence is different depending on sectioning per capita income in two groups.

Most of the studies on the convergence of returns focus on that of financial markets in diverse countries. It seems there is no study on the convergence of returns of assets markets. Accordingly and given the different nature of Iranian asset markets with other countries, the present study aims to investigate the convergence of returns for Iranian stock markets. The main difference of present work compared to former ones on convergence area is to select portfolio markets and use of a new technique for convergence assessment.

## THEORETICAL BASICS

[Solow \(1956\)](#) addressed growth models and was one of the pioneers for convergence in the rate of economic growth, both theoretically and empirically. Obtaining different degrees of development for diverse societies gave rise to evolve comparison criteria of different regions economic status and thereby presenting suitable planning pattern to reduce the difference between diverse regions. As a result, neoclassic growth models such as [Solow's growth model \(1956\)](#), [Swan's growth model \(1956\)](#) and Solow-Swan growth model were addressed. Economic convergence of different regions was a result of these growth models. [Barro and Sala-I-Martin \(1991, 1992\)](#) were the first authors who introduced convergence concept where the convergence of economic growth rate among different countries was investigated.

The authors present diverse definitions for convergence hypothesis. There are at least three individual methods for convergence assessment, including (A) Beta convergence which can be divided into two groups including conditional beta-convergence and absolute-beta convergence, (B) Sigma convergence, and (C) stochastic convergence ([Lee et al., 1998: 358](#)). Beta convergence is obtained when the countries with lower per capita income move with a higher growth rate compared to wealthy countries in the long term in such a way that per capita income of all countries would be equal in the long run. Sigma convergence will be achieved with decreased dispersion of per capita income of countries over time. Also, stochastic convergence addressed the impact of shocks, namely, shocks of a country's per capita income will be temporary to average per capita income of the countries. [Nahar and Inder \(2002\)](#) introduced another method for convergence assessment, and this method is well-known as Nahar and Inder's convergence. Unlike previous approaches which look for convergence of all observations altogether, the present method seeks to assess convergence of each observation about a certain level ([Nahar and Inder, 2002: 2013](#)).

Convergence assessment is carried out in such diverse areas as per capita income, labor productivity, energy efficiency, price levels, inflation rate, interest rates, wages, etc. ([Drastichova and Ostrava, 2012: 108 & 109](#)). Financial convergence is another important area of convergence which can be taken into investigation based on price-based metrics, information-based metrics, and value-based metrics, according to the approached adapted by [Baele et al. \(2009\)](#). Assets returns are considered as a price-based metric ([Erasmus et al., 2012:7](#)).

## METHODOLOGY

15 markets including primary metals, telecommunications, banks and industrial companies, metal ore mining, automobile and automotive parts manufacturing, chemical products, engineering and technical services, petroleum products, cement, pharmaceuticals, transportation, computers, mass housing and food products were employed to assess convergence of price index in stock markets. The required statistical data over the period 5/2009- 2/2016 was obtained from the database of Tehran Stock Exchange. Also, [Nahar and Inder's method \(2002\)](#) was used for convergence assessment.

In this section, Nahar and Inder's convergence test (2002) is represented will was used in present work. This method investigates each section individually relative to a certain level. For example, assume  $y_{it}$  is  $i$ th stock returns ( $i=1,2,\dots,N$ ) over the time  $t$ . The introduced method by Nahar and Inder for assessment of convergence in diverse stocks relies on such a fact that difference of stock market returns long-term prediction from mean stock markets would tend towards zero. In other words:

$$\lim_{n \rightarrow \infty} E_t (y_{i,t+n} - \bar{y}_{t+n}) = 0 \quad (1)$$

Where  $\bar{y}_t$  is found through following equation as average returns of stock markets:

$$\bar{y}_t = \frac{\sum_{i=1}^N y_{it}}{N} \quad (2)$$

Assume that  $z_{it}$  is defined as returns difference of each stock market from average stock markets returns as follows:

$$z_{it} = y_{it} - \bar{y}_t \quad (3)$$

In this case,  $z_{it}$  tending toward zero over time can be recognized as an argument for convergence of returns of each stock towards average returns of stock markets. If  $z_{it}$  tends to zero over time, then for any positive and negative  $z_{it}$ , variations of  $z_{it}$  relative to time should be positive and negative, respectively. In other words, if  $z_{it}$  is converged towards zero, then for any  $z_{it}$ , variations of  $|z_{it}|$  relative to the time should be negative, namely:

$$\left(\frac{\partial}{\partial t}\right) |z_{it}| < 0 \quad (4)$$

This problem can be solved in another way, as well. For simplicity, assume that  $w_{it}$  is defined as follows:

$$w_{it} = z_{it}^2 \quad (5)$$

For convergence,  $w_{it}$  should approach zero. In other words, variations of  $w_{it}$  relative to time should be negative, namely:

$$\left(\frac{\partial}{\partial t}\right) w_{it} < 0 \quad (6)$$

The absolute convergence definition in Equation (1) implicates following relation:

$$\lim_{n \rightarrow \infty} E_t (w_{i,t+n}) = 0 \quad (7)$$

Where,  $w_{it} > 0$  and  $\left(\frac{\partial}{\partial t}\right) w_{it} < 0$  is compatible with  $w_{i,t+n} \rightarrow 0$  when  $n \rightarrow \infty$ .

Therefore, returns convergence of a market can be evaluated by the sign of  $\left(\frac{\partial}{\partial t}\right) w_{it}$ . In order to find sign of  $\left(\frac{\partial}{\partial t}\right) w_{it}$ , let  $w_{it}$  to be a function of time trend as follows:

$$w_{it} = f(t) + u_{it} = \theta_0 + \theta_1 t + \theta_2 t^2 + \dots + \theta_{k-1} t^{k-1} + \theta_k t^k + u_{it} \quad (8)$$

Where,  $\theta_i$  shows the parameters and  $u_{it}$  reveals independent disturbance terms with an average of zero and variance of  $\sigma^2$ . Equation (8) can be rewritten in matrix form as follows:

$$W = X\theta + U \quad (9)$$

Also, from Equation (8), it can be readily found that

$$\left(\frac{\partial}{\partial t}\right) w_{it} = f'(t) \quad (10)$$

Which indicates slope function. The mentioned slope function can be used for assessment of convergence of markets returns. In practice,  $w_{it}$  series are likely to be not decreased uniformly over time, however, if a market tends to be converged then  $w_{it}$  series should generally be decreased. For this purpose, negative sign of such average slopes are taken into consideration. In other words, average slope function  $w_{it}$  should be negative for convergence, namely:

$$\frac{1}{T} \sum_{t=1}^T \frac{\partial}{\partial t} w_{it} < 0 \quad (11)$$

This average slope is derived through Equation (10) as follows:

$$\frac{1}{T} \sum_{t=1}^T \frac{\partial}{\partial t} w_{it} = \theta_1 + \theta_2 r_2 + \dots + \theta_{k-1} r_{k-1} + \theta_k r_k = r\theta' \quad (12)$$

Where

$$r_2 = \frac{2}{T} \sum_{t=1}^T t, \dots, r_{k-1} = \frac{k-1}{T} \sum_{t=1}^T t^{k-2}, r_k = \frac{k}{T} \sum_{t=1}^T t^{k-1} \quad (13)$$

$$r = [0 \ 1 \ r_2 \ \dots \ r_{k-1} \ r_k] \ \&\theta = [\theta_0 \ \theta_1 \ \dots \ \theta_{k-1} \ \theta_k]$$

For convergence assessment, the hypothesis  $H_0: r\hat{\theta}' \geq 0$  (divergence) is considered versus  $H_1: r\hat{\theta}' < 0$  (convergence) for each tested return. For this purpose, Equation (8) is initially estimated by ordinary least squares method (Akaike's(1973) information criterion is used for optimal interruption length determination). Then, transposed values of estimated parameters vector ( $\hat{\theta}'$ ) is multiplied by the vector  $r$  to estimate average slope ( $r\hat{\theta}'$ ). Also, following equation is used for standard error  $r\hat{\theta}'$  estimation:

$$se(r\hat{\theta}') = \sqrt{(r'[s^2(X'X)^{-1}]r)} \quad (14)$$

Where  $s^2$  is the estimation of  $\sigma^2$ . The desired statistic for testing the hypothesis  $H_0$  is represented as follows:

$$t_{\theta} = \frac{r\hat{\theta}'}{se(r\hat{\theta}')} \quad (15)$$

The convergence of stock markets was investigated in present study. Price indices of 15 markets including basic metals, telecommunications, banks and credit institutions, multidisciplinary industrial companies, metal ore mining, automobile and automotive parts manufacturing, chemical products, engineering and technical services, petroleum products and materials, coke and nuclear fuel, cement, lime and plaster, pharmaceuticals, transportation, warehousing and communications, computers and related activities, mass housing and real state, and food and drink products except sugar were obtained from Tehran Stock Exchange Organization website. The returns for each market were found through following relation:

$$y_{it} = \ln p_{i,t} - \ln p_{i,t-1} \quad (16)$$

Where,  $\ln$  indicates natural logarithm and  $p_{i,t}$  shows  $i$ th price index at  $t$ th time.

The required statistics and information were collected through economic indicators of Iranian Central Bank and Statistical Center of Iran by documentary and library method. The studied time period is from May, 2009 to February, 2016.

## THE MODEL ESTIMATION

Table (1) shows convergence assessment results for prices indices of 15 selected markets over the period 05/2009-02/2016. Given the methodology, in the case of the negative average slope, the convergence of stock market price index towards average is somehow approved. Initially, the optimal interruption was specified for each stock market, and the results were reported in Table (1).

The average slope of basic metals stock was -0.00791, and due to decreasing value of this coefficient over time, the convergence of returns of this stock tend towards the average returns. However, this coefficient is statistically insignificant. Also, the average slope of telecommunications was 0.0000746 which indicates that returns variations of this market is not decreasing over time and is not converged towards average returns. This coefficient is not statistically significant, as well. The stock of banks and credit institutions with an average slope of -0.005449 indicates convergence of this stock returns towards average returns and its coefficient is statistically significant at a confidence level of 1%.

The stock of industrial companies with an average slope of -0.00637 moves towards average returns of the stock market and this coefficient is statistically significant at a confidence level of 10%. The average slope of metal ore mining was -0.01575 which reveals the convergence of returns of this stock towards average returns of the stock market. This coefficient is statistically significant at the level of 1%. The average slope of the automobile and automotive parts manufacturing was 0.001804 which shows the divergence of this market towards average returns. However, this coefficient is not statistically significant. The stock of chemical products with an average slope of -1.58634 indicates convergence of this stock returns towards average returns and its coefficient is statistically significant at the level of 1%. The stock of technical and engineering services market with an average slope of -0.00068 approves convergence of returns of this stock towards average returns while this coefficient is statistically insignificant. The average slope of petroleum products was -0.00629 which indicates convergence of returns of this market towards market's average returns. This coefficient is statistically significant at the level of 10%. The average slope of the cement was -0.2339 which shows converged returns of cement towards average returns and this coefficient is significant at a confidence level of 1%. The average score of pharmaceuticals and food products were 0.002011 and 0.000959, respectively, and such a coefficient indicates converged returns of these two markets towards average returns, however, the coefficients are not statistically significant. The average slope of the markets

transportation, computer, and mass housing were -0.00257, -0.00046 and -0.00078, respectively, which indicate convergence of returns of mentioned markets towards average returns, but these coefficients are statistically insignificant.

**Table (1): The results of assessments on stocks prices indices**

Stocks prices indices	Polynomial order	Average slope	Test statistic
Basic metals	1	-0.00791	-1.0618
Telecommunications	1	0.000746	0.485082
Banks and credit institutions	1	-0.005499	-390.48495*
Industrial companies	2	-0.00637	-1.84894**
Metal ore mining	1	-0.011575	-2.86417*
Automobile and Automotive parts manufacturing	5	0.001804	0.538549
Chemical products	1	-1.58634	-95.5372*
Technical and engineering services	3	-0.00068	-1.08963
Petroleum products	1	-0.00629	-1.66571**
Cement	7	-0.2339	-7.88446*
Pharmaceuticals	1	0.002011	0.4795
Transportation	3	-0.00257	-0.96308
Computer	2	-0.00046	-0.11856
Mass housing	1	-0.000078	-0.73139
Food products	2	0.000959	0.284026

Resource: Research findings, \* confidence level of 1%, \*\*confidence level of 10%

## CONCLUSION AND SUGGESTIONS

In present study, 15 markets including basic metals, telecommunications, banks and industrial companies, metal ore mining, automobile and automotive parts manufacturing, chemical products, engineering and technical services, petroleum products, cement, pharmaceuticals, transportation, computers, mass housing and food products were employed to assess convergence of price index in stock markets using Nahar and Inder's convergence approach. The required statistical data over the period 5/2009- 2/2016 was obtained from the database of Tehran Stock Exchange.

The results indicate that stock returns of such markets as banks and credit institutions, industrial companies, metal ore mining, chemical products, petroleum products and cement are converged towards average returns. In other words, returns difference of mentioned markets would lower compared to the returns over time and ultimately, returns of such markets tend to average returns.

The coefficients of returns of converged markets at a confidence level of 10% are statistically significant. However, the stock markets primary metals, telecommunication, automobile and automotive parts manufacturing, technical and engineering services, pharmaceuticals, transportation, computer, mass housing and food products were not converged towards average returns. In other words, returns difference of these markets from average returns were not decreasing over time. Necessary conditions for convergence of converged market can be ascribed to returns distribution way of mentioned markets in such a way that returns of mentioned markets would be closer to average returns of the stock market and have lower dispersion around mentioned average returns compared to additional markets.

Therefore, it seems that according to lack of convergence of divergent markets towards average returns, the investments in the markets with higher returns do not give rise to decrease returns of such markets in long-term. In so doing, there exist some degrees of independence among diverse Iranian markets regarding returns, therefore the investors can confidently look for the markets with higher returns.

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