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The transmission mechanism of 2008 global financial crisis to Tehran Stock Exchange

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C H R O N I C L E

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A B S T R A C T

After financial crisis in 2008, the effect of crisis spread in the world. Many countries were affected quickly and others slowed in a particular mechanism. Using data of TEPIX from Tehran Stock Exchange and DJI from New York stock Exchange as the main indexes of these two markets, this paper reported strong evidence of TEPIX's dependency on DJI after the crisis in a four-week delay. The index level series were non-stationary; therefore, we employed cointegration analysis and error correction vector autoregressions (VAR) techniques to model the interdependencies. To find the best lag time we used a heuristic method and the results surprisingly were the same as the result of applying a VAR model. The results support the hypothesis that financial stress was transmitted from the U.S to Iran primarily through trade and price channels.

1. Introduction

Previous global financial crisis, which is unprecedented scale since the great depression, initiated in the U.S. stock markets and passed through economies (Boshoff, 2006). After an initial period of resilience, the financial convulsions in advanced economies hit most of the markets, severely. Corsetti et al. (2011) documented the transmission of shocks across stock markets and made an analysis on the correlation of financial markets in term of contagion. They showed that sharp falls in stock prices tend to happen in clusters across national markets and covariances between the movement of stock markets frequently increase during crisis periods. In late 2008, stock markets tumbled in the most emerging regions. Tytell et al. (2009) stated that the extent of pass-through of financial stress was associated with the depth of financial linkages between advanced and emerging economies. According to Longstaff (2010) on 2008 financial crisis, the subprime crisis spilled over and became the catalyst for a much bigger global financial crisis. The resulting sub-prime crisis of 2007 led quickly to massive declines in the market values of large portfolios of highly rated asset-backed securities (ABS) held by various financial institutions. Besides, the subprime crisis brought about a comprehensive halt to the fledgling structured-credit market, a serious credit crunch for both individuals and financial institutions, and a major decline in the liquidity of debt securities in all markets.

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Over the past two decades, free trade of financial services, deregulations of financial markets and technological changes around the globe have created complexity and integrity of financial markets. According to Häusler (2002), this is evident from increased institutional investment activity across nations, increased cross-border financing of mergers and acquisitions and a general relocation of financial risks by banks from their balance sheets to the security markets. A number of research works have covered various characteristics of global financial services. Moshirian (2007) performed a survey on the issues associated with the emergence of a single global currency as a way of reducing risk and increasing income and improving business certainty for financial institutions and other business groups. Moshirian (2004), in other study, discussed the evolution and convergence of US currencies into the Greenback, the formation of the Euro and the way a global single currency could emerge. Moshirian (2005) also discussed this phenomenon that financial market integration had driven by market forces but constrained by regulatory barriers and the level of integration was not uniform across market segments nor was the across time. Hence, given this increased integration, under particular mechanism, country-specific financial stress may influence on foreign financial markets. Most researchers who analyzed correlation of markets had concentrated on mature stock markets. There are comparatively few studies of interdependencies among emerging markets in Middle East and other mature markets (Broder & Schoepfle, 1975). Some studies show how 2008 financial crisis impaired financial intermediation was transmitted from the U.S. to Iran. Eun and Shim (1989) performed a study on the U.S. In their study, stock market, by far, was the most influential market in the world, which reflects the dominate position of the U.S. in the world economy. It probably makes the country the most important producer of information influencing the world stock market.

The purpose of this study is to examine stock market linkage between them according to global financial crisis. It is argued that the results from this study can shed light on the existing literature to explain transmission of possible future global financial crises to the economy of Iran at large. This paper is organized as follows. In section 1, previous studies are reviewed and mechanism of crisis transmission is described according to previous experiences. In Section 2, we introduce the data. Section 3 is dedicated to reports of some preliminary statistical analyses including correlation and autocorrelation analysis, and the unit root and Johansen cointegration tests. In section 4 we examine stock market linkages by using linear regression model. Section 5 represents a heuristic method to show the best lag time between the data of these two indexes and then we apply an autoregressions (VAR) model to prove our empirical findings. In section 6 in order to find crisis effect, we split the data into before and after the crisis and show the correlation regarding the financial shock. In the end, section 7 concludes the paper.

2. Mechanism of transmission

2.1 Transmission Channel

Previous researches on the recent financial crisis demonstrate that surely it has been a kind of fast contagious crisis ever. Therefore, the channel of transmission of crisis should be considered. Some researches showed that different types of channel could transmit the crisis to different markets. An empirical investigation by Longstaff (2010) indicated that in the recent crisis financial, contagion was propagated primarily through liquidity and risk-premium channels, rather than through a correlated-information channel. Concerning the real effects of financial shocks within the US, Bagliano and Morana (2012) detected stronger evidence of an asset prices channel, rather than a liquidity channel and concerning the spillovers to the world economy. They reported that while financial disturbances were transmitted to foreign countries through US house and stock price dynamics, as well as excess liquidity creation, the trade channel was the key transmission mechanism of real shocks. Dees et al. (2010) provided measures of the effects of such shocks using a multi-country New Keynesian model.

2.2. Contagion crisis

An investigation of crisis transmission, however, requires a clear distinction between contagious and non-contagious crises, (Kaminsky et al., 2003). 'Contagion' became the catchword for such phenomena and is now widely being used to describe the events around the crises (Sander & Kleimeier, 2003). It reflects a situation where the effect of an external shock is larger than what was expected by experts and analysts (Edwards, 2000). The contagion literature has been identified by last researches. Sander and Kleimeier (2003) categorized crises into four major strategies, correlation of asset prices; conditional probability of currency crises; volatility changes; and comovements of capital flows and rates of return. Pericoli and Sbracia (2003) deliberated five definition of contagion including wide variety of meanings ascribed to the term: "1.Contagion is a significant increase in the probability of crisis in one country conditional on crisis occurring in another country … 2. Contagion occurs when volatility spillover from the crisis country to the financial market of other countries … 3. Contagion is a significant increase in co-movement of prices and quantities across market, conditional on a crisis occurring in one market or group of market. 4. (Shift-) Contagion occurs when the transmission channel is different after a shock in one market. 5. Contagion occurs when co-movement cannot be explained by fundamentals". In addition, Longstaff (2010) identified contagion at three possible mechanisms in which shocks in one market may spill over into other markets.[1] First at a mechanism in which negative shocks in one market represent the arrival of economic news that directly influences on the collateral values or cash flows associated with securities in other markets. Second mechanism shows how investors who suffer losses in one market may find their ability to obtain funding impaired, potentially leading to a downward spiral in overall market liquidity and other asset prices via a ''flight to quality. Third, one implies that a severe negative shock in one market may be associated with an increase in the risk premium in other markets. In this mechanism, contagion happens as negative returns in the distressed market influence on subsequent returns in other markets via a time-varying risk premium. After the recent financial crisis, crisis transmission became the debatable issue in Iran. Some parties believed that as long as Iranian economy was not connected to global market there was not a serious threat from global financial stress. Others did not. However according to Mesa-Lago and Vidal-Alejandro (2010), the transmission mechanisms from developed to developing economies that were in turn conditioned by domestic factors might attenuate or accentuate the economic and social effects of the recession, hence this study shows that Iranian economy was affected by 2008 global financial crisis in an specific mechanism.

2.3 Sample data

The weekly data is provided in a five-year-period from November of 2005 to December of 2010. At the beginning of this period, new law on Tehran Stock Exchange (TSE) has been ratified and implemented. This new law is considered a turning point in history of TSE. TSE opened in February 1967. During its first year of activity, only six companies were listed in TSE. Then Government bonds and certain State-backed certificate were traded in the market. In 1989, economic authorities' attention to restarting of TSE activities increased the number of listed companies from 56 in 1988 to 422 in 2006. Furthermore, in 1988 the annual value of shares traded in the TSE, was 9.9 b IRRs, which increased to 44.8 b IRRs in 2006. During this period, especially between 2001 -2004, return of TSE investments grown up considerably and in 2003 reached to 131.4% which on that year was the highest return between World Federation of Exchanges (WFE's) members. Today TSE has evolved into an exciting and growing marketplace where individual and institutional investor trade securities of over 463 companies. At the beginning of considered period time in this research TSE new law is ratified by parliament after a long time since 1966 and the number of Regional floors increased to 21. So it is the meaningful time for this market and also for the research. TEPIX is the main index in TSE and it compares with Dow Jones Indices (DJI) of New York Stock Exchange (NYSE).

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[1] It is categorized based on previous researches by Kiyotaki and Moore (2002), Kaminsky et al. (2003), Allen and Gale (2004), Brunnermeier and Pedersen (2005, 2009), Vayanos (2004), Acharya and Pedersen (2005), Longstaff (2008)

3. Preliminary analysis

3.1. Unit root test

Regressing non-stationary variables on each other leads to possibly deceptive inferences about the estimated parameters and the degree of association. Therefore, it is important to check whether indexes series are stationary or not before using it in a regression. To test for a unit root we employ the Augmented Dickey–Fuller (ADF) test (Dickey & Fuller, 1979). The test indicates that stock indexes are very likely to be *I (1)* processes. This result indicates that the first difference in the indexes of these two stock markets returns is likely to be stationary processes. Augmented Dickey Fuller Regression is as follows,

$$\Delta x_t = \rho_0 + \rho x_{t-1} + \sum_{i=1}^{n} \delta_i \Delta x_{t-i} + \varepsilon_t \tag{1}$$

The null hypothesis is that a series is non-stationary if $\rho = 0$, so in order to support stationary process the unit root hypothesis should be rejected.

Table 1
Augmented Dickey-Fuller test statistic

	t-Statistic	Prob.*
DJI	-1.424386	0.5702
TEPIX	-1.160230	0.6920
ΔDJI	-17.27550	0.0000
ΔTEPIX	-10.01775	0.0000

*MacKinnon (1996) one-sided p-values. Δ denotes the first difference. The lag length in the ADF regression is chosen by Schwartz's Information Criterion (SIC). Critical values are: 10%, -2.57; 5%, -2.87; 1%, -3.46 (Fuller, 1976)

Table 1 presents the results of the ADF unit root test in the levels and first differences of stock indexes. The test results show that the null hypothesis that stock indexes in the levels are non-stationary is not rejected for both of the markets, while the hypothesis that there is a unit root in the first difference is rejected. Hence, both stock indexes follow by an *I (1)* process and the series can be modeled by cointegration analysis.

3.2. Cointegration test

The term of cointegration was first coined by Granger (1981) who showed that linear regressions on non-stationary time series data would be a dangerous approach that could produce spurious correlation. A stock market index is a good example of this concept which moves through time, each following a random walk approximately. Engle and Granger (1987) suggested a method for testing the cointegration hypothesis. A levels regression is performed to generate residuals, which may be considered as equilibrium pricing errors. Then residuals are subjected for cointegration tests. The ADF test for cointegration is used for this method. With p time series $x_{it}, \dots, x_{pt}$, each of which is *I (1)*, the cointegration regression equation is

$$x_{it} = \eta_0 + \sum_{j=2}^{p} \eta_j x_{jt} + s_t \tag{2}$$

A test of no cointegration is given by a test for the significance of *x* in the model

$$\Delta s_t = \mu + x s_{t-1} + \sum_{i=1}^{k} w_i \Delta \mathrm{s}_{\mathrm{t-i}} + \mathrm{e}_{\mathrm{t}} \tag{3}$$

which is equivalent to a test for a unit root in the estimated residual s_t. If the residual s_t is found to be stationary, the null hypothesis of no equilibrium relationship between stock indexes of two markets is rejected. In a cointegrating vector Engle and Granger (1987) apply an OLS estimation to obtain parameter estimates for cointegration tests based on superconvergence result. Johansen (1988) and Johansen and Juselius (1990) derived the maximum likelihood estimators of the cointegrating vectors for an autoregressive process with independent Gaussian errors and a likelihood ratio test for the number of cointegrating vectors which permit more than one cointegrating relationship. In a VAR of order p:

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + Bx_t + \varepsilon_t, \tag{5}$$

where y_t is a k-vector of non-stationary *I(1)* variables, x_t is a d-vector of deterministic variables, and ε_t is a vector of innovations. We may rewrite this VAR as,

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \varepsilon_t \tag{6}$$

where

$$\Pi = \sum_{i=1}^{p} A_i - I, \qquad \Gamma_i = -\sum_{j=i+1}^{p} A_j \tag{7}$$

Granger's representation theorem assures that if the coefficient matrix Π has reduced rank $r < k$, then there exist $k \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is *I(0)*. r is the number of cointegrating relations (the *cointegrating rank*) and each column of β is the cointegrating vector. Johansen's method is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π. Johansen (1988, 1991) proposed two methods for estimating the number of cointegration vectors: the trace test and the maximal eigenvalues test. The trace test is a likelihood ratio test for maximum r cointegration vectors against the alternative equal to n. The maximal eigenvalues test has an identical null hypothesis, while the alternative is $(r + 1)$ cointegration vectors. Both tests have a non-standard asymptotic distribution and the critical values for the trace test are tabulated in Johansen and Juselius (1990).The maximal eigenvalues test tends to give better results when the trace tests are either large or small. Table 2 shows that there is no cointegration between two indexes according to trace test. It means the null hypothesis that the stock indexes of the two countries the U.S. and Iran are cointegrated against the alternative no cointegrating is rejected for the overall sample at the 5% significance level.

Table 2
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.025590	7.961311	15.49471	0.4696
At most 1	0.005163	1.325117	3.841466	0.2497

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

4. Examine Stock market linkage

According to previous section for avoiding spurious correlation we run linear regression on first deference of indexes.

Table 3
Regression result of first Difference TEPIX, DJI

Variable	Coefficient	Prob. **
Constant	11.95268	0.2625
	(10.64408)	
ΔDJI*	-0.003310	0.9291
	(0.037178)	
R-squared		0.000031
Ser		171.6225
No. observations		260

*Δ denotes

Table 3 shows the results. It can be seen that the hypothesis that TEPIX got affected by DJI totally rejected. Therefore, there is no linkage between the data at the level of significant.

5. Define Lag time

In order to find lag-correlation we introduce a technique as we call it *Sliding Trend*. Lag-correlation may occur between two weak correlated time series variable of arbitrary shape, whereas rolling data makes the strong correlation between them. In Eq. (8) the best lag time between two time series is define by i and β^* is the coefficient of data in regressing model. Therefore, we execute a seven-step($n = 6$) linear regression on the data. In each step, the data of TEPIX y_t move back one week and adjust to DJI $x_t$for regressing on each other. For example in step 5 the data of TEPIX on first week of December 2005 match with the data of DJI on first week of November 2005 (4 weeks delay). It shows as DJI4 in this paper. Table 4 indicates the results of regression model for each step. Fig. 1 and Fig. 2 report the P-value and R-squared in the graphs.

$$
\begin{aligned}
&0\ lag: y_t = \alpha_0 + \beta_0 x_t + \varepsilon_{0t} \\
&1\ lag: y_t = \alpha_1 + \beta_1 x_{t-1} + \varepsilon_{1t} \\
&2\ lags: y_t = \alpha_2 + \beta_2 x_{t-2} + \varepsilon_{2t} \\
&\dots \\
&n\ lags: y_t = \alpha_n + \beta_n x_{t-n} + \varepsilon_{nt} \\
&\beta^* = \max_{i=0\ to\ n} \beta_i \quad \text{where} \\
&(p - value)_i < 0.05 \text{ and } r^{2*} = \max_{i=0\ to\ n} r_i^2
\end{aligned}
\tag{8}
$$

Table 4

Results of regression on the first Difference of TEPIX and DJI considering lag weeks from 1 to 6

Step	Variable	Coefficient	Std. Error	t-Statistic	P-Value	R Square	Prob(F-statistic)
1	ΔDJI	-0.00331	0.037178	-0.08904	0.9291	0.000031	0.929123
2	ΔDJI1	0.025854	0.037232	0.694407	0.4881	0.001866	0.488052
3	ΔDJI2	0.025892	0.037228	0.695494	0.4874	0.001871	0.487372
4	ΔDJI3	0.06909	0.037008	1.866891	0.0631	0.013329	0.063051
5	**ΔDJI4**	**0.090628**	**0.036826**	**2.46098**	**0.0145**	**0.022936**	**0.014511**
6	ΔDJI5	0.053037	0.03705	1.431481	0.1535	0.00791	0.153507
7	ΔDJI6	0.035161	0.036849	0.954191	0.3409	0.003544	0.340887

* ΔDJI1 to 6 are 1st Difference of DJI with 1 to 6 weeks delay adjusted to 1st difference of TEPIX

According to the results, there is an optimum point of lag time which R-squared is at the peak point and P-Value is at the minimum result. It conveys this hypothesis that TEPIX has 4 weeks delay to DJI. Other result of correlation coefficient, which comes in Table 5 emphasizes the hypothesis. To prove the hypothesis we apply a vector autoregression (VAR) model to show the best lag time between the indexes.

Table 5

Correlation Coefficient of TEPIX and DJI for 6 lag weeks

	DJI	DJI1	DJI2	DJI3	**DJI4**	DJI5	DJI6	TEPIX
TEPIX	0.001258	0.045463	0.039825	0.115921	**0.147702**	0.090431	0.063915	1

The results shown in Table 6 are the same, significantly. VAR is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system.

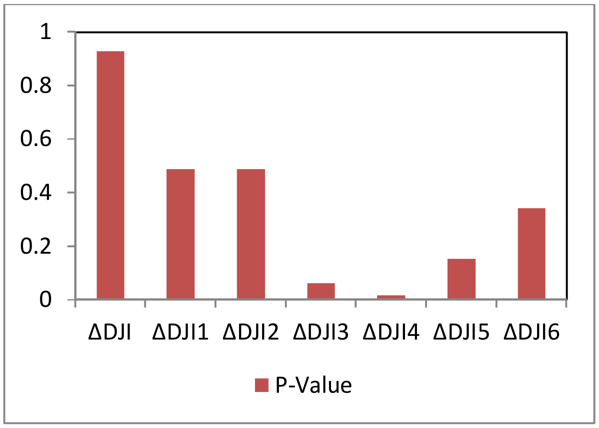

Fig. 1. P-Value for reviewing of delay TEPIX to DJI

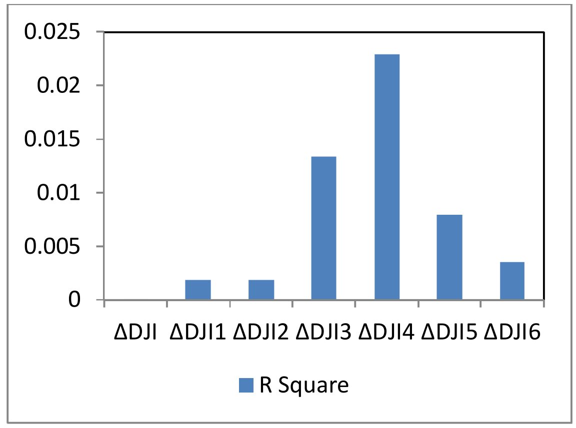

Fig. 2. R Square for reviewing of delay TEPIX to DJI

In a VAR model, each variable has an equation explaining its evolution based on its own lags and the lags of all the other variables in the model. The mathematical representation of a VAR is:

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + B x_t + \epsilon_t \tag{9}$$

where y_t is a k vector of endogenous variables, x_t is a d vector of exogenous variables, $A_1, \dots, A_p$ and B are matrices of coefficients to be estimated, and ϵ_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

Table 6
Results of VAR model on First Difference of TEPIX and DJI

	ΔTEPIX	ΔDJI		ΔTEPIX	ΔDJI
	0.345541	-0.020348	ΔDJI(-1)	0.030788	-0.071197
ΔTEPIX(-1)	(0.06393)	(0.12188)		(0.03375)	(0.06433)
	[5.40479]	[-0.16696]		[0.91232]	[-1.10671]
	0.061778	-0.064271	ΔDJI(-2)	0.017972	0.085398
ΔTEPIX(-2)	(0.06872)	(0.13100)		(0.03344)	(0.06376)
	[0.89900]	[-0.49062]		[0.53736]	[1.33943]
	0.091959	0.016663	ΔDJI(-3)	0.060069	-0.100127
ΔTEPIX(-3)	(0.06835)	(0.13030)		(0.03355)	(0.06396)
	[1.34543]	[0.12789]		[1.79034]	[-1.56544]
	0.108062	-0.000861	**ΔDJI(-4)**	**0.066428**	-0.014147
ΔTEPIX(-4)	(0.06831)	(0.13023)		**(0.03372)**	(0.06428)
	[1.58188]	[-0.00661]		**[1.97004]**	[-0.22009]
	-0.029555	0.215428	ΔDJI(-5)	0.014608	0.131155
ΔTEPIX(-5)	(0.06861)	(0.13079)		(0.03398)	(0.06478)
	[-0.43078]	[1.64711]		[0.42984]	[2.02449]
	-0.043336	-0.027967	ΔDJI(-6)	0.002858	0.043638
ΔTEPIX(-6)	(0.06420)	(0.12239)		(0.03419)	(0.06517)
	[-0.67498]	[-0.22850]		[0.08360]	[0.66959]
C	3.680240	-0.154139			
	(9.57652)	(18.2560)			

6. Analysis of crisis effect

The period of time is divided into two parts at a point of date in October 2008 in order to understand the transmission mechanism clearly. The first part seems the less dependency of these two markets before financial crisis of 2008 whereas the second part shows the data after crisis, which is more relevant. For each part coefficient of data is calculated precisely.

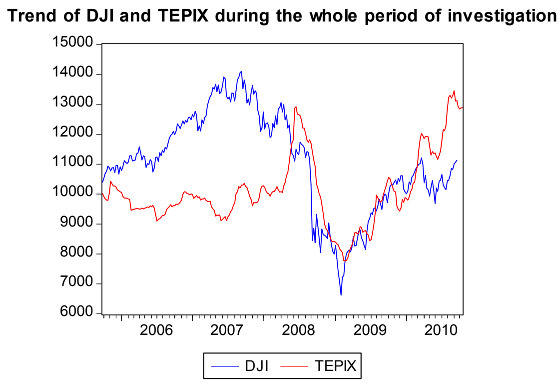

Fig. 3. Trend of DJI and TEPIX during the whole period of investigation

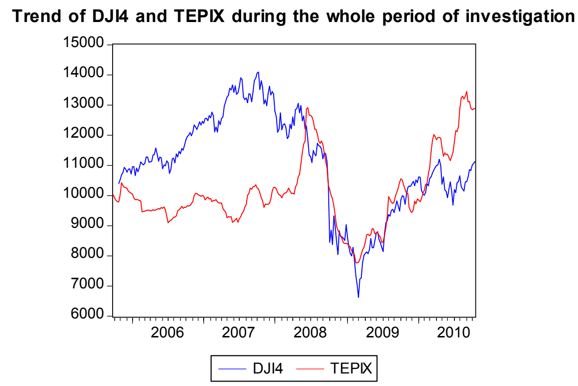

Fig. 4. Trend of DJI4 and TEPIX during the whole period of investigation

6.1.Before crisis

According to the previous study by Demyanyk (June 2011) who described the 2008 financial crisis, the subprime Mortgage market follows a classic lending boom-bust scenario, in which unsustainable growth leads to the collapse of the market. Problems could have been detected long before the crisis, but they were masked by high house price appreciation between 2003 and 2005. This crisis was characterized by an unusually large fraction of subprime mortgages originated in 2006 and 2007 becoming delinquent or in foreclosure only months later. At the same time with raising of the price of oil and base metals Iranian economy faced a steady increase at the growth rate. The expansionary monetary policy implemented by central bank of Iran helped firms to develop their businesses and also it increased income per capita of the country. Stock market in Iran had a new experience to attract private sector investment. However the growth rate of indexes of TSE was not exactly as same as the world economy, it was improved slightly. The results of Table 7 show that there was not a meaningful connection between TEPIX and DJI during this period of time. In other words, TSE's trend followed after exogenous variables which shows that all changes happened according to domestic factors and internal economic policies. The P-Value 0.3906 at 5% level of significant shows the lack of dependency between the markets.

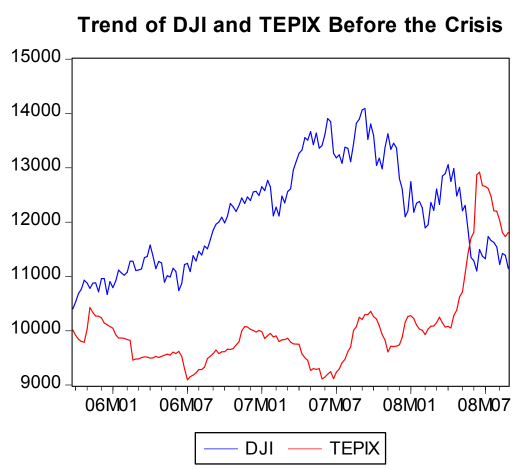

Fig. 5. Trend of DJI and TEPIX before the crisis

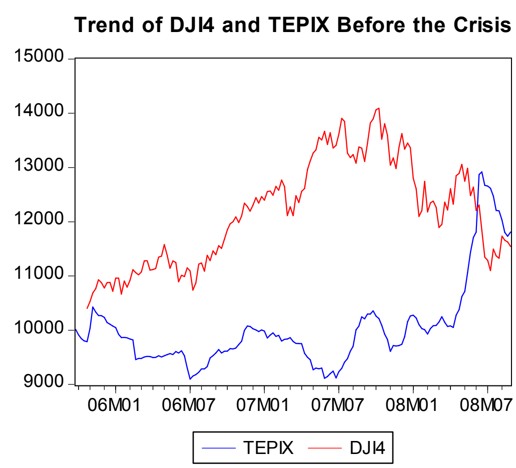

Fig. 6. Trend of DJI4 and TEPIX before the crisis

6.2.After Crisis:

As Spiegel (June 2011) implies, in 2008 the financial markets came into a bad condition and froze hardly. Firms suddenly found that they could no longer roll over their corporate paper, a normally very liquid and easy-to-issue security. Banks stopped lending to each other in fear they would never be paid back. In the US government, officials requested congress for both the authority and funds to fill in for the absent credit markets. Congress complied, and thus was born the Troubled Asset Relief Program (TARP), an institution that lives on over two years later. Therefore, the U.S originates the biggest financial crisis over the globe. On the other hand other research by Chari et al. (October 2008) discussed that the United States was undergoing a financial crisis could not be disputed. Evidence of the financial crisis consists of the following: First, several major financial institutions failed. Second, various stock markets fell, dramatically, especially in the week after the bailout plan was passed. Third, it spread on a variety of different kinds of loans over comparable U.S. Treasury securities were widened, dramatically. At the same time, economic condition in Iran was changed. On September 5, 2007 when the new head of Central Bank of Iran was appointed, the monetary policies were gone through changes. Contractionary monetary policy was implemented by the Central Bank of Iran. Many enterprises were in debt to the banks, which further more they did not have the possibility of taking a loan again. Therefore, the situation gradually deteriorated. The global crisis led to the rapid falling down of the oil and mineral productions. It was a trigger for an internal recession simultaneously with global financial meltdown. The data shows that by considering the lag time that calculated in section 5, after crisis these two markets behaves more concurrently. Fig. 7 and Fig. 8 show the trend that provides an overview to illustrate a strong connection between TEPIX and DJI after the financial crisis.

Table 7

Result of Linear Regression on TEPIX and DJI before and after 2008 Financial Crisis

	Before		After	
Variable	Coefficient	Prob. **	Coefficient	Prob. **
Constant	13.32684	0.2675	10.83279	0.5678
	(11.97286)		(18.90361)	
ΔDJI4*	0.043468	0.3906	0.118550	0.0349
	(0.050477)		(0.055493)	
R-squared		0.005053		0.040187
Ser		145.5792		199.1614
No. observations		152		111

* ΔDJI4 is the first Difference of DJI with 4 weeks delay, calculated in section 5, adjusted to the first difference of TEPIX

** MacKinnon-Haug-Michelis (1999) p-values

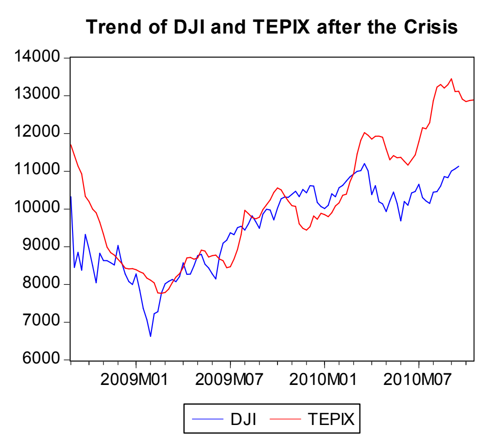

Fig. 7. The trend of DJI and TEPIX after the Financial Crisis on Oct 2008

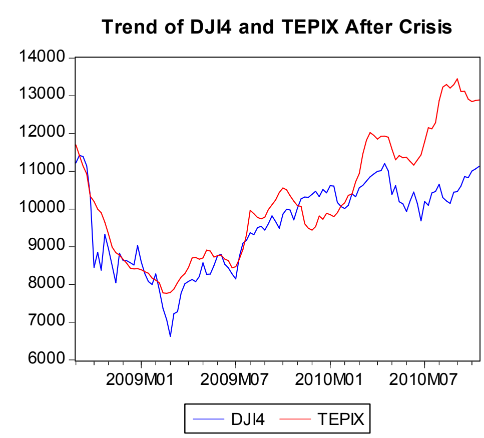

Fig. 8. The trend of DJI4 and TEPIX after the Financial Crisis on Oct 2008 (weekly data and they are shifted 4 weeks backwardly

7. Conclusion

Crises are typically identified as periods in which return volatility is abnormally high. Suppose that a crisis is driven by large shocks to a common factor, influencing all asset returns across the world. Other things equal, a higher variance of the common factor simultaneously causes higher-than-usual volatility and stronger co-movements in all markets. There is no break in the international transmission of financial shocks; a rise in the magnitude of the common shock mechanically increases cross-country correlations. The Great Recession of 2008-2009 stands out for both its virulence and global nature. In fact, following a period of very low volatility in asset prices between 2004 and 2007 (below 15%), volatility rose to unprecedented levels (up to over 40% for the cross-country median), influencing on most countries. Stock markets shared a common trend. It implies that the markets move together and any market will be representative of the behavior of that group of markets. If, however, there are persistent deviations from the common trend, then international investors might make short term speculative investments based on the forecast that the market will revert to its long-term relationship with the world market (Phylaktis & Ravazzolo, 2005) The fact is in the Iranian economy there are a lot of barriers for international investors and speculators. Therefore, the mechanism of transmission of stock market movements is totally different. This research indicates that the correlation of TSE and NYSE after crisis is more than what has been expected whereas there has been no meaningful correlation before the crisis. Although major indicators of international markets such as DOW, NAZDAQ, S & P500 in the United States, STOXX50, FTSE100, DAX in Europe and NIKKEI, TOPIX, HANG SENG Asia, almost behaved, concurrently, TEPIX act-out with a delay of four weeks for adapting the market's fluctuations. It is obvious that dependency of TSE and international markets before and after crisis is deferent. The degree of contagiousness increased in economy during October 2008 to November 2010. Country-specific noise should not be arbitrarily ignored in interpreting of structural breaks in the international transmission of shocks. There are two major reasons implying why there is an indirect transition between the international collapse and the Iranian collapse. First regarding this fact that the economy of Iran is based on oil and mining industry; the less world price of oil and base metal in the markets, the less Iran's GDP could be observed. It can be understood that according to the definition of contagion by Pericoli and Sbracia, (2003), the third definition can explain better this transmission and contagiousness of the crisis to economy of Iran. The second reason is the structure of TSE. Fluctuation of prices in TSE was bounded in a limited range between -3% to +3% per a day. So a turmoil market could have not been accomplished in TSE in an instant shock. This Law of TSE is kind of strength, which allows government to respond with fiscal and credit policies to lessen the adverse impact of the global stress (Illing & Liu, 2003). Therefore as it is discussed in this research, Iran's domestic economic condition causes a delay in adaption of the world economy but there is no way to avoid connectivity of the world economy especially in terms of global crisis.

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References

Acharya, V. V., & Pedersen, L. H. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics*, *77*(2), 375-410.

Allen, F., & Gale, D. (2004). Financial intermediaries and markets. *Econometrica*, *72*(4), 1023-1061.

Bagliano, F. C., & Morana, C. (2012). The Great Recession: US dynamics and spillovers to the world economy. *Journal of Banking & Finance*, *36*(1), 1-13.

Boshoff, W. H. (2006). The transmission of foreign financial crises to South Africa: a firm-level study. *Journal for Studies in Economics and Econometrics*,*30*(2), 61-85.

Broder, I., & Schoepfle, G. (1975). Classification of economic indicators: an alternative approach. In *Annals of Economic and Social Measurement, Volume 4, number 3* (pp. 435-445). NBER.
Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *Review of Financial studies*, *22*(6), 2201-2238.
Corsetti, G., Pericoli, M., & Sbracia, M. (2011). Correlation analysis of financial contagion. *Financial Contagion: The Viral Threat to the Wealth of Nations*, 11-20.
Chari, V. V., Christiano, L., & Kehoe, P. J. (2008). Facts and Myths about the Financial Crisis of 2008. *Federal Reserve Bank of Minneapolis Working Paper*,*666*.
Dees, S., Pesaran, M. H., Smith, L. V., & Smith, R. (2010). Supply, demand and monetary policy shocks in a multi-country New Keynesian model.
Demyanyk, Y., & Van Hemert, O. (2011). Understanding the subprime mortgage crisis. *Review of Financial Studies*, *24*(6), 1848-1880.
Edwards, S. (2000). Contagion. *The World Economy*, *23*(7), 873-900.
Eun, C. S., & Shim, S. (1989). International transmission of stock market movements. *Journal of financial and quantitative Analysis*, *24*(02), 241-256.
Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, 251-276.
Granger, C. W. (1981). Some properties of time series data and their use in econometric model specification. *Journal of econometrics*, *16*(1), 121-130.
Hausler, G. (2002). The globalization of finance. *Finance and Development*,*39*(1), 10-12.
Illing, M., & Liu, Y. (2003). *An index of financial stress for Canada* (pp. 2003-14). Bank of Canada.
Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2), 231-254.
Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and statistics*, *52*(2), 169-210.
Longstaff, F. A. (2010). The subprime credit crisis and contagion in financial markets. *Journal of Financial Economics*, *97*(3), 436-450.
Kaminsky, G. L., Reinhart, C., & Vegh, C. A. (2003). *The unholy trinity of financial contagion* (No. w10061). National Bureau of Economic Research.
Kim, S. J., Moshirian, F., & Wu, E. (2005). Dynamic stock market integration driven by the European Monetary Union: An empirical analysis. *Journal of Banking & Finance*, *29*(10), 2475-2502.
Kiyotaki, N., & Moore, J. (2002). Evil is the root of all money. *American Economic Review*, 92(2), 62-66.
Kolb, R. W. (Ed.). (2011). *Financial contagion: The viral threat to the wealth of nations* (Vol. 604). John Wiley & Sons.
Longstaff, F. (2008). Flight-from-leverage in distressed asset markets. *Unpublished working paper, UCLA*.
Mesa-Lago, C., & Vidal-Alejandro, P. (2010). The impact of the global crisis on Cuba's economy and social welfare. *Journal of Latin American Studies*, *42*(04), 689-717.
Moshirian, F. (2004). Elements of global financial stability. *Journal of Multinational Financial Management*, *14*(4), 305-314.
Moshirian, F. (2007). Global financial services and a global single currency. *Journal of Banking & Finance*, *31*(1), 3-9.
Pericoli, M., & Sbracia, M. (2003). A primer on financial contagion. *Journal of Economic Surveys*, *17*(4), 571-608.
Phylaktis, K., & Ravazzolo, F. (2005). Stock market linkages in emerging markets: implications for international portfolio diversification. *Journal of International Financial Markets, Institutions and Money*, *15*(2), 91-106.

Sander, H., & Kleimeier, S. (2003). Contagion and causality: an empirical investigation of four Asian crisis episodes. *Journal of International Financial Markets, Institutions and Money*, *13*(2), 171-186.

Spiegel, M. (2011). The academic analysis of the 2008 financial crisis: round 1.*Review of financial studies*, *24*(6), 1773-1781.

Tytell, I., Elekdag, S., Danninger, S., & Balakrishnan, R. (2009). *The transmission of financial stress from advanced to emerging economies*. International Monetary Fund.

Vayanos, D. (2004). *Flight to quality, flight to liquidity, and the pricing of risk* (No. w10327). National Bureau of Economic Research.