Journal of
Business & Financial Affairs

Onikola, J Bus Fin Aff 2016, 5:1
DOI: 10.4172/2167-0234.1000161

Research Article Open Access

Equity Prices and Real Output: Evidence from a Structural VAR for the MINT Economies

Onikola HO*

ALBA Graduate Business School at the American College of Greece, Athens

Abstract

This paper presents a bivariate structural VAR model which investigates the interrelationships between the stock market indexes of the MINT economies - Mexico, Indonesia, Nigeria and Turkey; and a significant macro-economy proxy measured by the growth rate of industrial production using monthly data from 2000:1 to 2014:12 obtained from DataStream International, World bank, IMF and stock exchange sites of each countries where available. Improving on previous studies, we employed the Bai and Perron test to determine the significant break period and the Coefficient covariance matrix was specified by employing the HAC (Newey-West) method and allowing error distributions to differ across breaks which identified a common break (pre and post crisis) period for all the MINT economies corresponding to respective economic activity of the countries. Examining possible relationship between the variables, our Granger/Block exogeneity test reveals that, the null hypothesis will not be rejected in all cases, except the hypothesis that stock returns has a lead-lag effect on industrial production for the case of Mexico during the pre-crisis period but reverse is not the case. Our VAR estimation revealed that real activity shocks only explain a small fraction of the variability in real stock prices during the pre-crisis period than the post-crisis period in the case of Indonesia, Nigeria and Turkey excluding Mexico which explained larger variation in the pre-crisis than the post-crisis period for both the stock return and real activity. The results also reveals smaller variation of each variable on one another for variation of real activities due to innovations from stock returns for Nigeria and Indonesia alone while Mexico ant Turkey depicts the opposite. Thus, the study provides additional evidence for the absence of the direct linkage between real stock returns and real economic activities measured by industrial production which shows that the market is inefficient and perhaps not derived or guided by fundamentals, more so, the impact of the global financial crisis is also revealed and policy recommendation provided.

Keywords: MINT economies; Stock prices; Industrial production; SVAR; Structural breaks; Causality; Bai and Perron

Introduction

Over the recent periods, modeling and forecasting stock market volatility has been the subject of vast empirical and theoretical investigation by academics and practitioners alike. There are a number of motivations for this line of inquiry; perhaps, volatility is one of the most important and widely used concepts in the whole of finance. Notwithstanding, attention to the relationship between the share market and the rest of the economy has been on the increase by finance specialist, economist and other stakeholders. Furthermore, the severe market decline in 2008 resulting from the subprime lending in US has reawakened research on this topic. Traditionally, stock markets play an important role in the economy; by enhancing the growth of commerce and expanding the capital formation required for the development of industries and building capacities. In the economy, the financial sector is expected to serve as the driver and catalyst to achieving full diversification of the economy. The idea is to strengthen the domestic financial market by developing competence and skills for financial services industry which will in turn have an impact on the industrial productivity of the country by improve access to finance and build an integrated infrastructure for the financial industry and other growth driven industry of the economy. Indicatively, the stock exchange provides long-term capital for major sectors of the economy including businesses and the government and its indexes are often used as an indicator of economic health.

At any phase of an economy, a number of sectors of the economy need long-term capital to grow. The stock exchange is an essential establishment in the capital market that ensures the efficient re-distribution of resources for economic activities. Economic development requires commitment to long-term investment. The path to economic recovery and growth may require increasing production inputs - land, labor, capital and technology - and or increasing their productivity. From past trend, countries that have found themselves in a recession phase have revived their economies through several productivity enhancement schemes. For instance, Japan from the end of the World War II and the United States of America from the 1970's have made high productivity the center point of their economic planning and the results have been resounding. Also, middle income countries like Hong Kong, South Korea, Singapore, and the Philippines have embraced boosting productivity schemes as an integral part of their national planning and today they have made significant in-roads into the world industrial. Intuitively, we can argue that productivity is essential in boosting economic growth and the standards of living of the people – using per capita income; hence, its measurement cannot but be of importance to both policy makers and researchers.

Nonetheless, concerns about the inability of the stock market movements to be explained by economic fundamentals during the recent decades have been on its rise. These concern surfaces not only for the advanced economies; the US' stock market, European and Asian markets but also the perceived emerging market economies. This is well apparent in the advanced economies when their stock markets witnessed unprecedented highs in the mid-1990s but were sharply

***Corresponding author:** Onikola HO, ALBA Graduate Business School at The American College of Greece, Athens, Tel: +2348068684478; E-mail: hamonikola@gmail.com

Received November 17, 2015; **Accepted** January 06, 2016; **Published** January 20, 2016

Citation: Onikola HO (2016) Equity Prices and Real Output: Evidence from a Structural VAR for the MINT Economies. J Bus Fin Aff 4: 161. doi:10.4172/2167-0234.1000161

reversed in the early and late 2000s as a result of excessive speculation. Studies have revealed that most of the rise in equity prices during the second part of the 1990s in the US was not due to fundamental values such as projected earnings growth or dividends but to exogenous shocks and/or market irrational behavior. This is similar to the conclusion of other researchers who reported that fundamental variables themselves such as discount rates, earnings, dividends, industrial production etc. did not help explain stock price movements.

Motivated by the above, we observed that such explanations did not exist for emerging markets economies owing to the specificity and difference in the market conditions along development line. It is in this initiative we consider to examine the MINT economies which could not be explained by the class of models according to which the stock market may be a leading indicator of real economic activity considering the unambiguous results established by studies that real activity explained only a small fraction of the variation in real stock returns. More importantly, understanding the macroeconomic variables that could impact the stock market index, with the recent data of the MINT economies can be useful for investors, traders as well as the policy makers. As a distinguish factor from the conclusions of result above, the MINT countries face a number of economic and political challenges. For instance, Nigeria is the only member of MINT running a current Account surplus - US$5,016 million in the second quarter of 2013 [1]. There are leadership and economic challenges in Indonesia and political issues in Turkey while Nigeria has been grappling with serious security and terrorism challenges since 2009. Although MINT countries share some features in common, they also diverge in several respects. In terms of wealth for instance, Mexico and Turkey are at approximately the same level, earning annually about US$10,000 per capita. This compares with US$3,500 per head in Indonesia and US$1,500 per capita in Nigeria [2].

Literature Review

Several studies exist in the finance literature that examines the linkages between macroeconomic fundamentals and stock returns. For instance, the result of the study of equity prices and macroeconomic fundamentals of developed economies revealed different sensitivities in the way stock prices reacted to changes in the fundamentals suggesting that stock markets appeared to move independently of them in the long run, especially in the post-euro period while Fama, Barro, Schwert found that there exists a strong short-run correlation between stock returns and macroeconomic fundamentals for the United States (US) and between these magnitudes and other financial variables [3-5]. Lee, Groenewold, Laopodis, Rapach made contributions in this field by estimating SVAR models including stock prices and measures of real activity for several developed countries [6-9]. Furthermore, several studies exist in literature that examine the relation between stock returns and the growth rates of real activity). Allen and Yang estimates SVAR model including prices and dividends and/or earnings of several countries which is similar to the work of bhargava which examined the relationship between P/E ratios, dividend yields, and stock prices in the BRIC nations using monthly data (1999-2009) [11-14]. Chen et al. explored a set of macroeconomic variables as systematic influence on stock market returns by modeling equity return as a function of macro variables and non-equity assets returns for US. They empirically found that the macroeconomic variables such as industrial production anticipated and unanticipated inflation, yield spread between the long and short term government bond were significantly explained the stock returns.

Researching on developed countries, Laopodis examined the dynamic linkages among stock prices, interest rates, inflation, and economic activity for the United States since the 1970s and also reported that there was no consistent, dynamic relationship between real activity and stock prices across different monetary regimes during the last thirty years [8]. Binswanger [15], developed a bivariate structural VAR model which includes growth rates of industrial production and stock prices for US, Japan and an aggregate European economy between the periods of 1960 to 1999 and found that real activity shocks only explain a small fraction of the variability in real stock prices whereas some authors have also argued that the recent stock price movements cannot be explained by fundamental factors and that they are the result of speculative bubbles [16]. According to regression results presented, it suggests a breakdown between stock returns and real economic activity in the US in the early 1980s; which traditionally; have strong relationship. Such a breakdown indicates the development of new sources of variation in stock returns especially during the stock market boom over the 1980s and 1990s. However, this breakdown are not explained by the traditional discounted cash flow valuation model which forms the basis to which stock prices should lead measures of real activity [3].

Similarly, the results of the dynamic relationships between stock prices and economic fundamentals for the period 1990-2009 for France, Germany, Italy, the UK and the US using the rolling-sample co-integration technique and VAR specifications carried out by revealed different sensitivities in the way stock prices reacted to changes in the fundamentals which suggests that stock markets appeared to move independently of them in the long run of the post-Euro period i.e. there was no consistent, dynamic relationship between real activity and stock prices across different monetary regimes during the last thirty years. Nevertheless, economy concluded that not only has the share market increased relative to the real economy but it appears that the inter-relationship between them has also strengthened [7,17]. From the foregoing, we could infer that the share market reflects to some extent the activities and performances in the economy, however, we cannot also rule out the possibility of the influence in opposite direction. This has generated widespread recognition in recent time even though stock market and economic performances interrelationship of countries differs. In Nigeria for example, comparing recent indices from 2005 to 2012; the value of Market Capitalization increased by 191% from $19,356 to $56,389 contrary to the ratio of share-market capitalization to GDP (% of GDP) which declined from 17.2% in 2005 to 12.2% in 2012; however, other countries Mexico, Indonesia and Turkey increases significantly in market capitalization from $239,128, $81,428, and $161,537 in 2005 to $525,057, $396,772 and $308,775 in 2012 which also translates to an increase in (%GDP) 16.6%, 14.7% and 5.7% respectively.

In view of the above conflicting evidence and more significantly, 'developed-economies-dominated' studies, this paper sets out to re-examine the nature of the relationship between the aggregate stock market and general economic activity of the MINT economies which to the best of the our knowledge does not previously exist. The 'MINT" is an acronym coined by the major investment firm Fidelity in 2011 (popularized by Jim O'Neil) for a group of four countries-Mexico, Indonesia, Nigeria and Turkey-that are expected to show strong growth and provide high returns for investors over the coming decade. These countries have been grouped together because of their large populations, favorable demographics and emerging economies. Although, these countries have smaller economies than the BRICs-Brazil, Russia, India and China which is a group of emerging-market

economies that enjoyed strong growth for a number of years; however, the BRICs' have started to witness slowed-growth (with the exception of China), investors have started to turned their attention to MINTs, which analysts expected to be the next big thing.

An understanding of the MINT economies reveals that they share some common features: first, the countries have relatively large and growing young populations when compared to the ageing and shrinking populations in many developed countries (including China); second, these countries are geographically well placed to take advantage of large markets nearby. For example, Indonesia is close to China, Turkey being neighboring to the European Union, Mexico is also on America's doorstep, while Nigeria has the potential to serve as economic hub of Africa. Of the four MINT economies, only Nigeria is not yet a member of the G20 group of developed and developing countries; but has huge endowment of natural resource, especially oil and gas. Foreign Direct Investment (FDI) to the BRICS and MINT increased by 349% from US$113.6billion to US$510.4 Billion between the period of 2001 and 2012 [18]. Besides, BRICS and MINT attracted 30% of global FDI, contributed 19% to global GDP, and accounted for 51% of the global population in 2011(World Bank, 2013). For developmental purpose, BRICS and MINT have fundamental policies to promote FDI inflows to their respective countries (especially to sectors that have significant multiplier effects in respect of employment and output, promote technology transfer, or local innovation).

Leveraging on the work of who addresses the dynamic linkages between stock prices and economic fundamentals of developed economies (France, Germany, Italy, the UK and the USA) for the period of 1990-2009, this study empirically analyzes the relationship between stock prices and economic fundamentals of the MINT economies; proxied by industrial production growth rate starting with determining a common break for all the economies using a statistical approach. Also, other works such as Binswanger carried out a related study using developed countries like US, Japan and an aggregated of European countries using data from 1960 to 1999 presented with a bivariate structural VAR model would be a good framework to start with. There are several motivations for this study and approach [15]; examining the relationship of these variables in the MINT economies will give us a broader understanding of the theory and an advantage to compare with the result of previous researchers in the developing economies. Another significant part of this study is to ascertain if similar conclusion will be reached in our study and more importantly if there exist fundamental different between the break periods identified i.e. the pre and post financial crises period for each of the countries.

The rest of the paper is organized as follows. The next section presents a brief description of the data, some summary statistics, and the methodological design for the study. Furthermore, the next sections contains the results from the preliminary statistical investigation regarding correlations and unit root tests, and the main empirical findings from Granger causality analyses, impulse responses and forecast error variance decomposition. This section also contains a discussion of the empirical findings. The final section summarizes the study and concludes with some general policy recommendation.

Research Method

In this section, we approached our empirical investigation chronologically by describing the data and variable construction, outlining the theoretical methodology design; which entails SVAR modeling and Granger causality analyses and then we proceeding with a preliminary statistical analysis which is followed by the main empirical findings of the study.

Data and theoretical methodology

The data used for this study are sourced from the DataStream International for all the MINT economies and additionally from Central bank of Nigeria (CBN) statistical Bulletin where applicable. The data set consists of monthly observations over the period of 2000:01-2014:12 for Mexico, Indonesia, Nigeria and Turkey for each of the countries stock index (SI), industrial production (IND), as well consumer price indices (CPI). Real industrial production (IP) is calculated by dividing the industrial production index by the consumer price index, while its growth rate IPG or y_{1t} is calculated as the first difference of real IP. Real stock prices (SP) are calculated by dividing nominal stock prices by the CPI while real stock returns SR or y_{2t} are calculated as the first difference of real stock prices. All variables are presented in natural logarithms.

In addition to the above, the VAR model is also used for structural inference and policy analysis. In structural analysis, certain assumptions about the causal structure of the data under investigation are imposed, and the resulting causal impacts of unexpected shocks or innovations to specified variables on the variables in the model are summarized. These causal impacts are usually summarized with impulse response functions and forecast error variance decompositions. In a bid to capture the effect of these innovation and the periods of occurrence, we carried out a structural break test by employed the break test. More importantly, our inability to automatically detect a common break for all the MINT economy intuitively justifies our need to carry out the structural break test. The tests of structural break aid our detection of a common break period.

The structural VAR model, shock decompositions and lag length selection: The Vector Autoregressive (VAR) analysis is used in finance for the simulation of the effects on the endogenous variables of shocks to equation error terms. For purpose of simplicity, a VAR is a systems regression model which has more than one dependent variable that can be considered a kind of hybrid between the univariate time series models and the simultaneous equations models. The estimation method has often been advocated as an alternative to large-scale simultaneous equations structural models, however, given the non-theoretical nature of the model, the interpretation of generated shocks may be difficult to interpret. Therefore, an extension of the VAR model (the structural VAR or SVAR) which imposes theory-based restriction on the VAR to enable the identification of the errors terms will be adopted in this paper. Variant of the SVAR model have been extensively used in macroeconomics and finance, such as who use their model to decompose movements in real output and the rate of unemployment into those driven by aggregate demand and supply shocks.

The model adopted in this paper is similar to the SVAR model estimated by who analysis the important of fundamentals - evidence from a SVAR model for the stock markets in the US, Japan and Europe [15]. Similar model was also employed by who analyses the relation between growth rates of real GDP and growth rates of the stock market in Australia [7]. Our motivation has also been drawn of from the works of who concluded that forecasts for some fundamental variables are produced more accurately using VARs than from several different structural specifications. Hence, since this paper also requires the use of variables mentioned, we considered it more appropriate to adopt the method [19].

From the forgoing, the simplest case of VAR model is the bivariate VAR (adopted in this study), where there are only two variables, y_{1t} and y_{2t}, each of whose current values depend on different combinations of the previous k values of both variables, and error terms as specified below:

$$y_{1t} = \beta_{10} + \beta_{11}y_{1t-1} + \ldots + \beta_{1k}y_{1t-k} + \alpha_{11}y_{2t-1} + \ldots + \alpha_{1k}y_{2t-k} + u_{1t}$$
$$y_{2t} = \beta_{20} + \beta_{21}y_{2t-1} + \ldots + \beta_{2k}y_{2t-k} + \alpha_{21}y_{1t-1} + \ldots + \alpha_{2k}y_{1t-k} + u_{2t}$$

Where u_{it} is a white noise disturbance term with? $E(u_{it}) = 0$, (i = 1,2), $E(u_{1t}u_{2t}) = 0$

We estimate a two-variable model that consists of the first differenced log of real share index (ASI) denoted as y_{1t}, and the first differenced log of industrial production (IND), y_{2t} Given the importance of industrial production or real GDP as a measure of real economic activities especially by previous studies, we decided to follow this tradition in this paper because the relation between stock returns and growth rates of industrial production appears to be more significant than the relation between stock returns and growth rates of real GDP.

The reduced form of the VAR model is represented by the bivariate system

$$y_{1t} = \beta_{10} + \beta_{11}y_{1t-1} + \alpha_{11}y_{2t-1} + u_{1t}$$
$$y_{2t} = \beta_{10} + \beta_{21}y_{2t-1} + \alpha_{21}y_{1t-1} + u_{1t}$$

Or

$$\Delta Z_t = \begin{bmatrix}\Delta y_{1t}\\ \Delta y_{2t}\end{bmatrix} = \begin{bmatrix}\beta_{10}\\ \beta_{20}\end{bmatrix} + \begin{bmatrix}\beta_{11}(L) & \alpha_{12}(L)\\ \alpha_{21}(L) & \alpha_{22}(L)\end{bmatrix}\begin{bmatrix}\Delta y_{1t-1}\\ \Delta y_{2t-1}\end{bmatrix} + \begin{bmatrix}u_{1t}\\ u_{2t}\end{bmatrix}$$

Where

y_{1t} and y_{2t} = Endogenous variables

α_{i0} = Parameter representing intercept

L = Lagged operator (selection criteria explained below)

u_{1t}, u_{2t} = the observed error terms of the reduced VAR model (reduced form residuals or reduced form shocks). The error terms u_{1t}, u_{2t} are white noise disturbances which, however, will usually be correlated unless there are no contemporaneous effects between Δy_{1t} and Δy_{2t}. Ignoring intercept terms, we can write equation (1) in a more compact notation as

$$\Delta Z_t = \beta(L)L\Delta Z_t + u_t$$

Given the fact that the series y_{1t} and y_{2t} are both covariance stationary and assuming that β(L) is invertible, we can write:

$$\Delta Z_t = \left[I - \beta(L)L\right]^{-1}u_t$$

Which is the bivariate infinite order average representation (BMA) of (1)?

As the residual u_{1t}, u_{2t} are usually correlated, they cannot be structural innovations which are supposed to be uncorrelated with each other. The unobserved structural innovations come from a VAR representation of the structural form (SVAR), which we suppose can be written as

$$B(L)\Delta Z_t = u$$

Where B(L) a matrix of structural parameters is derived by identifying restrictions and u^t is a vector of the uncorrelated white noise disturbances u_{1t}, u_{2t} which are the structural shocks or structural innovations.

If the matrix polynomial $\left[I - \beta(L)L\right]$ is invertible, so is the matrix polynomial and the SVAR can also be expressed as BMA

$$\Delta Z_t = \left[\beta(L)\right]^{-1}u_t = \delta(L)u_t$$

Or

$$\begin{bmatrix}\Delta y_{1t}\\ \Delta y_{2t}\end{bmatrix} = \begin{bmatrix}\lambda_{11}(L) & \lambda_{12}(L)\\ \lambda_{21}(L) & \lambda_{22}(L)\end{bmatrix}\begin{bmatrix}u_{1t}\\ u_{2t}\end{bmatrix}$$

Where $\lambda_{ij}(L)$ are the infinite polynomials in the lag operator L

Lag length selection: The lag length for the VAR(p) model was determined by using model selection criteria. The general approach is to fit VAR(p) models with orders p = 0,…, p_{max} and choose the value of p which minimizes some model selection criteria. Model selection criteria for VAR(p) models have the form:

$$IC(p) = \ln|\bar{\Sigma}(p)| + c_T.\varphi(n,p)$$

Where $\bar{\Sigma}(p) = T^{-1}\sum_{t=1}^{T}\varepsilon_t\varepsilon_t'$ is the residual covariance matrix without a degree of freedom correction from a VAR(p) model, c_T is a sequence indexed by the sample size T, and $\varphi(n,p)$ is a penalty function which penalizes large VAR(p) models. The three most common information criteria are the Akaike (AIC), Schwarz-Bayesian (SIC) and Hannan-Quinn (HQ):

$$AIC(p) = \ln|\bar{\Sigma}(p)| + \frac{2}{T}pn^2$$
$$SIC(p) = \ln|\bar{\Sigma}(p)| + \frac{\ln T}{T}pn^2$$
$$HQ(p) = \ln|\bar{\Sigma}(p)| + \frac{2\ln\ln T}{T}pn^2$$

All criteria add a penalty to the one-step ahead MSE which depends on the sample size T, the number of variables m and the number of lags q. While for large T penalty differences are unimportant, this is not the case when T is small.

In general, for T ≥ 20 SWC and HQC will always choose smaller models than AIC. The three criteria have different asymptotic properties. AIC is inconsistent (in fact, it overestimates the true order with positive probability) while HQC and SWC are consistent and when m > 1, they are both strongly consistent (i.e. they will choose the correct model almost surely). Intuitively, AIC is inconsistent because the penalty function used does not simultaneously goes to infinity as T → ∞ and to zero when scaled by T. Consistency however; it is not the only yardstick to use since consistent methods may have poor small sample properties. Extensively study the small sample properties of these three criteria using a variety of data generating processes and data frequencies and found that HQC is best for quarterly and monthly data, both when y_t is covariance stationary and when it is a near-unit root process [19].

The AIC criterion asymptotically overestimates the order with positive probability, whereas the SIC and HQ criteria estimate the order consistently under fairly general conditions if the true order p is less than or equal to p_{max}. In general, we prefer to use a simple bivariate model instead of a VAR due to its ability to accommodate further fundamental variables, thus; we only need to impose one additional identifying restriction, which does not require a strong a priori assumption based on a specific economic theory. After the VARs model has been estimated, we will thereafter impose an additional restriction in order to identify the structural shocks.

Preliminary statistical results

Our initial descriptive result reveals that the hypothesis of normality for Jarque-Bera statistics is rejected for all variables. The distributions of stock returns and real IPG are negatively skewed and leptokurtic relative to the normal distribution (Table 1). The descriptive statistics of real stock price returns and growth of industrial production for the break period identified (Table 2).

We evaluated the effect of stationarity in the series using the ADF and KPSS method (Table 3); and observed that a variety of alternative unit root tests provides evidence of non-stationarity for the stock prices and the industrial production (result are presented in later sections) with the exception of only Nigeria which has its stock price stationary at level. Accordingly, real stock returns and real IP growth rate appear to be stationary for all observed series. Given that real stock returns and the real IP growth rate are stationary, and that there is no cointegration, a VAR model for real stock returns and real IP growth rate is thereby considered for our analysis.

The graphs in Figure 1 show the development of the log levels of real stock prices and industrial production from 2000:01 to 2014:12. Real stock prices have a similar trend of an initial decline from 2000 before starting to increase around 2003 until the 2007 crises period for Mexico, Indonesia and Turkey; while for the Nigeria's case there has been an initial steady increase until a slight decline in 2008 half way due to the capital market re-capitalization followed by the decline in caused by the financial crises originated from the US. However, since the 2003 the actual patterns of real stock price development vary similarly among the MINT economies swinging steady upward. The boom is most prevalent during the period of 2003 to 2007 in Mexico, followed by Indonesia, then Turkey and Nigeria. As the booming comes to an end; witnessing the financial crises, it also appears that all the MINT economies have a similar share of the loss in terms of the trend. However, it becomes obvious that Nigeria has a more prevalent period during the crises as it took the longest time to recover as compared to others. Out of the countries; Indonesia recovered faster followed by Mexico, Turkey and worst felt is Nigeria.

In a similar fashion, we observed several structural breaks for all the market at different point in time of the markets. Significant among these breaks is the financial crises in 2008 which was common among all market. We observed that the impact was more severe in the Nigeria capital than other markets. The markets of Mexico, Indonesia and Turkey increase steadily after the financial crisis while in the case of Nigeria; no increase in share price was noticed. From the foregoing; we identified a common structural break period between the periods of 2007 to 2009 which was as a result of the crisis 2). We also discover a similar recovery period of 2000:02, 2009:01, 2009:03 and 2009:02 for the Mexico, Indonesia, Nigeria and Turkey capital market respectively as reflected in their share prices. We therefore identified the period 2000:01–2009:03 associated with the re-boom of the market as a structural break period for this study as further explained by Figure 2.

	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera	pr.
2000:01-2014:12						
Mex return	0.006797	0.055708	-0.568579	4.012922	17.29691	0
Mex ipg	0.001084	0.008401	-0.179224	4.166856	11.1132	0.00382
Indo ret	0.005609	0.069612	-1.091788	7.457595	183.75	0
Indo ipg	0.004821	0.063188	-0.916941	9.857151	375.77	0
Nig. return	0.000386	0.072183	-0.34646	8.539174	232.42	0
Nig. ipg	0.001052	0.064249	-0.10273	4.872632	26.46935	0
Turk return	-0.002325	0.109709	-0.550691	4.734227	31.47851	0
Turk ipg	0.003676	0.055238	-0.543497	4.924529	36.43671	0

Table 1: Preliminary descriptive.

	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera	pr.
2000:01-2009:03						
Mex return	0.005895	0.064445	-0.627889	3.385314	7.908299	0.019175
Mex ipg	0.000547	0.009496	-0.050659	3.669583	2.101947	0.349597
Indo ret	0.000297	0.078274	-1.180658	6.730879	89.35333	0
Indo ipg	0.005134	0.076108	-0.854053	7.575195	109.3127	0
Nig. return	0.000908	0.072507	-1.451366	8.459756	175.2428	0
Nig. ipg	0.00134	0.073624	-0.187246	4.320866	8.639275	0.013305
Turk return	-0.010857	0.126364	-0.457688	4.038731	8.785682	0.012366
Turk ipg	0.002251	0.054149	-0.850187	5.926414	52.50286	0
2009:04-2014:12						
Mex return	0.008235	0.038245	0.419185	3.176303	2.110094	0.348176
Mex ipg	0.001939	0.006245	-0.314127	4.219438	5.409984	0.066871
Indo ret	0.014077	0.052395	0.199667	4.240889	4.885409	0.086925
Indo ipg	0.004321	0.034151	-0.254937	4.524938	7.433043	0.024318
Nig. return	-0.000447	0.072184	1.452825	8.807343	121.2331	0
Nig. Ipg	0.000592	0.046003	0.450283	3.326325	2.637831	0.267425
Turk return	0.011277	0.074866	0.000811	2.642711	0.367016	0.832345
Turk ipg	0.005947	0.057259	-0.139455	3.517771	0.994397	0.608232

Table 2: Structural break descriptive.

Augmented Dickey-Fuller Test [ADF]						
	Real stock prices			Industrial Production		
Country	Log Level	Log difference	Comment	Log Level	Log difference	Comment
Mexico	-0.862579	-12.18113[α]	I(1)	-0.57315	-15.81547[α]	I(1)
Indonesia	-0.7113	-10.63546[α]	I(1)	0.994704	-7.204279[α]	I(1)
Nigeria	-1.534423	-11.01869[α]	I(1)	-4.178927[α]	-	I(0)
Turkey	-2.34311	-15.21201[α]	I(1)	-0.919655	-14.52331[α]	I(1)
Kwiatkowski-Phillips-Schmidt-Shin Test [KPSS]						
	Real stock prices			Industrial Production		
Country	Log Level	Log difference	Comment	Log Level	Log difference	Comment
Mexico	1.518578	0.12143[α]	I(1)	1.469732	0.055696[α]	I(1)
Indonesia	1.557214	0.121791[α]	I(1)	1.708427	0.194179[α]	I(1)
Nigeria	0.374571	0.195799[α]	I(1)	1.163066[α]	-	I(0)
Turkey	0.618685	0.254862[α]	I(1)	1.590569	0.050471[α]	I(1)

Table 3: Unit root test (ADF and KPSS).

[α]Rejection of the null hypothesis of non-stationarity at the 5% level. For the ADF tests, we used the Schwarz Info Criterion. The KPSS bandwidth was automatic selected using Newey-West Bandwidth and the lag truncation for the Bartlett kernel is set to 4.

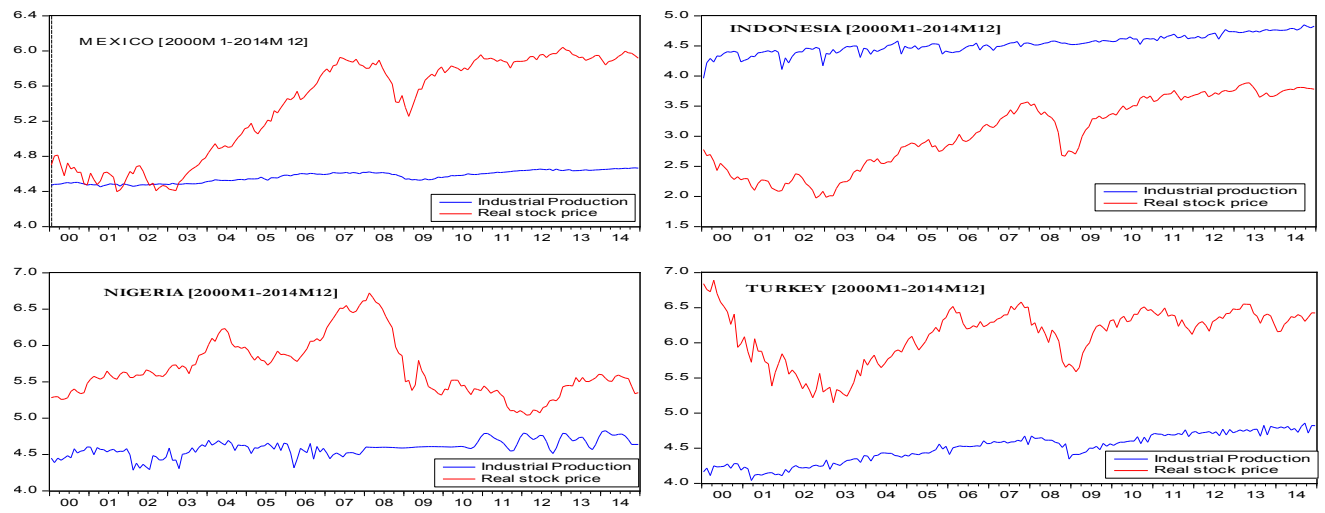

Figure 1: Log levels of real stock prices and industrial production.

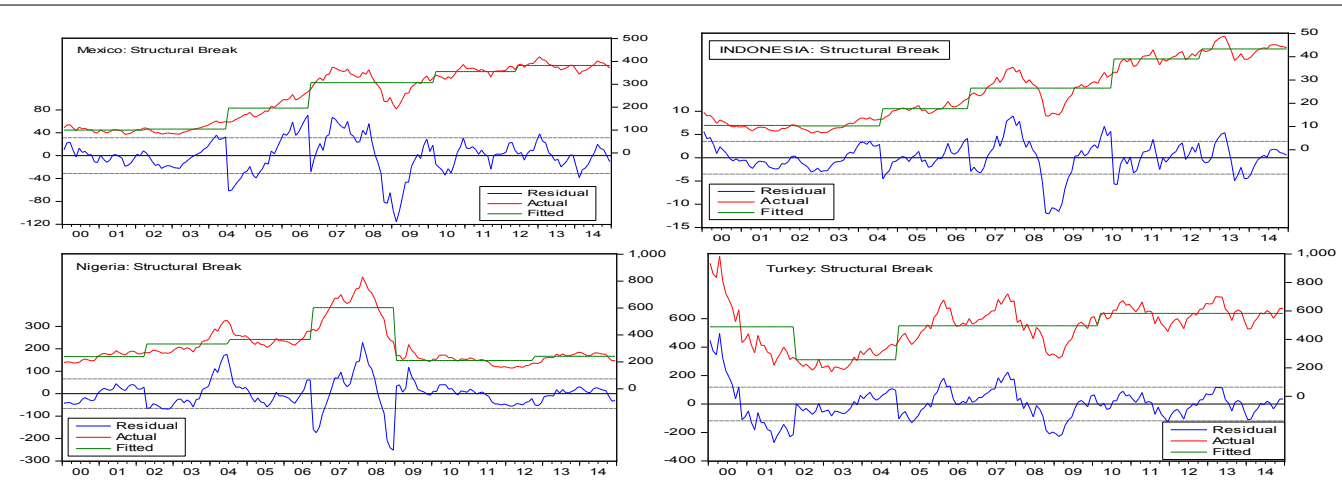

Figure 2: Prices level structural break of stock market shocks.

According to the results of the augmented Dickey–Fuller unit (ADF) root test, as well as of the Kwiatkowski-Phillips-Schmidt-Shin Test (KPSS), all variables (log levels) are I(1) and, therefore, non-stationary at their levels but stationary at their first differences except the time series for the Nigerian industrial production that is I(0) and, therefore stationary at level. However, when we test the presence of unit root in the same series during the break periods 2001:01-2009:03 and 2009:04-2014:12, we observed that the Nigeria industrial production series has unit roots in the post crisis period (2009:04-2014:12) and marginally shows the absence of unit roots before the crisis period (the full results from all tests and periods are available upon request).

Thus, it is concluded that each series is not stationary and thus needs to become stationary by being differenced once except for the Nigeria industrial production variable that is already stationary at level; hence, requires no differencing. Consequently, the new test values are 0.2830, 0.3423 and 0.0914, respectively (the full results from all tests are available upon request). In general, it was found that each variable is non-stationary in its raw form but becomes stationary when expressed in first differences. This holds true for all countries' series and both sub-periods. In addition, when using the 2001 instead of 1999, there was not qualitative difference in our results.

After determining the stationarity level of the series, we estimated the VAR model by including the growth rate of the two variables as well as a constant parameter. Firstly, we set the lag length. The lag length for the VAR(p) model was determined by using model selection criteria. The general approach is to fit VAR(p) models with orders p=0,…, p_{max} and choose the value of p which minimizes some model selection criteria. We use four different lag length criteria (final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SIC), Hannan–Quinn information criterion (HQ)) and estimate the model for lag lengths of 0–12. The optimal lag length for each model was chosen by applying the Akaike Information Criterion on the un-differenced VAR models; however, for our series observed in the post crisis period with 67 observations, we chose the Hannan-Quinn Criterion (HQ) which appears to be the most accurate criterion [20] with the exception of sample sizes smaller than 120, for which the Schwarz Information Criterion (SIC) is more accurate. In case of the presence or absence of a long-run relationship, the possibility of a short-run relationship between the fundamental ratios and the stock indexes may still exist, we thereby carried out causality test employing the Granger causality/Block Exogeneity Wald test with an error correction term (if co-integration exists) or without an error correction term (if co-integration does not exist) to investigate this issue.

The FPE and the AIC advised the inclusion of more lags than the SC and HQ criterion in both the pre and post crisis period. For the pre-crisis period with more observation, we employed the AIC criteria which suggest two lag criteria in the case of Indonesia and Turkey while eight and four lag criteria for the case of Mexico and Nigeria respectively while the HQ criteria employed for the post crisis period; suggests different lag criteria for each of the countries; Mexico (two), Indonesia (four). Nigeria (six) and Turkey (three) to explain the current level of the growth rate of industrial production in the VAR. We thereby set our lag criteria for the VAR models as given in Table 4 and Appendix 1 and 2.

Main empirical results

Table 5 presents the Granger-causality test results which show that, the null hypothesis will not be rejected in all cases, except the hypothesis that Mexico SR has a lead-lag relationship with IPG but not vice versa during the pre-crises period. That means there is a unidirectional causality running from SR to IPG. We proceed with the observation and analysis of the impulse response shocks from and to each variable for all the MINT nations. The figures at the appendix reveals some selected impulse response graphs for stock returns (SR) and industrial production growth rate (IPG) for both the pre and post structural breaks identified.

	FPE	AIC	SC	HQ
2000:01-2009:03				
Mexico	8	**8***	1	1
Indonesia	2	**2***	1	1
Nigeria	4	**4***	1	2
Turkey	2	**2***	2	2
2009:04-2014:12				
Mexico	3	12	2	**2***
Indonesia	12	12	1	**4***
Nigeria	10	10	4	**6***
Turkey	3	10	2	**3***
*lag length chosen				

Table 4: Optimal lag length selection.

	Summary
	Block Exogeneity/ Granger Causality Test
2000:01-2009:03	
Mexico	Uni-directional causality from IPG to SP return
Indonesia	No causality between SR and IP growth
Nigeria	No causality between SR and IP growth
Turkey	No causality between SR and IP growth
2009:04-2014:14	
Mexico	No causality between SR and IP growth
Indonesia	No causality between SR and IP growth
Nigeria	No causality between SR and IP growth
Turkey	No causality between SR and IP growth
SR - Stock price return	
IP- Industrial Production	

Table 5: Block exogeneity/granger causality test.

The results of the responses of stock return and industrial production growth of all the countries for both periods under investigation is presented in Figure 3. Several conclusions can be inferred; firstly, during the pre-crisis period for the case of Mexico, we observed a more turbulent alternating response from growth in industrial production to stock return which did not to be absorbed even after a year period; which is in contrast to the reaction in the other countries. During this period, an initial negative reaction in stock return is observed due to shocks in industrial production for the case of Indonesia; while Nigeria and Turkey depicts an alternating between positive and negative response before the shock is finally absorbed in periods 4, 7 and respectively. This could be as result of unexpected rise in stock prices that is not caused by real activity shocks which tends to induce investors to move funds into the stock market from the interest paying bond market; the length of period observed however, seems enough for this effect to take place. This is similar to the negative effect found in the four-variable SVAR model for the US estimated by previous researchers, therefore, it does not seem to be a statistical objective of our bivariate SVAR model [8]. For the reaction of the growth of industrial production due from stock return; it is evidenced that shocks in the Mexico stock return has an exerted positive response

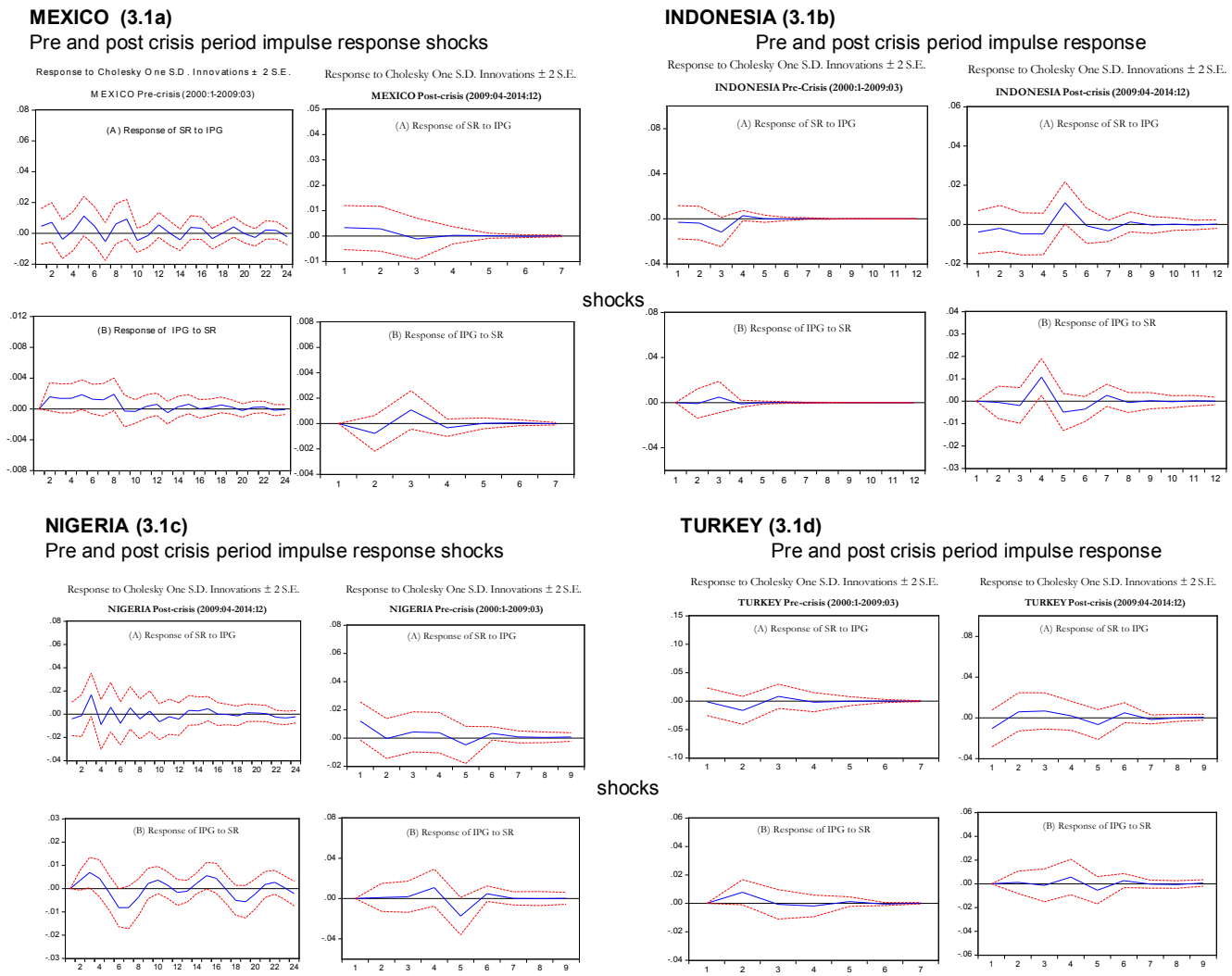

Figure 3: Impulse responses shock for pre and post crisis period.

in industrial production growth rate for a long period; same is true in the case of Indonesia, however, the influence was felt slightly and for a very short period. Conversely, for the case of Nigeria and Turkey, there is an alternating reaction positively and negatively before the shocks were fully absorbed.

For the period after the crisis 2009:03-2014:12, the picture is quite different in the sense that both stock return and industrial production growth 'behave well' to shocks from one another except for the case of Nigeria. For the responses of stock return in Mexico, Indonesia and Turkey; the behavior is relatively stable for shocks in industrial production than the reverse. Also, they get absorbed faster after periods of three, seven and seven months respectively. On the contrary, the Nigeria's story is different in terms of the signs, length of time and responses of the variables on each other. For the case of stock returns; an innovation in the industrial production growth takes a very long time to account for the sign and the shape of the responses in the former. Similarly, during this period, the behavior of the shocks of stock returns to industrial production behaved unstable continuously and persistently for a very long period. This is evidenced in the variance decomposition results where for the case of stock returns where almost 17% of the error forecasting variance of due from industrial production whereas 82% is due to own shock whereas the instability in the signs and response of industrial production due to shocks from stock returns is too long to imagine a possible absorption of the shock of the later.

Furthermore, an effort to analyze the forecast error variance decompositions reveals two interesting observations. On the first part, it provides clear evidence of the fundamental differences in the periods under consideration; and on the other part it reveals different how the each of the countries responded to the changes over the periods. As depicted in Table 6, the shock in industrial production for all the countries explains a small proportion of the variability in the stock returns during the pre-crisis period 2000:01-2009:03 while this proportion becomes larger in the model estimated for the period 2009:03-2014:12 except for the case of only Mexico which has the reverse as her case. For instance, the Mexico's industrial production shocks explained about 9.63% of the variability in stock returns at longer horizon over the pre-crisis period while only about 1.57% is observed for the same length of horizon. In contrast, for the cases of Indonesia, Nigeria and Turkey; innovations in the industrial production resulted in about 2.71, 3.53 and 2.03% the variability in stock returns during

Stock price forecast error variance decompositions for different periods					Industrial Production growth forecast error variance decompositions for different periods				
	2000:01-2009:03		2009:03-2014:12			2000:01-2009:03		2009:03-2014:12	
	variance attributed to:		variance attributed to:			variance attributed to:		variance attributed to:	
Period	Own shock	IPG rate	own shock	IPG rate	Period	Own shock	Stock return	Own shock	Stock return
Mexico					**Mexico**				
1	99.39467	0.605331	99.13196	0.86803	1	100	-	100	-
2	98.00684	1.993163	98.50715	1.49284	2	97.14649	2.853514	98.44535	1.554653
3	97.60157	2.398426	98.40768	1.59231	3	95.12809	4.871909	95.68613	4.313867
4	97.56401	2.435991	98.40208	1.59792	4	93.15534	6.844658	95.42686	4.573137
5	94.42554	5.574459	98.40128	1.59872	5	90.35379	9.646208	95.42992	4.570076
10	90.78156	9.218441	98.40072	1.59928	10	85.05036	14.94964	95.4216	4.578404
11	90.81805	9.181947	98.40072	1.59928	11	85.0539	14.9461	95.4216	4.578404
12	90.36423	9.635769	98.40072	1.59928	12	84.78054	15.21946	95.4216	4.578404
Indonesia					**Indonesia**				
1	99.83807	0.161929	99.22126	0.778739	1	100	-	100	-
2	99.61283	0.38717	99.02712	0.972883	2	99.98793	0.012074	99.97598	0.024019
3	97.41012	2.58988	97.89296	2.107045	3	99.53615	0.463846	99.66505	0.334952
4	97.28355	2.716452	96.84618	3.153816	4	99.51474	0.485258	90.73146	9.26854
5	97.28406	2.715945	91.70566	8.294344	5	99.51502	0.484983	89.33677	10.66323
10	97.28253	2.717466	91.2677	8.732297	10	99.51463	0.485365	88.25713	11.74287
11	97.28253	2.717467	91.26534	8.734663	11	99.51463	0.485365	88.25527	11.74473
12	97.28253	2.717467	91.26463	8.735372	12	99.51463	0.485365	88.25601	11.74399
Nigeria					**Nigeria**				
1	97.01704	2.982965	99.49871	0.501285	1	100	-	100	-
2	97.13698	2.863025	99.44785	0.55215	2	99.98045	0.01955	97.67057	2.329427
3	96.89593	3.10407	91.59557	8.404434	3	99.92587	0.074129	92.85788	7.142118
4	96.85703	3.142972	89.81294	10.18706	4	97.89383	2.106174	90.75016	9.249843
5	96.52762	3.472376	89.00123	10.99877	5	93.06253	6.937468	91.55512	8.444877
10	96.45861	3.541399	85.49513	14.50487	10	92.74547	7.254526	82.97347	17.02653
11	96.46086	3.539137	85.38961	14.61039	11	92.74571	7.254291	83.17712	16.82288
12	96.46229	3.537803	85.02481	14.97519	12	92.74229	7.257711	83.09575	16.90425
Turkey					**Turkey**				
1	99.99122	0.00878	98.00443	1.995572	1	100	-	100	-
2	98.40252	1.597483	97.38739	2.612611	2	97.82732	2.172678	99.94435	0.055653
3	97.98562	2.014376	96.62049	3.379508	3	97.87488	2.125119	99.9026	0.097402
4	97.96473	2.035272	96.56558	3.434417	4	97.7676	2.232399	99.01775	0.982255
5	97.96479	2.035214	95.81582	4.184183	5	97.71592	2.284076	98.23106	1.768941
10	97.96432	2.035698	95.33542	4.664581	10	97.70803	2.291968	98.02541	1.974589
11	97.96432	2.035698	95.33393	4.66607	11	97.70803	2.291968	98.02567	1.974327
12	97.96432	2.035698	95.33394	4.666056	12	97.70803	2.291968	98.0252	1.974804

Table 6: Impulse responses shock for pre and post crisis period.

the period before the crisis while this become larger after the crisis period over a longer horizon to 8.73, 14.97 and 4.66% respectively. In Indonesia, the explained proportion only increased by 2.03% to 4.66% while for Nigeria, an increased from 3.53% to 14.97% is observed.

It is worth mentioning that the result above is similar for the case of Indonesia and Nigeria when measuring the variability of industrial production due to the shocks in stock returns with the exception of Mexico and Turkey. In Mexico and Turkey, the explained proportion drops from 15.21 and 2.29% to 4.5 and 1.97% respectively for the different periods while for the case of Indonesia and Nigeria, the explained proportion becomes larger from 0.48 and 7.25 to 11.74 and 16.04 for the different periods under consideration respectively. Although, there are relatively close result in the causality test for both periods, however, results from the impulse responses and variance decomposition suggests the non-existence of link between the industrial production and stock market index for both the periods in the MINT during the period under study. This is in line with the study of [12,15].

Conclusions

This paper presents a structural vector autoregressive (SVAR) model which includes the growth rates of stock prices and industrial production of MINT economies using recent data (monthly) between the periods of 2000 to 2014. We statistically identified two common structural break periods for all the economies coincidentally at their recovery stages from the massive global financial crisis induced by the subprime market in the US. We used a bivariate - variable model to distinguish between two categories of structural shocks – the first being the stock market shock and the second is the macroeconomic shock. Following the work of who assumed that the stock market shock has only a temporary effect on real output although it may have

a permanent effect on real share price whereas the macro shock has a potentially permanent effect on the economy and real share prices [15]. Motivations for this study steam from examining whether the variables dynamic interaction differs during the identified pre and post crisis; and more importantly, to examine the impact and interaction of the duo on the economy; as well as provide relevant policy measures to achieve the perceived objectives for the coined word 'MINT'.

Evidence from our causality test reveals zero dynamic linkages between the economic performance and stock market growth for both identified period with the exception of Mexico; which shows that stock market have some linkages with the industrial production of the economy during the pre-crisis period. Of course, trend shows that Mexico has a substantial manufacturing sector which is becoming integrated into US supply chains (geographical advantage) and is producing increasingly sophisticated products; however, this is not justifiable during the post-crises period. This feature casts some reservation of the data and on our model specification which imply that the difference between the two series is driven by a stochastic trend which is independent of that underlying real output and fundamental share prices. Accordingly, manufacturing in Turkey is still concentrated towards the lower end of the value chain and its prospects are closely tied to its neighboring country - Europe's. Similarly, manufacturing in Indonesia and Nigeria is still relatively underdeveloped and oil production is far more important in these countries but hindering the development of the industrial sector as a result of resources mismanagement.

Furthermore, our estimated model assesses the effects of the two types of shocks for each of the two variables in the model. In general, it was found that the effects of both shocks appear to be unstable and not well behave especially for Nigeria in the post crisis period and Mexico in the pre-crisis period. Also, for the case of Indonesia and Turkey, the shocks seem to dies out quite quickly - most of the action was over after about four and six periods. This implies that in addition to the market size and strategic geographical location of MINT, these countries need to ensure that the existing legal framework for investment protects investors and creates a level field for competition in the domestic market. Another factor worth mentioning is the need for the MINT economies to ensure political stability in their countries as this will reduce investment risk. For the case of Mexico whose prospects are closely tied to USA's, it should create an enabling platform should be made to improve production capacity as it has the tendency to pick up significantly from this in the long run.

More importantly, there seems to be different priority of development of certain sector/infrastructure for each of the MINT; for instance, Nigeria and Turkey facing political crises coupled with relative underdeveloped production capacity requires urgent platform in order to keep up in the MINT-family this is because financial markets tend to overreact to political events. Furthermore, MINT need to invest more in their human capital to ensure FDI inflow result in sustainable long-term economic growth The governments of countries with relatively low level or inefficient infrastructure, especially transportation and energy (e.g. Indonesia and Nigeria) need to investment more in these sectors.

References

1. Waterman T (2014) MINT nations: The economies of Nigeria and Turkey at a glance, Punters gallery.
2. BBC (2014) The Mint countries: Next economic giants?
3. Fama EK (1990) Stock returns, expected returns, and real activity. Journal of Finance 45: 1089-1108.
4. Barro RJ (1990) The stock market and investments. Review of Financial Studies 3: 115-131.
5. Schwert GW (1990) Stock returns and real activity: A century of evidence. Journal of Finance 45: 1237-1257.
6. Lee BS (1995) Fundamentals and bubbles in asset prices: evidence from the US and Japanese asset prices. Financial Engineering and Japanese Financial Markets 2: 69-122.
7. Groenewold N (2000) Fundamental share prices and Aggregate Real Output. University of Western Australia, Department of Economics Discussion Paper.
8. Laopodis NT (2006) Dynamic interactions among the stock market, federal funds rate, inflation and economic activity. The Financial Review 41: 513-545.
9. Rapach DE (2001) Macro shocks and real stock prices. Journal of Economics and Business 53: 5-26.
10. Lee BS (1998) Permanent, temporary and non-fundamental components of stock prices. Journal of Financial and Quantitative Analysis 33: 1-32.
11. Chung H, Lee BS (1998) Fundamental and non-fundamental components in stock prices of Pacific-Rim countries. Pacific-Basin Journal of Finance 6: 321-346.
12. Allen DE, Yang W (2003) Do UK stock prices deviate from fundamentals? Mathematics and Computers in Simulation in press.
13. Bhargava V, Dania A, Malhotra DK (2006) The Relationship between Price-Earnings Ratios, Dividend Yield and Stock Prices: Evidence from BRIC countries. Journal of Emerging Market.
14. Binswanger M (2004) How important are fundamentals? Evidence from a structural VAR model for the stock markets in the US Japan and Europe. Journal of International Financial Markets, Institutions and Money 14: 185-201.
15. Shiller RJ (2005) Irrational Exuberance. Princeton University Press.
16. Balke N, Wohar M (2001) Explaining Stock price movements: Is there a case for fundamentals? Federal Reserve Bank of Dallas Economic Review.
17. WDI (2015) Standard and Poor's Global Stock Markets Fact book and supplemental S&P data. The World Bank.
18. Laopodis NT (2010) Equity prices and macroeconomic fundamentals: International evidence. Journal of International Financial Markets. Institutions and Money 21: 247-276.
19. Ivanov, Kilian (2005) A Practitioner's Guide to Lag Order Selection for VAR Impulse Response Analysis. Studies in Nonlinear Dynamics and Econometrics.