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To cite this article: Richard Adjei Dwumfour & Naa Adokarley Addy (2019): Interest Rate and Exchange Rate Exposure of Portfolio Stock Returns: Does the Financial Crisis Matter?, Journal of African Business, DOI: [10.1080/15228916.2019.1583977](https://doi.org/10.1080/15228916.2019.1583977)

To link to this article: <https://doi.org/10.1080/15228916.2019.1583977>



Published online: 01 Mar 2019.



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Interest Rate and Exchange Rate Exposure of Portfolio Stock Returns: Does the Financial Crisis Matter?

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ABSTRACT

The study examines the impact of changes in interest rate and exchange rates and their unexpected changes on industry and size portfolio returns on the Ghana Stock Exchange (GSE) controlling for the 2007/2008 financial crisis. Three main exchange rates (FX) namely, Ghana cedis (Gh¢)/US dollar, Gh¢/Great Britain Pounds (GBP) and the Gh¢/Euro are used. We use OLS, GARCH and ARIMA in our estimations. The study found that only depreciation of the Gh¢/USD reduces the returns of financial stocks and large firms. There is a direct positive impact of the financial crisis on the returns due to investment shift from developed markets where crisis occurs. Variations in the returns are mostly explained by the market index returns (RM), which has a positive impact. However, we find that the positive impact of RM on the portfolio returns (finance, medium and large portfolios) is reduced during the financial crisis. The results largely reveal that shocks to the conditional variance are highly persistent and the response of volatility decays at a slower rate.

KEYWORDS

interest rate; exchange rate;
portfolio stock returns;
emerging market; financial
crisis

1. Introduction

The liberalization of emerging financial markets results in the integration of developing countries' capital markets into global capital markets (Francis, Hasan, & Hunter, 2002). Consequently, the global nature of capital markets increases the likelihood of financial crisis in emerging markets if the same occurs in developed economies. This impact was evidenced in the spillovers of the financial crisis that started in the US in 2007 and threw the world economy into a state of serious turmoil and its consequent volatilities in stock returns. Some empirical studies (Akhigbe, Madura, & Marciniak, 2012; Kenourgios & Padhi, 2012) have been carried out to explore the impact of the 2007/2008 crisis through different transmission channels including interest rates and foreign exchange (FX) rates. Interest rates and FX rates are key variables in determining stock returns, hence have received much attention in recent studies. These results have remained mixed. Some studies (Joseph & Vezos, 2006) do not find a pronounced degree of sensitivity of stock returns to interest rates and FX rates. Other studies like those of Kolari, Moorman, and Sorescu (2008), Choi, Elyasiani, and Kopecky (1992),

and Chamberlain, Howe, and Popper (1997) provide some evidence that interest rates and exchange rates are priced into stock returns. Most of these studies have been for developed markets. The issue, however, is that regardless of the ongoing deepening of global financial integration, firms still retain some country-specific characteristics. As Hirtle (1991) posits, the internationalization of financial markets is not complete. Hence, the operations of firms in Ghana are more likely than not to differ from those in other countries developed or developing. In this regard, studies on the interest rates and exchange rates exposure of, for example, US firms, cannot accurately be used to draw conclusions about non-US firms.

To the best of our knowledge, no study has been carried out to examine the impact of the global financial crisis on portfolio stock returns on the Ghana Stock Exchange. Also, it appears that previous studies carried out to explore the FX rates and interest rates exposure of firms in Ghana have been limited. Those found in the literature that explored foreign exchange exposure of listed firms in Ghana were those of Adjasi, Harvey, and Agyapong (2008) and Salifu, Osei, and Adjasi (2007). Adjasi et al. (2008) uses the stock market index to calculate the returns and they use trade weighted index of the exchange rate using monthly data. Our study is different from these previous studies in five ways.

First, we estimate returns for portfolios grouped into industry (Finance, Manufacturing and Retail) and size (Large, Medium and Small) to better understand the size and industry differences. Analyzing industry and size exposure is important since industries differ in terms of pass-through and mark-ups (Allayannis & Ihrig, 2001; Bodnar, Dumas, & Marston, 2002), competitive structure (Griffin & Stulz, 2001; Marston, 2001) or industry concentration (Bartram & Karolyi, 2006) and hence may face different levels of exposure. Secondly, we use the three main exchange rates traded in Ghana and estimate them individually rather than creating an index. This will help us understand how each of the FX rates affects firms listed on the exchange.

Thirdly, the frequency of data (weekly) we use in the study is more suited for GARCH estimation. Unlike Salifu et al. (2007), who estimate monthly data of the three exchange rates using OLS estimation, this study uses GARCH (1, 1) estimation of weekly data. Due to volatility clustering and the ARCH effects of high frequency data (weekly), the linear (OLS) estimation methods produce bias and inconsistent results. Fourthly, we estimate the impact of unexpected changes of interest rate and FX rates on portfolio stock returns. This was used in similar studies like those of Fang and Loo (1994) and more recently by El-Masry and Abdel-Salam (2007) who found that the unexpected changes in FX rates have a significant cross-sectional effect on common stock returns.

Finally, the impact of the financial crisis on stock returns in Ghana needs to be examined. As indicated by Ackah, Aryeetey, and Aryeetey (2009), Ghana, just like other developing countries in the region, became increasingly vulnerable to the financial crisis, as its current account, fiscal deficit, exchange rate, inflation and debt indicators worsened during the crisis period. Thus, as globalization increases, with a high degree of international capital mobility, portfolio flows can have a significant effect on domestic asset prices (Sarno, Tsiakas, & Ulloa, 2016), especially during financial crisis (Fratzscher, 2012). Hence, investors are likely to shift their investment into emerging markets like Ghana, causing an impact on domestic stock returns. We therefore examine the impact of the financial crisis on the portfolio stock returns in Ghana.

In the light of these discussions, this study answers the following research questions:

- (1) Do changes in interest rate and exchange rates and their unexpected changes affect portfolio stock returns in Ghana?
- (2) Did the 2007/2008 financial crisis have any impact on portfolio stock returns in Ghana?

The rest of the paper is classified as follows. [Section 2](#) reviews some related literature on the subject matter. [Section 3](#) explains the data. [Section 4](#) describes the methodology used. [Section 5](#) describes the preliminary test on the data. [Section 6](#) presents the results and [section 7](#) concludes the study.

2. Review of literature

Interest rate and exchange rate risks may vary across countries. Foreign exchange rate exposure, interest rate risks and market risks are important financial and economic factors that influence the value of common stocks. Below we provide a brief review of related studies.

Abor (2005) examined how Ghanaian firms involved in international trade manage their foreign exchange risk. The results show that one of the main problems that firms in Ghana face is the frequent appreciation of foreign currencies against the local currency, which tends to affect the prices of their final products sold locally. Adjasi et al. (2008) find exchange rate to have a negative relationship with stock returns on the Ghana Stock Exchange. In the US, Jorion (1990) finds a significant impact of foreign exchange rate risk on stock prices only for 5.2% of the analyzed 287 US multinationals. Choi et al. (1992) also provide empirical evidence that both interest rates and foreign exchange rates are priced into the stock market for US banks. According to Fraser, Madura, and Weigand. (2002), this interest rate risk extends even to banks that are reliant on non-interest income since a high interest rate slows down economic growth and reduces banks' non-interest income from initial public offerings and acquisitions of related activities. Choi and Prasad (1995) find that only 14.9% of the individual firms in the United States show a significant foreign exchange rate exposure. Kolari et al. (2008) show that exchange rate risk measured by contemporaneous exchange rate changes is priced into the US stock market. However, Du and Hu (2012) provide contrary findings explaining that the results of Kolari et al. (2008) may have been spurious because their exchange rate risk factor had a strong correlation with the size factor, and that their exchange rate sensitivity portfolios have a strong factor structure.

On the Japanese market, Koch and Saporoschenko (2001) carried out an empirical study on the sensitivity of individual and portfolio stock returns for Japanese horizontal *keiretsu* financial firms to unanticipated changes in market returns, interest rates, exchange rate changes, and nominal interest rate spread changes. Results indicate that the stock returns of *keiretsu* financial firms often exhibit significant negative responses to interest rate increases while they find that the firms have higher average market risk but insignificant exposure to exchange rate changes. Using monthly Japanese data for the period 1991–2005, Hartmann and Pierdzioch (2007) examined the link between exchange rate movements and stock returns. They found that exchange rate movements *per se* do not help to explain stock returns. They however provide evidence of in-sample

predictability if one accounts for the interventions of the Japanese monetary authorities in the foreign exchange market.

In a broader study, Bartram and Bodnar (2012) examined the importance of exchange rate exposure in the return generating process for a large sample of non-financial firms from 37 countries and found that the effect of exchange rate exposure on stock returns is conditional and show evidence of a significant return impact to firm-level currency exposures when conditions of the exchange rate change. Their study shows that the realized return to exposure is directly related to the size and sign of the exchange rate change, suggesting fluctuations in exchange rates as a source of time-variation in currency return premia.

This study seeks to add to the body of knowledge of the literature by providing empirical evidence from an emerging market perspective. Through this we understand the behavior of stocks with regard to interest rates and FX rates changes. We compare the study's results with previous evidence in other markets to understand their consistency or otherwise.

2.1. Observations during the crisis

Here we plot the time series graph of changes in the interest rate and the exchange rates used in the study. These are shown in Figure 1, 2, 3 and 4. From these figures the FX rates show more volatilities than the interest rate. One observation is that GH¢/USD shows a relative tranquility from 2005 to the end of 2007 after which volatility increased. It can be also be seen with the FX rates that higher volatilities were experienced during the crisis period and even periods after the crisis especially for the GBP and EURO.

3. Data

The data for this study involved firms listed on the Ghana Stock Exchange (GSE). The selection of the firms listed on the GSE was based on the fact that these firms provided enough data for the study period. Those companies which listed before 2005 met the data

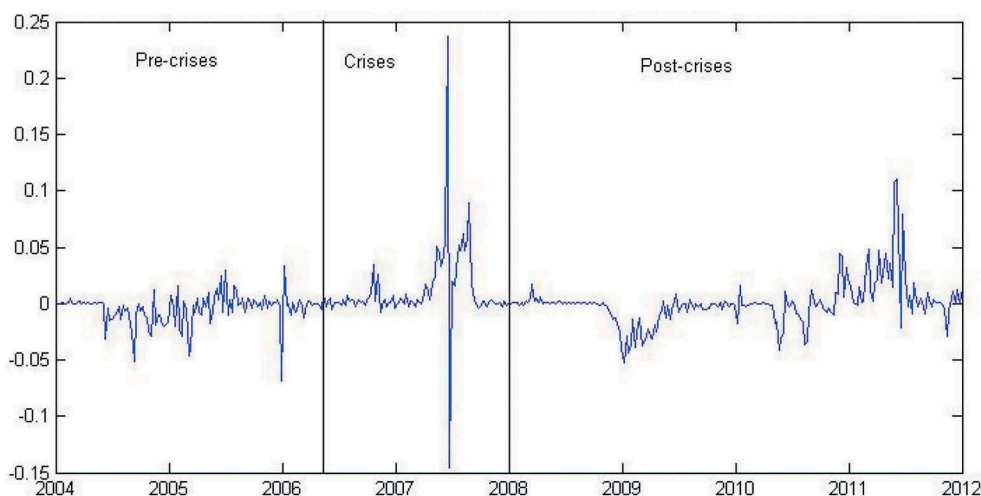


Figure 1. Trend of Changes in Interest Rate(91-Day).

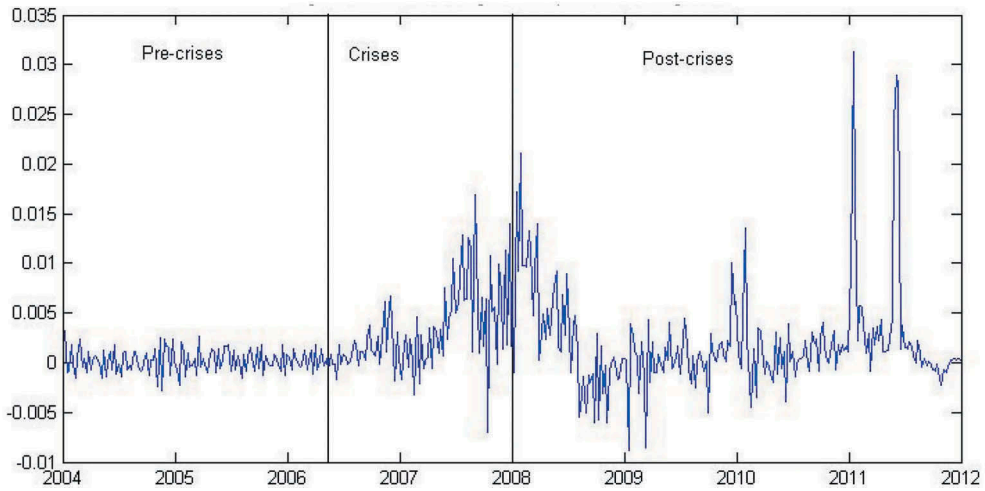


Figure 2. Trend of Changes in GH¢/USD Exchange Rate.

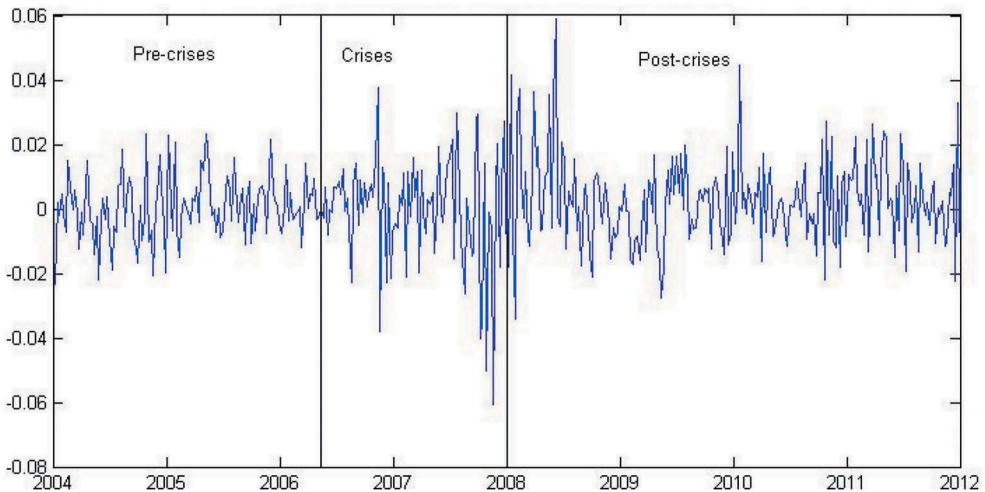


Figure 3. Trend of Changes in GH¢/GBP Exchange Rate.

requirement criteria and a total of 24 firms were selected. These firms were classified into portfolios based on their industry and their sizes (market capitalization). The formation of portfolios provides an efficient way for condensing a substantial amount of information about firm stock return behavior and it has the advantage of smoothing out the noisiness in the data, due to transitory shocks to individual firms (Elyasiani & Mansur, 1998). These shocks may, otherwise, distort the results significantly. The disadvantage of this approach, however, is that it masks the dissimilarities among firms within each portfolio. The portfolio returns were generated using equal weights. In all, three portfolios of industry, namely, finance (6), manufacturing (12), and retail (6) were obtained. Three portfolios based on size were also obtained and grouped into small (8), medium (8) and large (8) cap firms. We employed a dummy variable to control for the 2007/2008 global financial crisis.

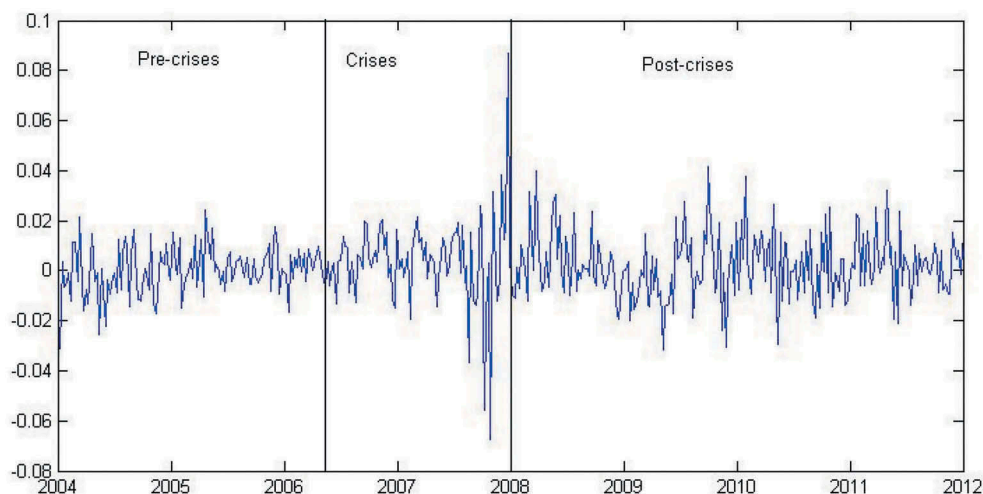


Figure 4. Trend of Changes in GH¢/EURO Exchange Rate.

We define the pre-crisis period from January 2005 to March 2007, the crisis period from April 2007 to December 2008, and the post-crisis period from January 2009 to December 2012. Weekly share prices (which we use to form the portfolios) and Ghana Stock Exchange Composite Index (GSE-CI) information for the period were obtained from the GSE. The currencies and the exchange rates chosen for the study were those widely used in international transactions in Ghana. The exchange rates were the Ghana cedi to US dollar (Gh¢/USD), the Ghana cedi to EURO (Gh¢/EURO) and the Ghana cedi to UK pound (Gh¢/GBP). These were the end mid-point interbank weekly rates obtained from the Bank of Ghana. The exchange rates are defined as the number of local currency which could purchase a unit of foreign currency. Weekly data were also obtained from the Bank of Ghana on the 91-day Treasury bill rates. We chose weekly data because this is the best compromise between maximizing observations and minimizing the day-to-day fluctuations that have less direct economic relevance (Chen & So, 2002).

4. Methodology

Since the ARCH and Generalized ARCH (GARCH) models proposed by Engle (1982) and Bollerslev (1986), respectively, many researchers have applied these conditional models and their extensions or modifications to revisit the CAPM and APT models. We estimate both the OLS and GARCH models.

4.1. OLS model

In this study, the OLS model adopted is that of Salifu et al. (2007) with some addition of variables (91-day Treasury bill rate, and a dummy variable to control for the crisis period). Again, we group the stocks into industry and size using weekly data. In addition, we use the GARCH (1, 1) model instead of the OLS. As stated earlier, most empirical studies employ (linear) OLS methods to estimate the sensitivity of stock returns to interest rate and FX rate changes. We initially follow this approach to compare our results with earlier results although

this comparison is limited due to differences in the time periods of those studies and their data frequencies. The suitability of the OLS estimation is tested with the ARCH test.

The OLS model is stated below:

$$r_t = \beta_0 + \beta_1 TBR_t + \beta_2 USD_t + \beta_3 GBP_t + \beta_4 EURO_t + \beta_5 RM_t + \beta_6 CRISIS_t + \mu_t \quad (1)$$

where: r_t denotes the capital gain or loss (portfolio return) of the portfolio for the period t . This variable is assumed to capture all financial and economic factors that are specific to the portfolio. TBR_t denotes the change in the short term risk-free interest rate (91-day Treasury bill rate) at time t . USD_t is the change in the cedi per US dollar. GBP_t is the change of the cedi per Great Britain Pound (GBP) and $EURO_t$ is the change of the cedi per Euro. RM_t is the return on the market (GSE-CI) which is considered to reflect economy-wide factors at time t . $\beta_1 - \beta_5$ represents the sensitivity of the portfolio returns to changes in interest rate, USD, GBP, EURO and RM, respectively. For example, concerning the FX rates, a positive β_2 indicates that a portfolio returns appreciates with a depreciation of the local currency while a negative β_2 indicates that a portfolio return depreciates with a depreciation of the local currency. NB: the change is calculated as for example: $USD_t = \frac{USD_1 - USD_0}{USD_0}$, where USD_1 is current exchange rate of Gh¢/USD and USD_0 is previous exchange rate of Gh¢/USD. This is done for all the FX rates, TBR and the RM. $CRISIS$ is a dummy variable taking the value of 1 during the crisis period (5 April 2007 to 24 December 2008) and 0 in other periods (pre-crisis period–7 January 2005 to 30 March 2007 and post-crisis period 2 January 2009 to 28 December 2012.). μ_t reflects the stochastic disturbance term assumed to be *iid*, $\mu_t \sim N(0, \xi_t^2)$. Eq. (1) is estimated for each of the portfolios.

The above model states that returns are a function of contemporaneous changes in interest rate, exchange rate and a market index with portfolio-specific intercept and slope coefficients. The market variable is intended to capture the influence of the general market on individual portfolio stock returns. The estimated interest rate and exchange rate coefficients will provide a measure of the effect of interest rate and exchange rates changes on the portfolio returns given its relation to the market index.

4.1.1. Testing for ARCH effects

Since we have argued for the case of estimation based on conditional variance, it is

useful to test for ARCH effects in the conditional variance of μ_t . The test is performed on one lag of the OLS residuals of Eq. (1). Thus we test the simple ARCH (1) specification for ξ_t^2 which is given by $\xi_t^2 = \rho_0 + \rho_1 \mu_{t-1}^2$. The null hypothesis of no ARCH effects requires that $\rho_1 = 0$ against the alternative that $\rho_1 \neq 0$. If the residuals in Eq. (1) contain autocorrelation or heteroscedasticity it is likely that the null hypothesis will be rejected. We use the LM test of order 1 for ARCH.

4.2. The GARCH model

In the empirical analysis of financial data, GARCH (1, 1) models have often been found to appropriately account for conditional heteroscedasticity (Palm, 1996). The Generalized

Autoregressive Conditional Heteroscedasticity (GARCH) process, first introduced by Bollerslev (1986), is estimated next. The GARCH (1, 1) process is specified as follows¹:

$$r_t = \lambda_0 + \lambda_1 TBR_t + \lambda_2 USD_t + \lambda_3 GBP_t + \lambda_4 EURO_t + \lambda_5 RM_t + \lambda_6 CRISIS_t + \varepsilon_t \quad (2.1)$$

$$\varepsilon_t \sim N(0, \sigma_t^2)$$

$$\sigma_t^2 = \theta_0 + \theta_1 \varepsilon_{t-1}^2 + \Phi \sigma_{t-1}^2 \quad (2.2)$$

where other variables are as defined before, the variance equation (2.2) includes the long-term average volatility θ_0 , news about volatility from the previous period which is defined as an ARCH term and the previous period's forecast variance which is defined as the GARCH term. The GARCH specification requires that in the conditional variance equation, parameters θ_0 , θ_1 and Φ should be positive for a non-negativity condition and the sum of θ_1 and Φ should be less than one to secure the covariance stationarity of the conditional variance.

4.2.1 Generating unexpected changes using ARIMA

We then estimate whether unexpected changes in interest rate, FX rates and market index returns have an impact on the portfolio stock returns. We use ARIMA to extract the unexpected changes in the interest rate, FX rates and market return variables. Fang and Loo (1994) and, more recently, El-Masry and Abdel-Salam (2007) used the ARIMA residuals as a proxy of unexpected changes in exchange rates and found that they have a significant cross-sectional effect on common stock returns. Following these authors, we use a two-step procedure to identify the unexpected changes in these variables. The first step is to find an ARIMA model. The Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) indicate ARIMA (1, 0, 0) to be appropriate for these factors. The residuals are then defined as the unanticipated changes in interest rate, FX rates and market returns. The second step is to substitute these residuals for the interest rate, FX rates, and market return variables in model 2.

5. Preliminary tests

5.1. Descriptive statistics and unit root test

Table 1 reports the descriptive statistics, normality test and the unit root test (ADF) for the returns of portfolios, the market, interest rate and FX rates. The table shows much volatility (standard deviation) for the EURO and GBP compared to the USD. It can be seen from the Shapiro-Wilk test that none of the variables is normally distributed at 1% significance level. Unit root tests are important in examining the stationarity of time series. In general, a stationary series is considered to have a constant mean and variance and time invariant covariance. To test for stationarity we applied the well-known Augmented Dickey-Fuller (ADF) tests which are now standard in time series applications. The tests were applied separately with a constant term only, a constant term and

¹Several GARCH models including EGARCH, GARCH-M and different lag values of GARCH were estimated for all series and the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) indicated GARCH (1, 1) to be the appropriate parameterization for all series.

trend. Even though only the results for the constant term are shown, the results for the constant term and trend also yielded similar results; thus, from [Table 1](#) we reject the null hypothesis of unit root. Hence, all the variables used are stationary at levels since all the test statistics were greater than the 1% critical values. Thus, overall, the OLS does not appear very reliable due to violations of certain important OLS classical assumptions.

We proceed to describe the data into pre-crisis, crisis and post-crisis to understand the trend of the data in these sub-periods. From [Table 1](#), it can be seen that all portfolios generated negative returns (Mean) prior to the crisis. In particular, with the industry portfolios, financial stocks had the maximum loss of 0.44% and the highest risk of 1.68% while with the size portfolios, medium firms had the highest loss of 0.31% even though their risk was 1.13% lower than that of large firms of 1.25% which was the highest. During the crisis period, all the portfolios had positive returns. This suggests the high risk-high return theory. Only the manufacturing, medium and large firms sustained their positive returns even after the crisis period.

5.2. Correlation matrix

To address the problem of multicollinearity between the independent variables – especially the problem of multicollinearity between the three exchange rates, a correlation matrix of these weekly returns was examined as seen in [Table 2](#). As indicated by Kennedy (2008), correlation coefficients of below 0.70 indicate that weaker relationships exist among the independent variables, hence the avoidance of any potential multicollinearity problems in the regression estimates.

6. Results

6.1. OLS estimations

As indicated earlier, we follow previous studies using the OLS to compare and to test the underlying reasons for using the GARCH (1, 1) model in our estimation. Thus, here we test the ARCH effect in the OLS residuals. Looking at the results in [Table 3](#), the models hardly provide a goodness of fit with low Adjusted R square values. Also, few of the portfolios are exposed to the interest rate and exchange rate variables as well as the market returns. Our results for the direct effect of interest rate and foreign exchange exposure applied to the portfolios are weak, but consistent with those documented previously in the literature. ARCH effects are found for five out of six regression estimates. ARCH effects are very strong for the majority of the regression estimates. Failure to account for these effects would affect the reliability of the linear estimates. This finding would also appear to question the reliability of prior studies. Therefore, GARCH-type models would appear to be more appropriate for estimating such data.

6.2. GARCH (1, 1) estimations with interest rate and exchange rates changes

In [Table 4](#), we estimate the GARCH (1, 1) model. The results of the mean equation show that interest rate has no effect on any of the portfolios. Thus, changes in Government of Ghana Treasury bill rate have no effect on the returns of any of the portfolios. This is inconsistent

Table 1. Descriptive Statistics.

	Obs.	Mean	Std. Dev.	Min	Max	Shapiro-Wilk test (Z)	ADF
Financial	417	-0.0001	0.0212	-0.1300	0.0800	8.3010***	-17.7950***
Manufacturing	417	0.0013	0.0190	-0.0900	0.0900	8.9500***	-24.9420***
Retail	417	0.0001	0.0154	-0.1300	0.0700	9.1300***	-17.374***
Small	417	-0.0007	0.0137	-0.0600	0.0800	8.6120***	-21.6560***
Medium	417	0.0006	0.0269	-0.1400	0.1400	9.1300***	-24.7790***
Large	417	0.0024	0.0169	-0.1000	0.0800	8.1810***	-16.4270***
RM	417	-0.0012	0.0474	-0.8649	0.1520	12.7180***	-19.457***
TBR	417	0.0009	0.0232	-0.1451	0.2367	10.6990***	-15.187 ***
USD	417	0.0018	0.0044	-0.0087	0.0313	10.2550***	-11.813***
EURO	417	0.0018	0.0133	-0.0676	0.0871	6.6340***	-19.493***
GBP	417	0.0014	0.0134	-0.0605	0.0591	4.8860***	-20.451***

Descriptive statistics-Sub periods (pre-crisis, crisis and post-crisis)

Variable	Obs.	Mean	Std. Dev.	Min	Max
Pre-crisis (Jan. 2005 – Mar. 2007)					
Finance	117	-0.0044	0.0168	-0.0800	0.0400
Manufacturing	117	-0.0013	0.0077	-0.0400	0.0200
Retail	117	-0.0010	0.0095	-0.0300	0.0600
Small	117	-0.0012	0.0084	-0.0300	0.0300
Medium	117	-0.0031	0.0113	-0.0600	0.0200
Large	117	-0.0012	0.0125	-0.0500	0.0600
RM	117	-0.0024	0.0100	-0.0692	0.0128
TBR	117	-0.0046	0.0138	-0.0683	0.0329
USD	117	0.0002	0.0012	-0.0027	0.0032
EURO	117	0.0001	0.0096	-0.0313	0.0242
GBP	117	0.0004	0.0098	-0.0233	0.0231
Crisis (Apr. 2007 – Dec. 2008)					
Finance	91	0.0058	0.0119	-0.0300	0.0500
Manufacturing	91	0.0044	0.0112	-0.0200	0.0600
Retail	91	0.0029	0.0072	-0.0100	0.0300
Small	91	0.0022	0.0127	-0.0200	0.0800
Medium	91	0.0042	0.0097	-0.0200	0.0600
Large	91	0.0075	0.0117	-0.0400	0.0400
RM	91	0.0080	0.0158	-0.0148	0.0872
TBR	91	0.0105	0.0343	-0.1451	0.2367
USD	91	0.0030	0.0041	-0.0070	0.0169
EURO	91	0.0039	0.0175	-0.0676	0.0871
GBP	91	0.0001	0.0166	-0.0605	0.0374
Post-crisis (Jan. 2009 – Dec. 2012)					
Finance	209	-0.0003	0.0255	-0.1300	0.0800
Manufacturing	209	0.0013	0.0251	-0.0900	0.0900
Retail	209	-0.0005	0.0199	-0.1300	0.0700
Small	209	-0.0018	0.0161	-0.0600	0.0600
Medium	209	0.0012	0.0364	-0.1400	0.1400
Large	209	0.0022	0.0202	-0.1000	0.0800
RM	209	-0.0046	0.0654	-0.8649	0.1520
TBR	209	-0.0001	0.0200	-0.0525	0.1098
USD	209	0.0021	0.0054	-0.0087	0.0313
EURO	209	0.0018	0.0129	-0.0318	0.0413
GBP	209	0.0025	0.0135	-0.0342	0.0591

Note. Computations based research data. Finance: portfolio of financial stocks, Manufacturing: portfolio of manufacturing stocks, Retail: portfolio of retail services stocks, Small: portfolio of small value stocks, Medium: portfolio of medium value stocks, Large: portfolio of large value stocks, RM: return on the market, TBR: Change in the government of Ghana 91-day Treasury bill rate, USD: change in the number of Ghana cedis per unit of USD, EURO: change in number of Ghana cedis per unit of Euros, GBP: change in number of Ghana cedis per unit of Great Britain Pounds.

ADF: Augmented Dickey-Fuller.

*** indicates significance at 1%

Table 2. Correlation Matrix.

	RM	TBR	USD	EURO	GBP	CRISIS
RM	1					
TBR	0.0441	1				
USD	-0.0201	0.3039***	1			
EURO	0.0188	0.0596	0.1161**	1		
GBP	-0.0105	0.0461	0.0761	0.5276***	1	
CRISIS	0.1035**	0.2189***	0.1426***	0.0829*	-0.0508	1

Note. Computations from research data. RM: return on the market, TBR: Change in the government of Ghana 91-day Treasury bill rate, USD: change in the number of Ghana cedis per unit of USD, EURO: change in number of Ghana cedis per unit of Euros, GBP: change in number of Ghana cedis per unit of Great Britain Pounds.

***, **, * indicate significance at 1%, 5% and 10% respectively.

with the results of Adjasi et al. (2008) who found that interest rate affects the stock market index. Again, unlike Salifu et al. (2007) who use OLS and monthly data on the GSE and show that the financial stocks did not show any risk exposure to any of the international currencies, the results of this study show that changes in the US dollar rate had a significant negative impact in the estimations specifically for financial and large stocks portfolios. Both GBP and EURO had no impact on any of the portfolio returns. Thus, even though the descriptive statistics show higher volatilities of GBP (1.34%) and Euro (1.33%) than the USD, it seems the financial and large portfolios are more engaged in foreign transactions in the USD, hence their exposure. Thus, the rationale for the negative relationship with the USD and the financial stocks can probably be explained by the size of foreign currency denominated assets and liabilities in the balance sheets of these firms. The movements in exchange rates can affect a bank balance sheet directly by generating translation gains or losses based on the net foreign positions. When foreign currency denominated liabilities exceed foreign currency denominated assets, the depreciation of the Ghana cedis may lead to damage in the bank balance sheet, and the weakening of bank equity may result in a decline in bank stock returns. This is consistent with the results of Kasman, Vardar, and Tunc (2011), who also find the US dollar to negatively affect the financial stocks. This is also consistent with the results of El-Masry and Abdel-Salam (2007), who also find exchange rate exposure to have a more significant impact on stock returns of the large firms compared with the small and medium-sized companies.

The results also show that changes in the market returns significantly and positively affect four out of the six portfolios returns. Thus, compared with the interest rate and the exchange rates, the market index returns explain most of the variations in the portfolio returns. This is consistent with the results of Joseph and Vezos (2006) and Kasman et al. (2011), who find market returns to explain most variations of stock returns in their samples. In addition, we find that generally the 2007/2008 financial crisis had a positive impact on the portfolio stock returns. This supports the classical positive risk-return relationship as espoused by Merton (1973, 1980)), contrary to the normal expectation of a negative risk-return relationship during crisis periods. This result may be because the GSE is not well integrated into the global stock market and hence, during the 2007/2008 financial crisis, investors shifted their investment from developed markets to invest in an emerging economy like Ghana, causing increases in expected returns of the stocks. This presents emerging stock markets as good alternatives to invest in during financial crises that happen in developed markets. This seems to affirm the contribution of Sarno et al. (2016) and Fratzscher (2012) who conclude that, during the recent global financial crisis, the influence of push factors

Table 3. OLS Estimation.

	β_0	β_1	β_2	β_3	β_4	β_5	β_6	R^2	ARCH (1)
Finance	-0.0005 (0.0012)	0.0413 (0.0460)	-0.6668 *** (0.2378)	0.0781 (0.0885)	-0.0710 (0.0893)	0.0924 *** (0.0212)	0.0073 *** (0.0025)	0.0732	8.6560***
Manufacturing	0.0004 (0.0011)	0.0121 (0.0430)	0.0722 (0.2219)	0.0953 (0.0826)	-0.1423 * (0.0833)	0.0169 (0.0198)	0.0041 * (0.0023)	0.0024	7.4430 ***
Retail	-0.0005 (0.0008)	0.0131 (0.0347)	-0.1904 (0.1791)	0.0239 (0.0667)	-0.0290 (0.0672)	-0.0352 ** (0.0160)	0.0042 ** (0.0019)	0.0092	0.0010
Small	-0.0016** (0.0008)	0.0140 (0.0306)	0.0913 (0.1579)	0.0935 (0.0587)	-0.0738 (0.0593)	0.0348 ** (0.0141)	0.0034** (0.0017)	0.0212	3.2340*
Medium	-0.0003 (0.0016)	0.0254 (0.0611)	-0.0761 (0.3155)	0.0880 (0.1174)	-0.0632 (0.1154)	-0.0218 (0.0282)	0.0049 (0.0033)	-0.0064	6.5680**
Large	0.0023** (0.0010)	0.0262 (0.0369)	-0.6248 *** (0.1904)	0.0199 (0.0709)	-0.1090 (0.0715)	0.0583*** (0.0170)	0.0067*** (0.0020)	0.0725	14.9940***
No. of significant cases	2/6	0/6	2/6	0/6	1/6	4/6	5/6		5/6

Note. Computations from research data. Standard errors in parenthesis. *** indicates significance at 1%, ** significance at 5% and * significance at 10%. Finance: portfolio of financial stocks, Manufacturing: portfolio of manufacturing stocks, Retail: portfolio of retail services stocks, Small: portfolio of small value stocks, Medium: portfolio of medium value stocks, Large: portfolio of large value stocks, RM: return on the market, TBR: Change in the government of Ghana 91-day Treasury bill rate, USD: change in the number of Ghana cedis per unit of USD, EURO: change in number of Ghana cedis per unit of Euros, GBP: change in number of Ghana cedis per unit of Great Britain Pounds.

Estimation for Model 1: $r_t = \beta_0 + \beta_1 TBR_t + \beta_2 USD_t + \beta_3 GBP_t + \beta_4 EURO_t + \beta_5 RM_t + \beta_6 CRISIS_t + \mu_t$

Table 4. GARCH (1,1) results with changes in interest rate and exchange rates.

	λ_0	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	θ_0	θ_1	ϕ
Finance	-0.0009 (0.0008)	0.0005 (0.0340)	-0.5240*** (0.1514)	0.0900 (0.0560)	-0.0481 (0.0617)	0.3559*** (0.0231)	0.0057*** (0.0018)	0.0001*** (0.0000)	0.3776*** (0.0833)	0.2764*** (0.0738)
Manufacturing	-0.0005 (0.0006)	0.0089 (0.0294)	0.1677 (0.1319)	-0.0120 (0.0432)	-0.0590 (0.0483)	0.0818*** (0.0113)	0.0020* (0.0010)	0.0000*** (0.0000)	0.0759*** (0.0114)	0.9023*** (0.0114)
Retail	-0.0009 (0.0007)	0.0131 (0.0145)	0.0377 (0.1174)	0.0066 (0.0352)	-0.0447 (0.0353)	-0.0026 (0.0168)	0.0024** (0.0012)	0.0000** (0.0000)	0.0644*** (0.0101)	0.9052*** (0.0120)
Small	-0.0014 (0.0010)	0.0277 (0.0330)	0.0578 (0.1753)	0.0548 (0.0530)	-0.0421 (0.0672)	0.0297 (0.0404)	0.0050*** (0.0017)	0.0000** (0.0000)	0.0406*** (0.0111)	0.9150*** (0.0213)
Medium	-0.0011 (0.0008)	0.0494 (0.0356)	-0.1078 (0.1189)	0.0580 (0.0488)	-0.0709 (0.0505)	0.1148*** (0.0150)	0.0035*** (0.0012)	0.0000** (0.0000)	0.1035*** (0.0158)	0.8753*** (0.0138)
Large	0.0016*** (0.0006)	-0.0022 (0.0218)	-0.1842* (0.1003)	0.0179 (0.0424)	-0.0481 (0.0431)	0.4383*** (0.0234)	0.0039*** (0.0011)	0.0001*** (0.0000)	0.3625*** (0.0979)	0.2081*** (0.0680)
No. of significant cases	1/6	0/6	2/6	0/6	0/6	4/6	6/6	6/6	6/6	6/6

Note. Computations from research data. Standard errors in parenthesis. *** indicates significance at 1%, ** significance at 5% and * significance at 10%. Finance: portfolio of financial stocks, Manufacturing: portfolio of manufacturing stocks, Retail: portfolio of retail services stocks, Small: portfolio of small value stocks, Medium: portfolio of medium value stocks, Large: portfolio of large value stocks, RM: return on the market, TBR: Change in the government of Ghana 91-day Treasury bill rate, USD: change in the number of Ghana cedis per unit of USD, EURO: change in number of Ghana cedis per unit of Euros, GBP: change in number of Ghana cedis per unit of Great Britain Pounds

Estimation for Model: $r_t = \lambda_0 + \lambda_1 TBR_t + \lambda_2 USD_t + \lambda_3 GBP_t + \lambda_4 EURO_t + \lambda_5 RM_t + \lambda_6 CRISIS_t + \varepsilon_t$ (2.1), $\sigma_t^2 = \theta_0 + \theta_1 \varepsilon_{t-1}^2 + \Phi \sigma_{t-1}^2$ (2.2)

(mostly explained by global economic forces) increases in explaining international portfolio flows. This may not be surprising as Cenedese and Mallucci (2016) find that international equity outflows are influenced by cash-flow news not real interest rate shocks and exchange rate shocks.

In the conditional variance equation, the intercept term is significantly positive for all the portfolios. This indicates that there is a significant time-invariant component in the return generating process. Further, both the ARCH and GARCH parameters satisfy the non-negativity condition. Also, the GARCH parameter is significantly greater than the ARCH parameter for all portfolios except for financial and large stocks. This implies that the volatility of each stock return is more sensitive to its own lagged values than it is to new surprises. However, the financial and large stocks are more sensitive to new surprises. Again, the sum of the ARCH and GARCH parameters for most of the regressions are close to unity, indicating that these returns have highly persistent effects and the response of volatility decays at a slower rate. In particular, market returns are more persistent than interest rate and exchange rate changes in explaining the conditional stock returns

6.3. GARCH (1, 1) estimations with unexpected changes in interest rate and exchange rates

Table 5 shows the impact of unexpected changes of interest rate and exchange rates on the portfolio returns. Here, in the conditional mean equation, the market returns again are seen to explain more of the conditional stock return changes than unexpected changes in interest rate and exchange rates. These results are similar to the earlier estimations for changes in these rates except that here the unexpected changes in the Gh¢/USD had no impact on the portfolio returns. The crisis period also positively affects all the portfolio returns. In the conditional variance equation, similar results are obtained as in the previous estimation.

6.4. GARCH (1, 1) estimations with interactions with CRISIS

Here, knowing that the crisis period did have an impact in almost all the portfolios, we proceed to identify the main transmission channel of this impact by interacting the crisis dummy variables with our other variables. We estimate using Model 2. The results are presented in Table 6. The results indicate that the major transmission channel of the financial crisis was through the market index returns not the interest rate and FX rates. As indicated earlier, this seems to affirm the contribution of Sarno et al. (2016) and Fratzscher (2012) who conclude that during the financial crisis, the influence of push factors (mostly explained by global economic forces) increases in explaining international portfolio flows, and the results of Cenedese and Mallucci (2016) who find that international equity flows are not influenced by real interest rate shocks or exchange rate shocks.

The interaction term (RM*CRISIS) was significantly negative for financial, medium and large portfolios. Given that the unconditional effects and conditional effects corresponding to all other inclusive variables (USD, GBP, EURO, TBR and their interactions with CRISIS) are not jointly significant, the computation of net effects

Table 5. GARCH (1,1) sector results with unexpected changes in interest rate, exchange rates and market returns.

	λ_0	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	θ_0	θ_1	ϕ
Finance	-0.0017** (0.0008)	-0.0089 (0.0377)	-0.2126 (0.2175)	0.0797 (0.0607)	-0.0438 (0.0643)	0.3566*** (0.0239)	0.0046** (0.0019)	0.0001*** (0.0000)	0.3264*** (0.0736)	0.3213*** (0.0742)
Manufacturing	-0.0005 (0.0006)	0.0083 (0.0339)	0.1379 (0.1488)	-0.0127 (0.0424)	-0.0560 (0.0486)	0.0797*** (0.0112)	0.0021** (0.0010)	0.0000*** (0.0000)	0.0772*** (0.0116)	0.9006*** (0.0116)
Retail	-0.0009 (0.0007)	0.0050 (0.0128)	0.0771 (0.1285)	0.0056 (0.0363)	-0.0435 (0.0356)	-0.0028 (0.0168)	0.0025** (0.0012)	0.0000** (0.0000)	0.0656*** (0.0102)	0.9037*** (0.0121)
Small	-0.0013 (0.0009)	0.0323 (0.0316)	0.0742 (0.2238)	0.0577 (0.0546)	-0.0459 (0.0692)	0.0302 (0.0425)	0.0051*** (0.0016)	0.0000** (0.0000)	0.0414*** (0.0113)	0.9138*** (0.0212)
Medium	-0.0014** (0.0007)	0.0375 (0.0414)	-0.0211 (0.1354)	0.0564 (0.0488)	-0.0695 (0.0494)	0.1180*** (0.0152)	0.0036*** (0.0012)	0.0000** (0.0000)	0.1010*** (0.0154)	0.8776*** (0.0136)
Large	0.0007 (0.0005)	-0.0111 (0.0232)	-0.1020 (0.1361)	0.0106 (0.0431)	-0.0485 (0.0429)	0.4388*** (0.0237)	0.0039*** (0.0011)	0.0001*** (0.0000)	0.3683*** (0.0992)	0.2176*** (0.0686)
No. of significant cases	2/6	0/6	0/6	0/6	0/6	4/6	6/6	6/6	6/6	6/6

Note. Computations from research data. Standard errors in parenthesis. *** indicates significance at 1%, ** significance at 5% and * significance at 10%. Finance: portfolio of financial stocks, Manufacturing: portfolio of manufacturing stocks, Retail: portfolio of retail services stocks, Small: portfolio of small value stocks, Medium: portfolio of medium value stocks, Large: portfolio of large value stocks, RM: return on the market, TBR: Change in the government of Ghana 91-day Treasury bill rate, USD: change in the number of Ghana cedis per unit of USD, EURO: change in number of Ghana cedis per unit of Euros, GBP: change in number of Ghana cedis per unit of Great Britain Pounds

Estimation for Model: $r_t = \lambda_0 + \lambda_1 TBR_t + \lambda_2 USD_t + \lambda_3 GBP_t + \lambda_4 EURO_t + \lambda_5 RM_t + \lambda_6 CRISIS_t + \varepsilon_t$ (2.1), $\sigma_t^2 = \theta_0 + \theta_1 \varepsilon_{t-1}^2 + \phi \sigma_{t-1}^2$ (2.2)

Table 6. GARCH (1, 1) results with interaction with CRISIS.

	Finance	Manufacturing	Retail	Small	Medium	Large
Mean equation						
Constant	-0.0009 (0.0008)	-0.0005 (0.0006)	-0.0010 (0.0007)	-0.0013 (0.0009)	-0.0012 (0.0008)	0.0016*** (0.0006)
TBR	-0.0008 (0.04870)	-0.0237 (0.03662)	-0.0231 (0.0365)	0.0069 (0.0560)	0.0577 (0.0440)	-0.0189 (0.0316)
TBR*CRISIS	0.0081 (0.0652)	0.08266* (0.0434)	0.0485 (0.0410)	0.0604 (0.0649)	-0.0195 (0.0778)	0.1022* (0.0496)
USD	-0.5184*** (0.1668)	-0.0275 (0.1761)	-0.0059 (0.1869)	-0.0827 (0.1917)	-0.0195 (0.1436)	-0.2433** (0.1107)
USD*CRISIS	0.0052 (0.5142)	0.7908*** (0.2831)	0.1899 (0.2637)	0.6771 (0.5563)	0.0672 (0.2608)	0.2725 (0.2674)
GBP	0.1477** (0.0626)	-0.0334 (0.0557)	-0.0070 (0.0529)	0.0892 (0.0580)	0.0787 (0.0627)	0.0297 (0.0496)
GBP*CRISIS	-0.1361 (0.0717)	0.1054 (0.1007)	0.0322 (0.0779)	-0.1056 (0.2014)	-0.036 (0.0983)	-0.0235 (0.0921)
EURO	-0.1312* (0.0717)	-0.0459 (0.0163)	0.0335 (0.0588)	-0.0597 (0.0830)	-0.0101 (0.0880)	-0.0877* (0.0534)
EURO*CRISIS	0.1833 (0.1681)	-0.0622 (0.0919)	-0.1406* (0.0767)	0.0670 (0.1583)	-0.1004 (0.1102)	0.0699 (0.0872)
RM	0.3826*** (0.02630)	0.0655*** (0.0113)	-0.0051 (0.0184)	0.0271 (0.0358)	0.1802*** (0.0191)	0.4394*** (0.0253)
RM*CRISIS	-0.1607* (0.0946)	0.0432 (0.0596)	0.0016 (0.0458)	0.0038 (0.1468)	-0.1635*** (0.0502)	-0.3380*** (0.0567)
CRISIS	0.0059** (0.0023)	0.0006 (0.0011)	0.0025* (0.0013)	0.0025 (0.0024)	0.0043*** (0.0013)	0.0036*** (0.0013)
Net effects	0.2219	n.a.	n.a.	n.a.	0.0167	0.1014
Variance equation						
Constant	0.0000*** (0.0000)	0.0000*** (0.0000)	0.0000** (0.0000)	0.0000** (0.0000)	0.0000** (0.0000)	0.0001*** (0.0000)
Arch(1)	0.3626*** (0.0801)	0.0789*** (0.0118)	0.0643*** (0.0103)	0.0520*** (0.0144)	0.0985*** (0.0147)	0.3625*** (0.1001)
Garch(1)	0.2626*** (0.0757)	0.8989*** (0.0116)	0.9057*** (0.0122)	0.8879*** (0.0276)	0.8783*** (0.0131)	0.2075*** (0.0692)

Note. Computations from research data. Standard errors in parenthesis. *** indicates significance at 1%, ** significance at 5% and * significance at 10%. Finance: portfolio of financial stocks, Manufacturing: portfolio of manufacturing stocks, Retail: portfolio of retail services stocks, Small: portfolio of small value stocks, Medium: portfolio of medium value stocks, Large: portfolio of large value stocks, RM: return on the market, TBR: change in the government of Ghana 91-day Treasury bill rate, USD: change in the number of Ghana cedis per unit of USD, EURO: change in number of Euros, GBP: change in number of Ghana cedis per unit of Great Britain Pounds.

Net effects calculated for RM*CRISIS as their conditional and unconditional effects are significant. n.a: not applicable because at least one estimated coefficient needed for the computation of net effects is not significant.

is not feasible for them. We therefore compute the net effects for the ‘RM*CRISIS’ relationship to evaluate the complementary role of financial crisis in the effect of RM on the financial, medium and large portfolios. For instance, in the second column of Table 6, the net effect obtained from the interaction between RM and CRISIS is 0.2219 ($[-0.1607 \times 1] + [0.3826]$), where: 0.3826 is the unconditional effect of RM; 1 is the value when crisis occurs and -0.1607 is the conditional effect from the interaction between RM and CRISIS. The results show that all the net effects of CRISIS on RM for financial, medium and large portfolios remain positive (columns 2, 6 and 7).

Thus, we find that the net effect of financial crisis at the macro level enhances the positive impact of the market index returns (RM) on financial, medium and large portfolios even though the impact on these portfolios is lower than the impact of the unconditional effect of RM. This shows that in periods of financial crises, higher volatility of the economy-wide factors leads to a decrease in the positive impact of RM on these portfolio returns.

7. Conclusion and recommendations

It is observed that few studies have been undertaken to explore the impact of interest rate and exchange rates and their unanticipated changes on stock returns in Ghana controlling for market returns (as well as unanticipated market returns) and the financial crisis. Especially after the 2007/2008 financial crisis, no study has been carried out in Ghana to test the impact of the crisis on stock returns. This study fills the gap. The results show that depreciation of the Ghana cedis against the US dollar reduces the returns of the financial stocks and large cap firms. Interest rate, GBP and EURO had no impact on any of the portfolios. The study also shows that changes in market returns explain most of the variations of the portfolio returns. The results, however, show that in the period of financial crisis, higher volatility of the economy-wide factors leads to a decrease in the positive impact of RM on these portfolio returns. The return generating process of all the portfolios is affected by their own previous information and new surprises, even though their own previous information exerts more variations in almost all the portfolios except for financial and large stock portfolios, where new surprises explain most of their return variations. The results for the unanticipated changes in interest rate, exchange rates and market returns were similar to the results in their level changes.

The study recommends that financial firms and large stock firms should manage their exchange rate exposure to the US dollar well. A look at their dollar denominated balance sheet items would help them control any mismatch. Stakeholders should be more concerned about the betas of firms to the market returns. All exposures to the market returns were significantly positive showing that most of the returns on the GSE move in tandem with the market changes. Particular attention should be paid to financial and large stocks as new surprises influence most of its return generating process than previous information about these stocks.

Disclosure statement

No potential conflict of interest was reported by the authors.

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