Exchange Rate Uncertainty and Domestic Investment in Ghana

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Abstract

The impact of exchange rate uncertainty on domestic investment remains a topical issue in international finance. The existing studies based on macro- or micro-level data have produced mixed findings leaving the issue widely open for further investigation. We revisit this issue at the macro-level by differentiating the short-run impacts of exchange rate uncertainty from long-run impacts. Using annual data for Ghana covering the period 1980–2015, we found that exchange rate uncertainty has differential impacts on domestic investment in the short run. That is, while the current level of uncertainty enhances investment, previous levels of uncertainty dampen investment. In the long run, exchange rate uncertainty has a positive impact on domestic investment. These findings are robust to alternative specifications of our model.

Keywords: Exchange Rate Uncertainty; Domestic Investment; Ghana.

JEL Classification: F31; C22.

1. Introduction

Modern economies favour flexible over fixed exchange rate arrangements. The commonly practised flexible exchange rate arrangement is the managed-float or dirty-float, whereby monetary authorities allow the value of local currency against foreign ones to be determined by market forces, and occasionally intervene during periods when the currency deviates from its equilibrium. This exchange rate arrangement creates volatilities or uncertainties in the real exchange rate. In the literature, it has been established that real exchange rate uncertainty can produce undesirable consequences. For example, Caballero and Corbo (1989) and Chowdhury (1993) have found that increases in real exchange rate uncertainty have significantly negative effects on export. Exchange rate uncertainty may also pass-through to prices of goods and services, thereby introducing price uncertainty, which affects domestic investment positively or negatively. On the one hand, Hartman (1972) and Abel (1985) argue that the high price uncertainty may promote current levels of investment by competitive risk-neutral firms in their attempt to prevent uncertainty in the future. On the other, Pindyck (1988) and Bertola (1998) demonstrate that high uncertainty reduces the investment process by risk-neutral firms.

Other theoretical models demonstrate the impact of exchange rate uncertainty on investment. Dixit and Pindyck (1994), using their theory of optimal inertia, show that investors are generally hesitant to invest under uncertainty. By extending the Dixit and Pindyck (1994) framework, Darby et al. (1999) demonstrate that if a firm's opportunity cost of waiting is lower than its present value or scrapping price, the firm will not invest. However, under lower uncertainty, the same firm will invest. This suggests that uncertainty may promote or hurt investment. By estimating an aggregate investment function for France, Germany, Italy, U.K, and the U.S., Darby et al. (1999) found that investment increases if exchange rate uncertainty is lowered. Similarly, Sarkar (2000), using the real option model of McDonald and Siegel (1986) and Dixit and Pindyck (1994), demonstrate that uncertainty may be negatively or positively associated with investment. Wong (2007) followed Sarkar (2000) by re-examining the effect of uncertainty on investment. However, unlike Sarkar (2000), Wong (2007) used investment timing instead of the probability of investment. He found that higher uncertainty shortens the expected exercise time and thus, enhances investment for relatively safe projects. This positive uncertainty investment nexus is more likely for high growth projects than for low growth projects.

In his empirical study, Aizenman (1992) shows that nominal exchange rate uncertainty is more likely to discourage investment than real uncertainty. Also, Bacchetta and Van Wincoop (2000) found that the size of net capital flows is higher under a more stable exchange rate regime. In addition, Servén (2003) stated that investors will be less motivated to invest in an economy with high exchange rate uncertainty. He found that the impact of real exchange rate uncertainty on investment in developing countries depends on their degree of openness to trade. More open developing countries suffer more from real exchange rate uncertainty than less open ones. In a recent study, Bahmani-Oskooee and Hajilee (2013), using a sample of 36 countries, found that exchange rate uncertainty has significant short-run effects on domestic investment in 27 of the 36 countries. They also found that the short-run effects are translated into the long-run effects in only 12 countries.

Owing to the fact that domestic investment is essential for achieving sustainable economic growth, full employment, intensive poverty reduction, and income equality, we re-assess the impact of real exchange rate uncertainty on domestic investment by focusing on Ghana, a developing country currently experiencing slow economic growth. Apart from Bahmani-Oskooee and Hajilee (2013), the previous studies failed to differentiate long-run impacts of exchange rate uncertainty from short-run impacts. We focus on Ghana for two main reasons. Firstly, apart from Kyereboah-Coleman and Agyire-Tettey (2008), who examined the impact of real exchange rate volatility on foreign direct investment (FDI) in Ghana, no study focuses specifically on the impact of exchange rate uncertainty on domestic investment. Secondly, Ghana has experienced episodes of frequent real depreciations (undervaluations), and appreciations (overvaluations) thereby, providing an excellent case study for examining the exchange rate uncertainty-domestic investment relationship. From 1957–1982, the country practised a fixed exchange regime, which led to an overvalued Cedi, deteriorating economic performance, excessive import of finished goods, falling domestic investment, and balance-of-payment crisis (see Baffoe-Bonnie, 2004; Bhattarai and Armah, 2005).[1] To realign the exchange rate, Ghana undertook a series of devaluation exercises between 1983–1986 under the Economic Recovery Programme and the Financial Sector Adjustment Programme (Baffoe-Bonnie, 2004; Alagidede and Ibrahim, 2016). From 1986 onwards, Ghana gradually shifted from a fixed exchange regime to a managed-float regime (see Bhattarai and Armah, 2005). Ever since the managed-floating regime replaced the fixed exchange regime, the country's

[1] The cedi was the official name of Ghana's currency from 1965 until 2007 when it was renamed the Ghana cedi (see Dzokoto et al., 2010).

currency, the Cedi, became volatile. Hence, we aim to assess how the volatility in the Cedi has influenced domestic investment in the country. Ideally, our data should have started from 1986, when the country officially started shifting from a fixed exchange regime to a managed-float regime, in order to avoid regime-shifts from influencing the empirical results. However, this will shorten the data size and bias the coefficient estimates. Nevertheless, the empirical results presented does not show evidence of structural instability. Therefore, regime-shifts do not appear to be driving the results.

As a preview of our results, we found that exchange rate uncertainty has differential impacts on domestic investment in the short run. In other words, the short-run results suggest that, while the current level of uncertainty enhances investment, previous levels of uncertainty dampen investment. In the long run, exchange rate uncertainty has a positive impact on domestic investment. These findings appear to be robust to alternative specifications of the model. We then offered some explanations of these results. The rest of the paper is organised as follows. Section 2 presents the methodology. Section 3 reports the empirical results. Section 4 concludes the paper.

2. Methodology

2.1. Empirical Specifications

We closely follow the literature and formulate domestic investment as a function of real domestic income, the nominal interest rate, and the real exchange rate (see Bahmani-Oskooee & Hajilee, 2013). We then include a measure of real exchange rate uncertainty in order to examine whether uncertainty influences domestic investment. Ghana's investment model will be of the form:

$$lnI_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 r_t + \alpha_3 lnRER_t + \alpha_4 VOL_t + \mu_t, \tag{1}$$

where I is a measure of domestic investment; Y is real income, which is measured as real GDP; r is the nominal interest rate; RER is the real effective exchange rate between Ghana and the rest of the world – an increase in RER denotes real appreciation and a decrease real depreciation of the Ghana Cedi; VOL is a measure of real exchange rate uncertainty to be explained later; ln is the natural logarithm operator; α are the coefficients of the model; μ is the white-noise error term; t denotes the time subscript.

In line with the theory, positive growth in the real income should create optimism among investors regarding the economy, thereby, leading to a boom in domestic investment. The reverse is true, other things unchanged. Hence, we expect α_1 to be positive. An increase in the nominal interest rate should raise the cost of borrowing and decrease the level of investment in economy. The estimated value of α_2 should be negative. Changes in the real exchange rate has an ambiguous effect on domestic investment (see Alexander, 1952). Hence, the value of α_3 could be either positive or negative. Finally, like the real exchange rate, exchange rate uncertainty could be either conducive or harmful to investment (see Hartman, 1972; Abel, 1985; Bertola, 1998; Servén, 2003). Therefore, the expected sign of α_4 could be either positive or negative.

To differentiate short-run impact from long-run impact of exchange rate uncertainty on domestic investment, we reformulate Eq. (1) as an error correction model. Although, other error correction mechanisms exist in the literature, Pesaran et al. (2001) proposes we use the

ARDL bounds testing approach to reformulate Eq. (1). This approach is empirically useful in our case because it does well in small samples and it does not require pretesting of the variables for unit roots. The ARDL specification of Eq. (1) will be of the following form:

$$\begin{aligned}\Delta lnI_t = \beta_0 &+ \sum_{i=1}^{q} \beta_{1i}\,\Delta lnI_{t-i} + \sum_{i=0}^{q} \beta_{2i}\,\Delta lnY_{t-i} + \sum_{i=0}^{q} \beta_{3i}\,\Delta r_{t-i} + \sum_{i=0}^{q} \beta_{4i}\,\Delta lnRER_{t-i} \\ &+ \sum_{i=0}^{q} \beta_{5i}\,\Delta VOL_{t-i} + \delta_1 lnI_{t-1} + \delta_2 lnY_{t-1} + \delta_3 r_{t-1} + \delta_4 lnRER_{t-1} \\ &+ \delta_5 VOL_{t-1} \\ &+ \epsilon_t, \qquad (2)\end{aligned}$$

where ϵ, β, and δ are the white-noise error terms, the short-run and the long-run coefficients of the model, respectively; Δ is the first-difference operator; and q is the maximum lag of the model. The short-run impacts of the variables on domestic investment are the coefficients of the first-differenced variables. For their long-run impacts on domestic investment, we set the non-first-differenced lagged component of Eq. (2) to zero and normalised δ_2 to δ_5 on δ_1.

The reliability of the estimates of Eqs. (1) and (2) are contingent on the joint significance of the coefficients δ_1, δ_2, δ_3, δ_4, and δ_5. In other words, the variables in Eq. (2) should be cointegrated in order to ensure that the coefficients are efficiently estimated. We can verify the existence of cointegration by testing the hypothesis that $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$. Pesaran et al. (2001) calculate two sets of critical values under this null hypothesis. The first set of critical values are calculated by assuming that the variables in Eq. (2) are integrated of order zero, I(0), while the second set are calculated by assuming that they are integrated of order one, I(1). We can reject the presence of cointegration if the calculated F-statistic is smaller than the first set of critical values. Similarly, we fail to reject the presence of cointegration if the calculated F-statistic is larger than the second set of critical values. The test is inconclusive if the calculated F-statistic lies in-between both sets of critical values.

2.2. Data

The results presented in what follows are based on an annual data covering the period 1980–2015. The restriction of data to this period is due to lack of observations on the real effective exchange rate (RER) before 1980. More importantly, Ghana began its roadmap to trade and exchange rate liberalisation from 1983. Therefore, the exchange rate is unlikely to be volatile before 1983, since the exchange regime then was largely fixed (see Baffoe-Bonnie, 2004; Bhattarai and Armah, 2005). The RER is the real effective exchange rate index (2010 = 100) taken from the International Financial Statistics (IFS) database compiled by the IMF. We constructed our main measure of real exchange rate uncertainty, VOL, out of the log of RER spanning the period 1980:01–2015:12. Following other studies such as West and Cho (1995), Bahmani-Oskooee and Xi (2011), and Alagidede and Ibrahim (2016), VOL is calculated as the monthly conditional variance of GARCH (1,1). The yearly average of this monthly index is used as VOL. To ensure that our results are not sensitive to the choice of the real exchange rate uncertainty measure, we calculated another measure, VOL_SD, and used it in the empirical analysis as a robustness check. This measure is the annualised standard deviation of the log of monthly RER for the period 1980:01–2015:12 (see De Vita and Abbott, 2004). Domestic investment (I) is measured as gross capital formation as a percentage of GDP and it is taken from the World Development Indicators (WDI). The measure of real income, Y, is the GDP at

market prices (constant 2010 US$) taken from the WDI. Finally, the nominal interest rate, r, is measured as the 91-day Treasury bill rates. Data on this variable for the period 1987–2015 is taken from the Bank of Ghana's Monetary Time Series Data. Since observations are not available for this variable during the period 1980–1987, we supplement this period with Central Bank Policy Rates taken from the IFS. The summary statistics of these variables are shown in Table 1. In what follows, we report and discuss the empirical results.
<<Dear Author: you may not have written VOL out in full initially. Apologies if I am wrong.Thank you>>

Table 1: Summary Statistics.

Statistic	*ln*I	*ln*Y	r	*ln*RER	VOL	VOL_SD
Mean	1.212	10.244	23.812	2.232	0.266	1.481
Median	1.324	10.219	21.775	2.088	0.017	1.250
Maximum	1.502	10.667	47.880	3.563	2.763	3.802
Minimum	0.528	9.9214	9.600	1.841	0.000	0.645
Std. Dev.	0.263	0.223	10.410	0.418	0.626	0.712
Skewness	-1.259	0.370	0.794	1.899	2.795	1.614
Kurtosis	3.535	2.036	3.018	5.713	10.034	5.131
Jarque-Bera	9.941	2.217	3.783	32.698	121.120	22.463
P-value	0.006	0.330	0.150	0.000	0.000	0.000
Sum	43.661	368.795	857.250	80.357	9.603	53.335
Sum Sq. Dev.	2.438	1.741	3793.535	6.138	13.753	17.748
Observations	36	36	36	36	36	36

Notes: Std. Dev. and Sum Sq. Dev. denote, respectively, standard deviation and sum of squared deviations. *ln* denotes the natural log operator.

3. Empirical Results

3.1. The Main Results

The ARDL approach does not required pretesting of the variables to establish stationarity. The variables can be either I(0), I(1) or mixed-integrated processes. Since the variables considered here are known empirically to exhibit these integration properties, we do not test for unit roots. Because the results in the error correction model in Eq. (2) are sensitive to lag choices, we followed the literature and restricted the maximum lag in the model to four and used the Akaike information criterion (AIC) to select the optimal lags to be included for each variable (see Halicioglu, 2007; Tang, 2007; Bahmani-Oskooee and Hajilee, 2013). The estimated short- and long-run results following these restrictions are reported in Table 2. The selected model is ARDL (1, 3, 2, 4, 3). The bottom of Table 2 displays the diagnostic tests. The model must pass these tests in order for the coefficients to be reliable. The diagnostic tests are: The LM, RESET, BPG, CUSUM, and CUSUMSQ tests.[2] These tests suggest that there is structural stability, no serial correlation and heteroscedasticity, and no functional misspecification of the investment

[2] These tests are, respectively, Ramsey's Regression Equation Specification Error Test (RESET), the Lagrange Multiplier (LM) test, the Breusch-Pagan-Godfrey test for heteroscedasticity, the Cumulative Sum of Recursive Residuals (CUSUM) test and the Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) test (see Breusch, 1978; Breusch, and Pagan, 1979; Brown et al., 1975; Godfrey, 1978; Ramsey, 1969).

model, implying that the results are reliable. Also, the estimated error correction term is negative and statistically significant, indicating the presence of cointegration. The presence of cointegration is further supported by the calculated F-statistic, which is greater than the upper bound critical values at 1%.[3]

Now let us examine the coefficient estimates. The short-run results show that real exchange rate uncertainty has differential impacts on domestic investment. While the current level of uncertainty enhances investment, previous levels of uncertainty dampen investment. However, in the long run, uncertainty has a positive impact on investment. Considering the other variables, real income has a persistent positive impact on domestic investment in the short run. The impact is reversed in the long run. The nominal interest rate has negative impact on investment in the short run, but a positive impact in the long run (see, also, Beccarini, 2007). Also, while the real exchange rate has differential effects on investment in the short run, its effect is negative on investment in the long run. This means that, in the short run, real depreciation of the Ghana Cedi may either enhance investment or harm it. However, in the long run, depreciations are conducive for domestic investment in the country. Finally, each year, a disequilibrium in domestic investment is correct at a rate of 89.6%.

Table 2: The Main Results.

Lag	0	1	2	3	4	
Selected Model: ARDL (1, 3, 2, 4, 3)						
Short-run						
Δ*ln*I						
Δ*ln*Y	4.155[4.366]	3.694[2.860]	4.604[3.802]			
Δr	-0.000[-0.074]	-0.003[-1.908]				
Δ*ln*RER	-0.943[-7.136]	0.629[3.059]	1.002[5.626]	0.456[2.196]		
ΔVOL	0.277[3.220]	-0.354[-4.626]	-0.156[-1.849]			
ECM(-1)	-0.896[-7.150]					
Long-run						
Constant	12.793[7.142]					
*ln*Y	-0.686[-3.305]					
r	0.005[4.208]					
*ln*RER	-1.765[-5.939]					
VOL	0.604[4.012]					
Diagnostics						
Adj. R-sq.	F-statistic	RESET	LM	BPG	CUSUM	CUSUMSQ
0.929	7.952	0.002(0.963)	3.635(0.161)	7.623(0.974)	S	S

Notes: The values in the block parentheses are the t-statistics. P-values for the diagnostic tests are in the parentheses. S denotes stable.

3.2. Sensitivity Analysis

[3] The F-statistic is compared to Table CI (iii) Case III: Unrestricted intercept and no trend of Pesaran et al. (2001, p.300) for four independent variables (i.e. k = 4).

Are the above results robust to: (i) an alternative maximum lag, (ii) the choice of optimal lags for each variable, (iii) the measure of real exchange rate uncertainty, or (iv) a different estimation approach? We attempt to verify this question in this section. First, let us consider the results when we reduced the maximum lags to be included in the model from 4–2. We used the AIC to select the optimal lags for each variable. The preferred model, in this case, is ARDL (1, 1, 0, 1, 0). The results are reported in Table 3. Looking at the diagnostic tests reported at the bottom of the table, it is clear that there is structural stability, no serial correlation and heteroscedasticity, and no functional misspecification of the investment model. Moreover, the error correction term indicates cointegration and convergence. These results are therefore, reliable. The current level of exchange rate uncertainty has a positive impact on domestic investment in the short run, similarly to the main results. In addition, the exchange rate uncertainty improves investment in the long run, consistent with the main results. Real income has a positive influence on domestic investment in the short run, but an insignificant impact in the long run. Both nominal interest rate and real exchange rate have no impact on domestic investment in the short run. However, in the long run, their impacts on domestic investment look identical to those reported in Table 2, namely: nominal interest rate affects domestic investment positively, while real exchange rate affects it negatively. Importantly, the reduction in the maximum number of lags allowed in the model did not affect the results much.

Table 3: Results based on ARDL Model Restricted to Two Lags.

Lag	0	1	2			
Selected Model: ARDL (1, 1, 0, 1, 0)						
Short-run						
Δ*ln*I						
Δ*ln*Y	2.756[3.094]					
Δr	0.001[0.956]					
Δ*ln*RER	-0.120[-1.663]					
ΔVOL	0.144[3.342]					
ECM(-1)	-0.649[-5.104]					
Long-run						
Constant	1.722[5.110]					
*ln*Y	0.011[0.060]					
r	0.004[1.995]					
*ln*RER	-0.798[-3.160]					
VOL	0.256[1.820]					
Diagnostics						
Adj. R-sq.	F-statistic	RESET	LM	BPG	CUSUM	CUSUMSQ
0.942	4.297	0.343(0.563)	3.004(0.181)	7.879(0.343)	S	S

Notes: The values in the block parentheses are the t-statistics. P-values for the diagnostic tests are in the parentheses. S denotes stable.

Now, what happens if we maintain the restrictions in Table 2 but select the optimal lags using the SIC? These results are reported in Table 4. Here the preferred model is ARDL (1, 3, 1, 4, 2), which differs from the one using the AIC [ARDL (1, 3, 2, 4, 3)]. Obviously, the information criterion matters when determining the optimal lags for each variable in the model. Again, considering the diagnostic tests reported at the base of Table 4, it is clear that there is structural stability, no serial correlation and heteroscedasticity, and no functional misspecification of the investment model. Similarly, the calculated F-statistic shows evidence in support of cointegration, while the error correction term indicates convergence. Hence, these results are also reliable. The results suggest that exchange rate uncertainty has differential effects on domestic investment in the short run. The current level of exchange rate uncertainty has a positive influence on domestic investment, while the previous level of uncertainty hurts it. In the long run, uncertainty enhances investment. Real income has a positive and persistent impact on domestic investment in the short run, but this becomes negative in the long run. Nominal interest rate has no impact on domestic investment in the short run. However, it has a positive impact on investment in the long run. Real exchange rate has differential effects on investment in the short run but its effect on investment in the long run is negative. Overall, these results are similar to the main results.

Table 4: Results base on Optimal Choice of Lags using SIC.

Lags	0	1	2	3	4	
Selected Model: ARDL (1, 3, 1, 4, 2)						
Short-run						
Δ*ln*I						
Δ*ln*Y	4.287[4.265]	2.197[1.808]	3.460[3.036]			
Δr	-0.000[-0.259]					
Δ*ln*RER	-0.855[-7.188]	0.420[2.172]	0.864[4.889]	0.090[1.780]		
ΔVOL	0.156[1.926]	-0.281[-3.685]				
ECM(-1)	-0.830[-7.427]					
Long-run						
Constant	9.816[7.427]					
*ln*Y	-0.713[-2.487]					
r	0.004[2.918]					
*ln*RER	-1.705[-4.304]					
VOL	0.514[2.726]					
Diagnostics						
Adj. R-sq.	F-statistic	RESET	LM	BPG	CUSUM	CUSUMSQ
0.923	8.825	0.081(0.778)	3.181(0.206)	7.730(0.934)	S	S

Notes: The values in the block parentheses are the t-statistics. P-values for the diagnostic tests are in the parentheses. S denotes stable.

Will the results change if we use a different measure of real exchange rate uncertainty? To answer this question, we calculated an alternative measure of uncertainty using the annualised standard deviation method. We derived the annualised standard deviation of the log of monthly real effective exchange rate. We denoted this variable as VOL_SD and maintained the restrictions imposed on *Eq.* (2) in section 3.2. The estimates are reported in Table 5. The preferred model, in this case, is ARDL (2, 4, 3, 1, 4). As with the other results, there is structural stability, no serial correlation and heteroskedasticity, and no functional misspecification of the investment model, implying the estimates are reliable. Real exchange rate uncertainty has differential effects on domestic investment in the short run. In the long run, however, its effect is positive. Real income has differential effects on investment in the short run. It has no impact on investment in the long run. Similarly, nominal interest rate has differential effects on investment in the short run. In the long run, nominal interest rate has no impact on investment. Real exchange rate has a negative effect on domestic investment in the short and long run.

Table 5: Results based on Annualised Standard Deviation Measure of Uncertainty.

Lag	0	1	2	3	4	
Selected Model: ARDL (2, 4, 3, 1, 4)						
Short-run						
ΔlnI		0.244[1.723]				
ΔlnY	3.590[3.493]	-2.117[-1.803]	2.006[1.963]	-3.162[-3.815]		
Δr	0.000[0.410]	-0.001[-0.663]	-0.004[-3.482]			
ΔlnRER	-0.634[-5.427]					
ΔVOL_SD	0.014[0.422]	-0.001[-0.042]	0.091[3.461]	-0.036[-1.579]		
ECM(-1)	-0.902[-5.660]					
Long-run						
Constant	0.180[4.498]					
*ln*Y	0.203[1.327]					
r	0.006[3.973]					
*ln*RER	-0.461[-2.515]					
VOL_SD	0.160[2.749]					
Diagnostics						
Adj. R-sq.	F-statistic	RESET	LM	BPG	CUSUM	CUSUMSQ
0.921	4.900	0.017(0.896)	4.237(0.120)	15.744(0.610)	S	S

Notes: The values in the block parentheses are the t-statistics. P-values for the diagnostic tests are in the parentheses. S denotes stable.

As an additional robustness check, we re-estimated the investment function using the vector error-correction modelling (VECM) approach. Unlike the ARDL approach, the VECM approach includes the same number of lags for each variable in the model. So, to avoid overfitting the investment function, we included a maximum of two lags for each variable in the model. The reliability of estimates obtained from this approach depends on the assumptions that the variables are cointegrated, there is not serial correlation and heteroscedasticity, the residuals are normally distributed, and that the specification is structurally stable. To ensure that these assumptions are fulfilled we performed a number of diagnostic tests. The results are shown at the bottom of Table 6. From these results, it is clear that the variables are cointegrated[4], there is no serial correlation and heteroscedasticity, the errors are normally distributed, and the function is structurally stable. Therefore, the corresponding coefficient estimates shown at the upper part of Table 6 are reliable. Looking at Table 6, we gather that both the short and the long run results are similar to those reported in the tables above. Real exchange rate uncertainty has differential impacts on domestic investment in the short run. In the long run, however, uncertainty has a positive impact on investment. Regarding the remaining variables, real income has a positive impact on domestic investment in the short run, which reverses in the long run. The nominal interest rate has a negative impact on investment in the short run, which reverses in the long run. The real exchange rate has a negative impact on investment in the short run, which passes on to the long run. Finally, each year, a disequilibrium in domestic investment is correct at a rate of 83.0%.

[4] We found evidence in support of at most two cointegration relationships among the variables using the Trace and Maximum eigen-value tests.

In sum, the effect of exchange rate uncertainty on domestic investment appears to be robust to these alternative specifications. The results are generally consistent with existing studies such as Aizenman (1992), Wong (2007), and Bahmani-Oskooee and Hajilee (2013).

Table 6: Estimates based on a VECM Approach.

Lags	1	2				
Model: VECM(2)						
Short run						
ΔlnI	0.223[2.189]	0.288[1.415]				
ΔlnY	2.903[2.568]	1.889[0.452]				
Δr	-0.001[-0.531]	-0.003[-1.343]				
ΔlnRER	-0.528[-2.657]	-0.355[-1.071]				
ΔVOL	0.158[2.148]	-0.008[-0.238]				
ECM(-1)	-0.830[-2.658]					
Long run						
Variable	Coefficient					
Constant	0.022[0.606]					
lnY	-0.777[-3.874]					
r	0.005[3.122]					
lnRER	-1.729[-6.139]					
VOL	0.891[5.091]					
Diagnostics						
Adj. R-sq	Chi-Sq.	LM	Joint JB	Stability	Trace	Max-Eigen
0.558	338.014	22.254	8.422	S	19.574	12.368
	0.3769	0.6210	0.587		0.452	0.512

Notes: Chi-sq. is the chi-square statistic for the heteroscedasticity test, LM is the Lagrange multiplier statistic for serial correlation test, Joint JB is the joint Jarque-Bera statistic for the normality test, Stability denotes the status of the model based on the inverse roots of an autoregressive characteristic polynomial function (see Iyke, 2015). Trace and Max-Eigen are, respectively, the Trace and the Maximum eigen-value statistics for the Johansen cointegration test. S denotes stable.

3.3. A Synthesis of the Main Findings

Overall, the evidence brought forth in the empirical analysis suggest two things. Firstly, real exchange rate uncertainty has differential impacts on domestic investment in the short run. Specifically, the current level of uncertainty enhances investment, while the previous levels of uncertainty dampen investment. Secondly, real exchange rate uncertainty has a positive impact on investment in the long run. These conclusions are not at odds with the literature. The direction of the impact of real exchange rate uncertainty on investment remains divisive in theory. The direction can be positive or negative depending on the underlying assumptions regarding adjustment costs (see Dixit and Pindyck, 1994), risk-aversion (see Zeira, 1990), the degree of industry competition (see Caballero, 1991). Hartman (1972) and Abel (1985) document the fact that in the short run the current level of uncertainty enhances investment . According to these studies, uncertainty may promote the current level of investment by competitive risk-neutral firms in their attempts to prevent uncertainty in the future. An alternative explanation regarding the positive relationship between investment and real exchange uncertainty has been provided by Darby et al. (1999). In their study, they demonstrated that if a firm's opportunity cost of waiting is higher than its present value or scrapping price, the firm will still invest under uncertainty. Along this line of reasoning, according to Wong (2007), higher uncertainty shortens the expected exercise time and thus, enhances investment for relatively safe projects. Furthermore, studies such as Cushman (1985) and Cushman (1988), Sarkar (2000) have documented evidence in support of a positive relationship between exchange rate uncertainty and investment. The previous levels of uncertainty may affect investment negatively because if investors perceive that the uncertainty will persist, they will lower their investment portfolios (see Pindyck, 1988; Bertola, 1998; Jeanneret, 2007; Wong, 2007). Often, their reactions to exchange rate uncertainty may not be quick due to factors such as production and delivery delays, recognition lag, among other factors (see, Magee, 1973). Hence, although the impact of previous level of uncertainty on investment may be negative, this impact may also be weak. Finally, the positive impact of uncertainty on investment in the long run is consistent with Cushman (1988), Wong (2007) and Bahmani-Oskooee and Hajilee (2013).

A caveat applies to our findings. Our measure of domestic investment – gross capital formation as a percentage of GDP – does not distinguish investment by foreign investors from domestic investors. Hence, it is complicated isolating the specific effects of local and foreign investors' reactions to uncertainty. In reality, foreign and local investors perceive and react to uncertainty differently. This may be attributed to the fact that while foreign investors are less susceptible to nominal illusions including those induced by uncertainty owing to alternative investment avenues available to them, the same cannot be said for domestic investors. Therefore, a better measure of domestic investment, which explicitly controls for investment activities undertaken by foreign investors, would reveal a cleaner investment-uncertainty relationship. However, a measure of domestic investment, which purges foreign investor activities is not obtainable at least for the period considered in the study. In fact, World Bank argues that the quality of the data on our proxy for domestic investment (i.e. gross capital formation as a percentage of GDP), depends on the quality of government accounting systems, "which tend to be weak in developing countries" (World Bank, 2017). This reinforces the argument that it is difficult to obtain a near perfect measure of domestic investment in Ghana. In sum, although we presented dynamic links between domestic investment and uncertainty, it is important to understand these links beyond the face value of our empirical results. A better measure of domestic investment could provide interesting policy insights.

4. Conclusion

Apart from determining the direction of trade (i.e. exports and imports), the real exchange rate also performs a greater role in the movement of capital. The real exchange rate performs these roles by influencing other prices and returns to investment. Modern economies have adopted free-floating currencies with the aim of achieving market efficiency. However, floating currencies are susceptible to large appreciations or depreciations, introducing exchange rate risks and uncertainties. How do these uncertainties influence investment? Previous studies found that exchange rate uncertainty may promote or harm domestic investment – in fact, sometimes, these studies are inconclusive. Also, the extant literature tends to focus on the short-run effects of exchange rate uncertainty on investment, thereby neglecting the long-run effects. We re-visit the impacts of exchange rate uncertainty on investment by differentiating short-run impacts from long-run impacts. By focusing on Ghana due to reasons stated in the introduction of this paper, and using annual data covering the period 1980–2015, we found that exchange rate uncertainty has differential impacts on domestic investment in the short run. That is, while the current level of uncertainty enhances investment, previous levels of uncertainty dampen investment. In the long run, exchange rate uncertainty has a positive impact on domestic investment. These findings are robust to alternative specifications of our model.

Although, uncertainty may not be generally conducive for economic activities as documented extensively in various studies, our findings suggest that it may enhance domestic investment in particular. Policymakers could be more concerned about short-term uncertainty, which appears to harm investment in Ghana. Besides, it is possible that this evidence may extend to developing countries with similar economic, political, demographic, and institutional fundamentals like Ghana. Hence, the policy implication of our findings may carry over to such countries. A caveat of the evidence present in our study is that the dynamic links documented between investment-uncertainty may not be complete. This is because our measure of domestic investment, gross capital formation as a percentage of GDP, does not explicitly differentiate the quantity of investment attributable to foreign and local investors. Hence, the heterogeneous reaction of foreign and local investors to uncertainty is not purged from the investment-uncertainty nexus. While it is complex to control for the contribution of foreign investors to domestic investment in the present study due to lack of data, things may change in the future.

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