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Abstract

There has been an on-going debate on whether dollarization helps stabilize exchange rates for emerging economies. This paper discusses this issue in a highly dollarized country, Cambodia, by empirically examining the relationship between dollarization and exchange rate movements. The GARCH analysis suggests that dollarization induces the depreciation of the Cambodian riel as well as intensifies exchange rate variability. The result is consistent with the argument that dollarization is one of the crucial causes of exchange rate instability. Dollarization in Cambodia could be a constraint on poverty reduction since it tends to affect the living standard of the poor who earn the income in the riel through the depreciation of the currency and intensified volatility of exchange rates.

Keywords: dollarization; exchange rates; Cambodia

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1. Introduction

Prolonged price instability has enforced some developing countries to allow for free circulation of foreign currency, particularly the US dollar, alongside their local currency. Cambodia is now one of the highly dollarized economies.[4] However, this does not imply that exchange rates are irrelevant to the economy. Indeed, exchange rates are still one of the main concerns for low-income people, especially in rural areas, since most of them receive their daily earnings in the local currency, the riel (Beresford et al., 2004; Kang, 2005).[5] Given the fact that Cambodia has been adopting floating, although managed, exchange rate regime since 1993, the National Bank of Cambodia (NBC) has always paid attention to exchange rate movements.

A main focus in this study is on the relationship between dollarization and exchange rate movements in Cambodia. Although some literature on currency substitution mentions that dollarization mitigates price instability,[6] several studies, such as McKinnon (1982, 1993), Willett and Banaian (1996), Akçay et al. (1997), Berg and Borensztein (2000), and Yinusa (2008), emphasize that dollarization could be a crucial source to exchange rate instability. Despite its importance of this issue, only a few attempts have been made to evaluate dollarization especially in Cambodia. Among them, Kem (2001) shows a long-run relationship between the expected rate of depreciation and dollarization during the period 1993-2001, and Ra (2008) finds a positive effect of

[4] Highly dollarized countries currently include Argentina, Bolivia, Cambodia, Lao P.D.R., Peru, Uruguay, and some other countries (see, e.g., Honohan, 2007).

[5] Only non-poor people earn their income in the US dollar, whereas the rest (the poor) receive their income in the riel (Beresford et al, 2004; Kang, 2005). Moreover, the durable products with a high price are sold in the US dollar, and the prices of goods in the supermarkets and some shops are also labeled in the US dollar while the riel is used only for the change.

[6] See Giovannini and Turtelboom (1994) for a review of currency substitution.

the expected rate of depreciation on dollarization during the period 1994-2007. Menon (2008) explains persistent dollarization in Cambodia and discusses possible policy options. Unfortunately, none of these previous studies have systematically examined how dollarization affects exchange rate stability in terms of exchange rate movement and volatility in the case of Cambodia.

This paper aims at reexamining the role of dollarization on exchange rate movements in Cambodia over the post-Asian crisis period during which it has experienced the deepening of dollarization. The notable difference between this and previous studies is that we empirically address the issue on how dollarization would affect both exchange rate and its volatility by applying the Generalized Autoregressive Conditional Heteroskedastic (GARCH) analysis. For the poor whose earnings are typically in terms of the riel, the depreciation reduces the purchasing power, and exchange rate instability causes them to face the risk of changing their asset values. Examining such an issue would be valuable for policymakers to evaluate whether or not dollarization helps the poor in Cambodia.

This paper conducts two empirical methods, the causality test and the GARCH model, with monthly data from June 1998 to January 2008. The result of the causality test shows that dollarization causes exchange rates in the Granger's sense. The GARCH analysis shows that dollarization provokes the depreciation of the riel and also intensifies its volatility. The result is consistent with the argument of McKinnon (1982, 1993) that the instability of exchange rate is caused by dollarization. Dollarization may be the burden of the Cambodian government with national strategic plan of poverty alleviation. It worsens distributional problems between the poor and the non-poor through the depreciation and instability of exchange rate. The poor people typically

have to pay for some goods and services in the US dollar while their earnings are in local currency, the riel. These people are facing the problem of losing the purchasing power with a higher risk of exchange rate fluctuations.

The remainder of the paper is structured as follows: Section 2 briefly describes the evolution of dollarization and exchange rate movements in Cambodia. Section 3 explains the empirical models and shows the derived results. Some related discussions are also provided. Section 4 offers conclusions.

2. Recent Evolution of Dollarization and Exchange Rates

Since the early 1970s, Cambodia has historically undergone a civil war and political turmoil.[7] Lon Nol's coup d'état in March 1970 brought Cambodia into a new regime where currency notes were discarded and new notes were printed to replace the former ones. During the period from 1970 to 1975, the country was under the severe political unrest of external and internal conflicts which ultimately led Cambodia to another regime where the Khmer Rouge seized power in April 1975. The new regime, which was even worse than its predecessor, exposed Cambodia to 'year zero', the year in which educated people were killed, and people were driven from the city and forced to work in agriculture. Public and private offices including banks were closed, and the currency notes were just pieces of discarded paper and were no longer used.[8] The so-called "killing fields" regime did not only brutally kill millions of innocent Cambodians

[7] For the detail of Cambodian economic history, see, e.g., Kem (2001) and de Zamaróczy and Sa (2002).

[8] The building of the central bank was totally ruined during the Khmer Rouge regime.

but also completely destroyed the infrastructure and the economy of Cambodia until January 1979.

After the end of the Khmer Rouge regime, a Cambodian communist state strongly influenced by the Soviet Union and backed by the communist Vietnam was installed in 1979. In the process of national restoration, public sectors were gradually reestablished and developed. The central bank, called People's Bank of Kampuchea, was then reopened but with limited services and the local currency, the riel, was reintroduced in 1980. However, the banking system stayed awfully poor and almost all transactions were made under barter system.[9] Economic liberalization in the early 1990s caused the economy to noticeably improve. Cambodia opened its economy by building up diplomatic relations with her neighboring countries as well as Western countries through the promotion of trade, investment, and humanitarian relations. As a result, the inflow of foreign currencies, particularly the US dollar, began to increase.

Dollarization in Cambodia emerged after the signing of the Paris Peace Agreement in 1991 when the peacekeeping forces of the United Nations Transitional Authority in Cambodia (UNTAC) undertook the peace building operations, especially to organize the first democratic election. The cost of the election was too huge to be controlled because the banking system of Cambodia at that time was still poor, resulting in the US dollar being freely circulated in the economy.[10] The subsequent increase of

[9] From the experience of these two regimes, local residents were not much willing to hold the riel anymore; instead, they would shift to store their assets in terms of gold and other valuable metals or stones. However, although gold became the main unit for transactions, some commodities such as rice, food and other basic living commodities were popular for bartering.

[10] The cost of election was estimated at approximately USD 1.7 billion, which was about 75 percent of the total 1993 Cambodian GDP (see de Zamaróczy & Sa, 2002).

the US dollar share in currency has been due to the huge inflow of foreign aid, loans, remittances, and export earnings.

Since the financial and banking systems were at its early stage, the NBC has made great efforts to stabilize the economy by enforcing a series of new regulations for the supervision of the financial institutions. The state-owned Foreign Trade Bank (FTB) was ultimately separated from the NBC and privatized as a commercial bank. In spite of this, local residents prefer to hold the US dollar owing to the lack of confidence in local currency and the weaknesses in laws and regulations with an anticipation of a high inflation. The period 1997-1998 is a good example providing that the inflation rate hit 15 percent due to the domestic political turmoil and the Asian financial crisis.

Dollarization has been continuing to be pervasive and beyond the control of the monetary authorities, even though Cambodia has achieved political stability and economic prosperity in the last decade (Beresford et al., 2004, Menon, 2008).[11] Figure 1 shows that the degree of dollarization, which is measured by the ratio of foreign currency deposits (FCDs) to broad money (M2), as estimated by the National Bank of Cambodia, has been steadily increasing since the late 1990s. The dollarization index has surged from around 55 percent in 1998 to around 80 percent in 2007.

[11] Another factor of persistence of dollarization is the magnitude of reforms. Although the country has significantly progressed after the long suffering, a lot more reforms needs to be taken into account, especially in the development of financial and monetary systems. As argued by Unteroberdoerster (2004), banking system in Cambodia is under the process of rebuilding rather than transforming. The process has been implemented through the reforms which consist of re-licensing of viable commercial banks under new banking laws, strengthening banking supervision, and restructuring the state-owned commercial banks with a view of eventual privatization. The reforms have led to the restructuring of 23 commercial banks where 16 of them were de-licensed and liquidated as a result of the imposition of minimum capital requirement, while the others were merged because of the re-licensing procedure from 1995 to 2002 (Oum & Sok, 2006; NBC, 2006).

The presence of dollarization in Cambodia entails both benefits and costs (see, e.g., Kem, 2001; de Zamaróczy & Sa, 2002; Beresford et al., 2004; Kang, 2005). The benefits may include protection against exchange rate risks, reduction in the risk of national default, the opportunity for re-intermediation, and the promotion of financial deepening in the economy of Cambodia.[12] The costs of dollarization may come from the losses of seigniorage and monetary independence. Another crucial cost, which is the focus of this study, is the potential distortion of income distribution associated with exchange rate movements (Beresford et al., 2004; Kang, 2005). In general, the poor, especially in rural areas, earn their income in the riel, while the non-poor earn income in the US dollar. The exchange rate movements associated with dollarization could affect welfare especially for the poor whose income is in the riel.

The high degree of dollarization in Cambodia does not mean that exchange rates are totally stable. The current policy of NBC without effective monetary autonomy due to dollarization is the exchange market intervention to maintain the purchasing power of the riel and to control inflation rather than supporting export industry (Beresford et al., 2004). Figure 2 shows the nominal and real exchange rates against the US dollar, and Figure 3 illustrates inflation rate in Cambodia. Inflation rate has successfully been reduced to an average of 3.5 percent over 1998-2007 from an average of 56 percent over 1990-1998 (Menon, 2008). Nominal and real exchange rates sometimes present the

[12] Kem (2001), de Zamaróczy and Sa (2002), and Beresford et al. (2004) maintain that the re-intermediation process may happen when foreign currency deposits are allowed in domestic banks; therefore, domestic agents may have more confidence and may be more willing to deposit their money in domestic intermediaries. The expansion of foreign currency in the domestic banks, as the authors mentioned, will facilitate the integration of the domestic market into the rest of the world since the US dollar is a widely used currency for international trade.

different directions, since inflation rates are relatively high during the late 1990s and are relatively low during the period after 2005.

3. Empirical Analysis

This section investigates the relationship between dollarization and nominal exchange rate movements in Cambodia. Monthly data is used from June 1998 to January 2008 (115 observations). Nominal exchange rate of the riel against the US dollar (NER), broad money (M2), and interest rate (deposit rate) are obtained from the International Financial Statistics (IFS) of the International Monetary Fund (IMF). The data of foreign currency deposits (FCDs) from June 1998 to February 2006 is compiled from IFS, and the rest (from March 2006 to January 2008) is from the monetary survey of the National Bank of Cambodia.[13] After examining the Granger causality between dollarization and nominal exchange rate, we apply the GARCH models to discuss how the degree of dollarization influences exchange rate movements. Since the interest rate is one important factor affecting the holdings of the US dollar and exchange rates, we incorporate it into the empirical models.

Given the fact that holding foreign currencies is not restricted in Cambodia, foreign currency deposits (FCDs) might be considered as an appropriate proxy of total foreign currency holdings, although it is difficult to measure the accurate holdings (including foreign currency deposits, foreign currency in circulation within the domestic

[13] The data of FCDs from March 2006 is not available in the IFS; thus, we take the rest of the data from the National Bank of Cambodia.

economy, and cross-border deposits held at foreign banks).[14] Dollarization index (DI), which is measured by the ratio of foreign currency deposits (FCDs) to broad money (M2), captures the degree of total foreign currency holdings. This measurement of the degree of dollarization is used in the studies on currency substitution and dollarization (see, e.g., Clements & Schwartz, 1993; Agénor & Khan, 1996; Sahay & Végh, 1996; Komárek & Melecký, 2001; Kem, 2001; Rennhack & Nozaki, 2006; Yinusa, 2008). Table 1 shows descriptive statistics for main variables in this study.

Before discussing the impact of dollarization on exchange rate movements, we first check whether or not each variable is non-stationary by applying two stationary tests: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests and then examine the Granger causality between the dollarization index and the nominal exchange rate. The lag length is chosen according to the Akaike Information Criterion (AIC) or Schwarz Information Criterion (SIC). Table 2 shows that the dollarization index (DI), the interest rate (i), and the logarithm of nominal exchange rate (LNNER) are non-stationary at the level but stationary at the first-difference. The results of the Granger causality in Table 3 suggest that the dollarization index Granger causes nominal exchange rate, but there is no statistical evidence to support the Granger causality from nominal exchange rate to dollarization. These imply that current and past value of the dollarization index help to forecast future values of nominal exchange rate, but not vice versa.

[14] As argued by Mizen and Pentecost (1996) and Kem (2001), the data of foreign currency holdings of domestic residents is not plausible due to the lack of statistical records since households in the developing countries may hold currency in the form of actual cash, kept under the mattress or in the safe, without passing through the banking system.

Once the causality from the dollarization index to nominal exchange rate is supported in the Granger's sense, we now apply the GARCH approaches to identify how dollarization influences exchange rate movements. Following the work of Akçay et al. (1997), Cavoli and Rajan (2007), and Behera et al. (2008), the GARCH model is written as the following mean and variance equations:

$$\Delta e_t = b_0 + \sum_{i=1}^{j} b_i e_{t-i} + \gamma_1 \Delta DI_t + \gamma_2 \Delta i_t + \mu_t, \qquad \mu_t = h_t^{1/2} \varepsilon_t$$

$$h_t = \omega + \sum_{i=1}^{j} \delta_i \mu_{t-i}^2 + \sum_{i=1}^{q} \emptyset_t h_{t-1} + \eta_1 \Delta DI_t + \eta_2 \Delta i_t$$

where the dependent variable is the log difference of nominal exchange rate (ΔLNNER) which is abbreviated as Δe_t, and the independent variables are the autoregressive of ΔLNNER, the difference of dollarization index ΔDI, and the difference of interest rate Δi, respectively. For the purpose of robustness check, we also estimate the exponential GARCH (EGARCH) model proposed by Nelson (1991). The variance equation is given as:

$$ln(h_t) = \omega + \sum_{i=1}^{j} \delta_i \varepsilon_{t-i} + \sum_{i=1}^{q} \emptyset_i \, ln(h_{t-i}) + \eta_1 \Delta DI_t + \eta_2 \Delta i_t$$

where ε_t is a dependent white noise process with zero mean and unit variance. The EGARCH specification may be more advantageous than the standard GARCH one since the logarithm of the variance of h_t will be positive regardless of signs of the

ARCH coefficients (Hamilton, 1994). Based on SIC, we use AR(3) for the mean equation and GARCH(1,0) and EGARCH(3,2) for the variance equation (see Table 4).[15]

Table 5 presents the empirical results of the mean and variance equations of GARCH(1,0) and EGARCH(3,2) models. Notice that the Ljung-Box Q-statistics with five lags for testing residual serial correlation cannot reject the null hypothesis of no autocorrelation for the residuals and the square residuals at conventional significance level. This implies that the model specifications can explain the data well. The results show that the coefficients on ΔDI are statistically significant, while those on Δi are statistically insignificant. Dollarization in Cambodia influences the level and the volatility of nominal exchange rates. However, the models cannot find any evidence to explain the relationship between the exchange rate movements and interest rates.

In the mean equation of GARCH(1,0) and EGARCH(3,2), the coefficient of ΔDI is significantly positive. Moreover, in the variance equation of GARCH(1,0) and EGARCH(3,2), the coefficients of ΔDI are also significantly positive. The prevalence of dollarization provokes depreciation of nominal exchange rate as well as exchange rate instability in Cambodia. The result is consistent with some arguments that the instability of flexible exchange rate is caused by dollarization (see, e.g., McKinnon, 1982, 1993,

[15] In most empirical researches, AIC and SIC have been widely employed in order to determine the model of autoregressive in the GARCH and EGARCH models. Since different criteria may lead to different results, selecting the most appropriate criterion is crucial in this study. Based on the study by Liew (2004), AIC performs well under the sample size of 60 observations or below. Furthermore, Wang and Bessler (2005) suggest that AIC is the best criterion for only small samples, and they propose that SIC provides the better result for large sample size. Therefore, SIC will be the most appropriate criterion for the lag length selection in this study in order to determine the lags for the AR, GARCH and EGARCH since our sample size is 115 observations which are assumed to be large enough.

1996; Willett & Banaian, 1996; Akçay et al., 1997; Berg & Borensztein, 2000; Honohan, 2007; Yinusa, 2008).

The depreciation and intensified volatility of exchange rate as a result of dollarization might be one of the constraints on poverty reduction in Cambodia. According to a poverty profile of Cambodia 2004 by Ministry of Planning (MoP), 35 percent of the Cambodians lived below the poverty line in 2004, in which 91 percent of whom were living in the rural areas, while the rest were living in the urban areas working as labors or workers. These people, such as farmers, cyclo drivers, small vegetable sellers, rice-field workers, skilled and unskilled construction workers, mostly receive their daily earnings in local currency, the riel (Beresford et al., 2004). Likewise, it is undeniable that while the US dollar is mainly used for large business transactions and by the rich and is practically the main currency of Cambodia, the riel remains the currency of the poor (Beresford et al., 2004; Kang, 2005). Dollarization in Cambodia has a negative impact on rural areas, where the riel is widely used, through the depreciation of the currency and intensified exchange rate volatility.

4. Conclusion

This paper has investigated the relationship between dollarization and exchange rate movements in Cambodia by applying the GARCH models with monthly data from June 1998 to January 2008. The empirical findings present that dollarization may not be suitable for Cambodia due to the depreciation and instability of exchange rate, consistently with the well-known arguments of McKinnon (1982, 1993, 1996) that dollarization is a crucial cause of exchange rate instability. This enables us to raise policy issues on whether de-dollarization is the best policy option. As maintained by

Beresford et al. (2004), the riel remains the currency of the poor, while the US dollar is mostly used by the rich. From the standpoint of poverty reduction, de-dollarization may be helpful to improve the living standard of the poor through stabilizing the value of the riel.

However, as mentioned in Galindo and Leiderman (2005), it should be noted that de-dollarization incurs various costs and is difficult to implement, so that only a few countries have been able to successfully achieve it. Abdelati (2006) suggests three approaches to reduce dollarization in Cambodia. The first is the implementation of macroeconomic policies aiming to maintain exchange rate and price stability and to liberalize its financial system. The second is the regulatory or legal reforms with incentive and penalty structures for holding foreign and domestic currencies. Examples include a transaction tax on check payment in foreign currency and lower reserve requirements on local currency deposits. The third is the administrative enforcements, such as the prohibition of FCDs, restrictions on residents holding accounts abroad, and forcing conversions of the dollar into local currency deposits.

Erasmus et al. (2009) suggest that since forced de-dollarization proves to be a failure and has significant macroeconomic costs, a market-driven approach seems to be more successful. This approach may be applicable to the current situation of Cambodia. However, given the fact that dollarization was not the result of policy decision but the hysteresis, it might take time to rebuild the confidence of the people partly due to the change of the political regime (Beresford et al., 2004). Based on this argument, the best policy is now to maintain sound macroeconomic stabilization through the reforms in the financial and legal sectors.

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Figure 1: Evolution of dollarization

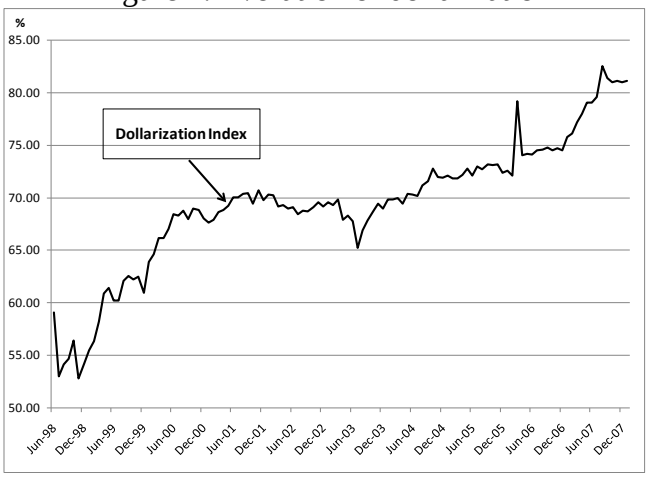

Figure 2: Nominal and Real Exchange Rate

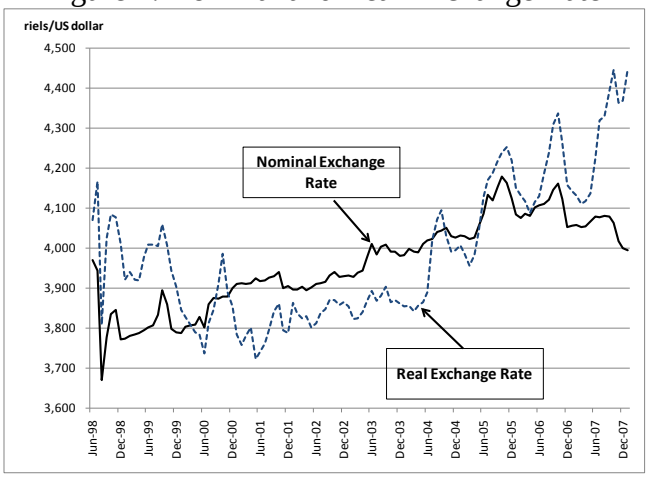

Figure 3: Inflation Rate

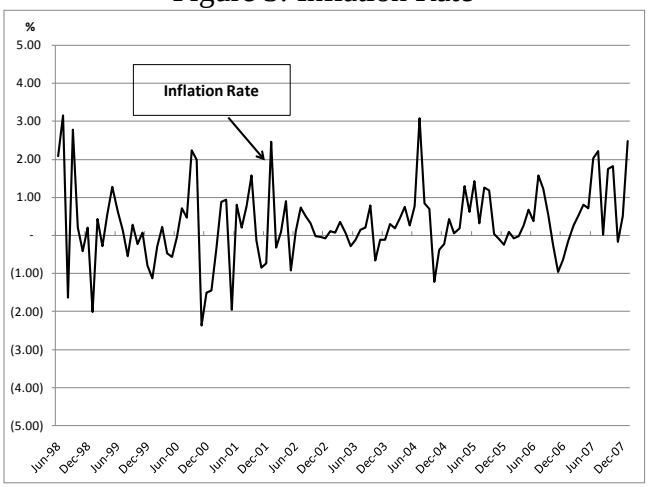

Table 1: Description Statistics for Main Variables

	Obs.	Mean	Median	Min.	Max.	Std. Dev.
DI	115	0.69	0.70	0.53	0.82	0.06
ΔDI	115	0.00	0.00	-0.06	0.07	0.01
LNNER	115	8.28	8.28	8.21	8.34	0.03
ΔLNNER	115	0.00	0.00	-0.07	0.03	0.01
i	115	3.60	2.00	1.70	7.90	2.32
Δ*i*	115	-0.05	0.00	-1.00	0.50	0.19

Notes: DI is the dollarization index; LNNER is the log of the nominal exchange rate; and *i* is interest rate. Δ represents the first-difference.

Table 2: Unit root test

Variables	Unit root tests				Likely degree of integration
	ADF		PP		
	Levels	1st diff.	Levels	1st diff.	
With intercept only					
DI	-1.5584	-15.8830*	-0.6651	-16.0704*	I (1)
i	-1.8582	-7.8100*	-1.8835	-7.8252*	I (1)
LNNER	-1.7392	-11.2998*	-1.7392	-11.7021*	I (1)
With trend and intercept					
DI	-2.3644	-15.8242*	-2.5072	-16.0283*	I (1)
i	-0.7546	-8.0570*	-0.4769	-8.0554*	I (1)
LNNER	-5.0387*	-11.2491*	-5.1994*	-11.6330*	I (0)

* indicates significance at 1% confidence level.

Table 3: Causality Test

Variables	Δ*LNNER*	Δ*DI*
C	-0.0004 [-0.5268]	0.0030* [2.6810]
Δ*LNNER (-1)*	0.0786 [0.9150]	-0.0883 [-1.7235]
Δ*DI (-1)*	0.2773* [4.8623]	-0.2823* [-3.4811]
Summary statistics		
F-statistic	12.0909	6.4233
SE of regression	0.0084	0.0119
Prob.	0.000018	0.0023

* indicates significance at 1% confidence level. T-statistics are in [ ].

Table 4: Lag Order Selection for AR, GARCH, and EGARCH

AR(ρ)		*GARCH(p,q)*		*EGARCH(p,q)*	
Lag	SIC	Order	SIC	Order	SIC
0	-6.4485	(0, 1)	-7.3598	(0, 1)	-7.3649
1	-6.4051	(0, 2)	-7.3140	(0, 2)	-7.4290
2	-7.2832	(0, 3)	-7.3364	(0, 3)	-7.4170
3	**-7.4731***	(0, 4)	-7.2550	(0, 4)	-7.3750
4	-7.4634	**(1, 0)**	**-7.5155***	(1, 0)	-7.6066
5	-7.4124	(1, 1)	-7.3626	(1, 1)	-7.6423
6	-7.4666	(1, 2)	-7.4571	(1, 2)	-7.6034
7	-7.4263	(1, 3)	-7.3928	(1, 3)	-7.5721
8	-7.4223	(1, 4)	-7.2985	(1, 4)	-7.6153
9	-7.4304	(2, 0)	-7.4412	(2, 0)	-7.5969
10	-7.4038	(2, 1)	-7.4127	(2, 1)	-7.6669
11	-7.4002	(2, 2)	-7.4589	(2, 2)	-7.6382
12	-7.3972	(2, 3)	-7.4082	(2, 3)	-7.5849
		(2, 4)	-7.3829	(2, 4)	-7.6925
		(3, 0)	-7.4200	(3, 0)	-7.5404
		(3, 1)	-7.3475	(3, 1)	-7.6166
		(3, 2)	-7.3155	**(3, 2)**	**-7.8182***
		(3, 3)	-7.2352	(3, 3)	-7.6209
		(3, 4)	-7.3791	(3, 4)	-7.6528
		(4, 0)	-7.3844	(4, 0)	-7.5588
		(4, 1)	-7.3393	(4, 1)	-7.5757
		(4, 2)	-7.3385	(4, 2)	-7.6720
		(4, 3)	-7.3086	(4, 3)	-7.6913
		(4, 4)	-7.2031	(4, 4)	-7.4619

* Indicates lag order selected by the criterion. SIC: Schwarz Information Criterion.

Table 5: GARCH and EGARCH Estimates

	GARCH(1, 0)		*GARCH(1, 0)*		*EGARCH(3, 2)*	
	Coefficients	SE	Coefficients	SE	Coefficients	SE
Mean equation						
Constant	0.0005	0.0004	0.0002	0.0005	0.0004*	0.0003
Δe_{t-1}	0.1665	0.1083	0.1554	0.1046	0.2504***	0.0874
Δe_{t-2}	-0.0299	0.0731	-0.1257	0.0980	-0.0789	0.0552
Δe_{t-3}	-0.1044***	0.0288	-0.0880*	0.0485	-0.0559**	0.0220
ΔDI	-	-	0.0500***	0.0157	0.0590***	0.0170
Δi	-	-	-0.0014	0.0012	-0.0013	0.0012
Variance equation						
Constant	9.52E-06***	2.02E-06	1.73E-05***	3.89E-06	-14.4564	8.8696
ARCH(1)	0.8126***	0.2699	0.2333**	0.0940	1.2789***	0.2378
ARCH(2)	-	-	-	-	0.4571	0.5615
GARCH(1)	-	-	-	-	-0.3474	0.4919
GARCH(2)	-	-	-	-	-0.3980	0.4261
GARCH(3)	-	-	-	-	0.1930	0.3335
ΔDI	-	-	0.0004*	0.0002	41.5975***	14.1382
Δi	-	-	1.62E-05	1.12E-05	-0.8717	0.5911
Q(5)	2.2646	[0.811]	3.5572	[0.615]	3.3402	[0.648]
$Q^2(5)$	4.8288	[0.437]	3.4299	[0.634]	6.2857	[0.279]
R^2	0.0922		0.1439		0.1235	
DW	1.9400		1.9296		2.1142	
AIC	-7.8723		-7.7582		-7.9300	
SIC	-7.7266		-7.5155		-7.5902	

*** indicates significance at 1% confidence level, ** indicates significance at 5% confidence level, * indicates significance at 10% confidence level. Q(k) and Q2(k) are the Ljung-Box Q-statistics with *k* lags for the standardized residuals and square residuals, respectively, and p-values are in [ ]. The selected lag length for the Ljung-Box Q-statistics test is 5. SIC: Schwarz Information Criterion; AIC: Akaike Information Criterion.