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Swiss Franc from the Croatian Perspective

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Abstract: In Croatia and other countries of Central and Eastern Europe, as a consequence of deep financial integration and abolition of capital controls, considerable loans to households indexed to the Swiss franc have emerged. Although all of researchers of the Swiss franc do not agree entirely on whether the Swiss franc is a safe haven currency, its property of continuous appreciation is commonly accepted. There was a continuous appreciation of the Swiss franc over the Croatian kuna. This paper examines the performance of several ARCH-based models for Swiss franc against the Croatian kuna on daily data sets within time period from 1997 to 2010. Evaluating the models through standard information criteria Component ARCH (1,1) is found to be the best-fitting model.

Keywords: Swiss franc, asymmetric GARCH, exchange rate, Croatia

JEL classification: C13, C58, F31, F32, G15

1. Introduction

Croatia as well as most of Central and Eastern European post-communist countries has entered and finished the process of economic transition from a centrally planned economy to a market economy. Consequently, the integration with the global financial market has deepened. At the same time, Croatia experienced higher inflation rate in comparison to Switzerland and the euro area before and after the implementation of the Stabilisation Programme introduced in October 1993. Monetary stability in Croatia has been achieved by the strategy of a stable exchange rate as the nominal anchor for price stability resulting from a restrictive monetary policy with higher interest rates as compared to Switzerland

and the euro area. Furthermore, monetary policy that actively smoothes the exchange rate by interest rate policy may create an additional incentive to borrow in foreign currency (Csajb'ok et al., 2009). As interest rates in many Central and Eastern European countries were permanently higher than in Switzerland and the euro area, domestic as well as foreign owned banks had started to sell housing loans in foreign currencies, predominately in Swiss francs and euros (Buszko and Krupa, 2015) and the phenomenon of loans with foreign currency clause (LFCC) has emerged¹. LFCC became very popular in all Central and Eastern European countries over the 2000–2011 period (Temesvary, 2016). Rapid expansion of LFCC made borrowers directly exposed to foreign exchange risk and foreign interest rate risk that might be transformed into credit risk (currency-induced credit risk). Some recent studies indicate the existence of the relationship between foreign exchange risk and credit risk in Croatia and neighbouring countries (Tanasković and Jandrić, 2015; Dumičić, 2016; Jović, 2016). The domestic household sector is unlikely to have any income in a foreign currency or to use sophisticated hedging instruments against the exchange rate risk and, therefore, private individuals are directly exposed to foreign exchange risk.

After 2010, the materialization of currency-induced credit has started to occur for LFCC to the Swiss franc as well as the strong growth of non-performing loans (NPLs) after 2011. The fact that a high portion of NPLs belongs to housing loans to private individuals begs the question of a moral hazard. As of 2013, the share of NPLs for housing LFCC to the Swiss franc was 12.5% while NPLs' share for housing LFCC to the euro was 4.5%, (CNB, 2014). Conclusively, the main aim of this paper is to explore the properties of Swiss franc from the Croatian perspective and contribute to honest identification of the existing problem in LFCC.

The remainder of the paper is organized as follows. Section 2 explores the properties of Swiss franc as a safe haven currency. Section 3 shortly describes exchange rate volatilities modelling literature overview. Section 4 briefly overviews the research data and empirical strategy. Section 5 presents applied methodology. Section 6 discusses the results of the empirical analysis and the last section concludes.

¹ Loans with foreign currency clause are loans that are disbursed and repaid in domestic currency but indexed to a foreign currency and require currency conversion during disbursement as well as during the repayment of instalments.

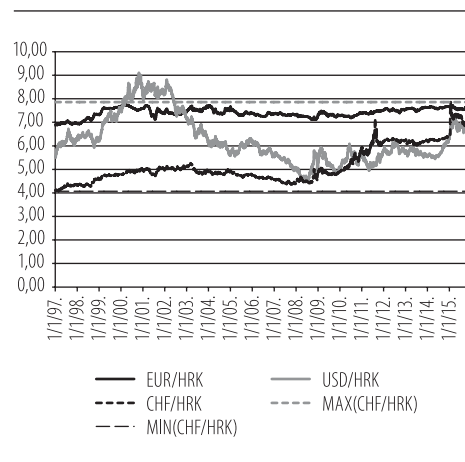
2. Properties of Swiss franc as a safe haven currency

The safe haven status of the Swiss franc has been the subject of many studies. Baltensperger and Kugler (2016) provided extensive historical overview and origins of Swiss franc as a safe haven currency. This property of the Swiss franc is explained by the exceptional political, economic and monetary stability of Switzerland, which leads investors to pay a premium for holding Swiss franc fixed-income assets (Kugler and Weder di Mauro, 2002, 2005). Empirical literature test for safe haven status directly by analysing dynamics of exchange rate for crisis and non-crisis periods and checking the conjecture of a strong appreciation of safe haven currencies in crisis (Ronaldo and Söderlind, 2010). De Bock and de Carvalho Filho (2013) find that the Japanese yen and the Swiss franc are the only two currencies that, on average, appreciate against the U.S. dollar during risk-off periods.

Grise and Nitschka (2015) analysed bilateral Swiss franc exchange rate returns in an asset pricing framework to evaluate the Swiss franc's safe haven characteristics and the results highlight that in response to increases in global risk, the Swiss franc appreciates against typical carry trade investment currencies such as the Australian dollar but depreciates against the US dollar, the Yen, and the British pound. Thus, the Swiss franc exhibits safe haven characteristics against many, but not all other currencies. Coudert et al. (2014) examined negative risk premia in the long run and positive excess returns during financial downturn as criteria for safe haven currency. Over a sample of 26 currencies from 1999 to 2013, the authors point to the JPY and the USD as the only currencies to meet these conditions whereas Swiss franc was found to exhibit a continuous trend of long-run appreciation rather than a specific reaction to global financial turmoil. Figure 1 shows daily nominal exchange rate dynamics for CHF/HRK, EUR/HRK and USD/HRK from January 1997 to December 2015.

A visual inspection of these data series in Figure 1 suggests that, from the Croatian perspective, the hypothesis of continuous Swiss franc appreciation

Figure 1: Daily nominal exchange rates for CHF/HRK, EUR/HRK and USD/HRK from January 1997 to December 2015



Source: Authors' calculation

trend against the Croatian kuna may be valid in the long-run. Eventually, Swiss franc might not have all of the properties of a safe haven currency. Nonetheless, what matters for the purpose of this paper is the property of its continuous appreciation and it has been confirmed in all of the presented recent empirical papers.

Since volatility essentially represents the cost of carry trade, determining the CHF/HRK pattern behaviour and the corresponding volatility is the focal point of this research.

3. Brief exchange rate volatilities modelling literature overview

Volatility modelling is an important tool for policymaking, investment analysis, asset pricing and risk management (Narsoo, 2016). Volatility is considered as being a 'barometer for the vulnerability of financial markets and the economy' (Poon and Granger, 2001; Narsoo, 2016).

The first autoregressive conditional heteroscedasticity (ARCH) model is the one developed by Engle (1982). The main purpose of the proposed model is to estimate and explain the conditional variance of a time series. Engle (1982) explained the conditional variance as a linear function of lagged squared residuals. The ARCH effects in exchange rates dynamics is consistent with well documented phenomenon of leptokurtosis (McFarland, 1982). Bollerslev (1986) included lagged values of the conditional variance and formulated Generalized Autoregressive Conditional Heteroskedastic (GARCH) model. Following Bollerslev (1986) extension of basic ARCH, conditional variance of the series can be explained with its lagged values and the square of the lagged values of the news or shocks. Nelson (1991) proposed another extension and formulated Exponential GARCH (EGARCH) model. EGARCH model specification takes into account news in the form of leverage effects. The extensions of Glosten et al. (1993) and Zakoian (1994) take into account the possibility of asymmetric influence of news while Ding et al. (1993) extensions nests a number of ARCH models. Engle and Lee (1999) offered the component ARCH model that decomposes the total conditional variance into a temporary and a permanent component. Many extensions of the ARCH model have been offered and tested, but the first models still remain the most prominent and influential. Following Berument and Günay (2003) and Oduncu (2011), GARCH (1,1) specification is found to be the most frequently used in the literature describing volatility as well as in market analyses. Ngowani (2012) used USD/RMB daily exchange rates from 2009 to 2011 and found GARCH (1, 1) as the best-fitting model to explain the volatility under consideration. Consistently, Ullah et al. (2012) examined Rupee behaviour pattern and found GARCH (1,1)

as the best-fitting model. Marreh et al. (2014) examined EUR/GMD and USD/GMD daily returns on a sample period from 2003 to 2013. Following Akaike information criteria, the ARMA (1,1) – GARCH (1,1) and ARMA (2,1) – GARCH (1,1) outperform other tested models. However, Arabi (2012) and Çağlayan et al. (2013) point to EGARCH as the preferred model specification to explain exchange rates volatility. Arabi (2012) used data sample from 1978 to 2009 to examine Sudanese pound exchange rate volatility and found EGARCH (1,1) to be the best-fitting model pointing on the existence of leverage effect. Consistently, Çağlayan et al. (2013) found EGARCH as the preferred model specification for Mexico. ARCH based models are designed to examine the high frequency data at the first place and research data sample often consist of daily or monthly observations. Olowe (2009) used monthly data from 1970 to 2007 to explain volatility of Naira/US Dollar exchange rates and tested six different GARCH models. The results revealed Asymmetric Power ARCH and Threshold Symmetric GARCH the best-fitting models to explain Naira/US Dollar exchange rates volatility. Wang and Yang (2009) found asymmetric volatility in the exchange rates of Australian Dollar, British Pound and Japan Yen all against US Dollar. The explanation authors offered for identified asymmetric volatility was the base currency effect and central bank intervention effect. Watanabe and Harada (2006) found no significant differences between GARCH and component ARCH in explaining Yen/US Dollar exchange rate volatility. But nonetheless, some authors found component ARCH specification superior for modelling exchange rate volatility comparing to other GARCH family models (Black and McMillan, 2004; Pramor and Tamirisa, 2006; Li et al., 2012). Bošnjak et al. (2016) found GARCH specification superior and no empirical evidence that negative and positive shocks imply different next period volatility of daily EUR/HRK or USD/HRK exchange rate return.

As illustrated earlier, ARCH based models are frequently employed to examine high-frequency time series of foreign exchange rates as they usually provide a better fit compared to other constant variance models. However, the reviewed literature points to the mixed results regarding a proper ARCH based model specification. In line with previous researches, selection of an appropriate model is the key instrument to determine the CHF/HRK exchange rate pattern behaviour.

4. Research data and empirical strategy

As in most empirical finance literature, the variable to be modelled is daily exchange rate return which is the first difference of the natural logarithm of the exchange rate and is given by the equation (1):

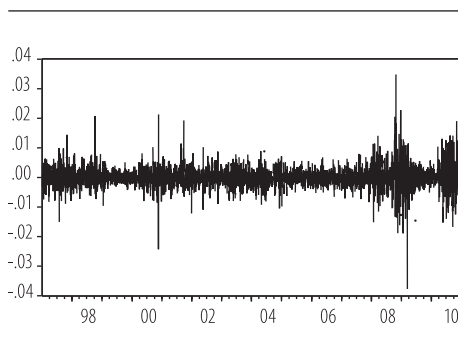
$$r_t = \ln\left(\frac{S_t}{S_{t-1}}\right) \quad (1)$$

Table 1: Descriptive statistics for $\ln(\text{CHF/HRK})$

	r_t
Mean	0.000105
Median	2.95E-05
Maximum	0.034817
Minimum	-0.037738
Std. Dev.	0.003659
Skewness	0.161140
Kurtosis	12.74231
Jarque-Bera	13919.91
Probability	0.000000
Sum	0.367568
Sum Sq. Dev.	0.047060
Observations	3516

Source: Authors' calculation

Figure 2: Daily CHF/HRK exchange rate return from January 1997 to December 2010



Source: Authors' calculation

Where r_t is the daily exchange rate return and S_t and S_{t-1} denote the Croatian National Bank (CNB) midpoint exchange rate of CHF against HRK at the current day and previous day, respectively. Since the Swiss National Bank introduced the exchange rate peg in 2011, the data span from 1st January 1997 to 31st December 2010 is used as a data sample for modelling daily CHF/HRK exchange rate return. Table 1 shows descriptive statistics for the observed variable.

The results in Table 1 indicate excess kurtoses and skewnesses. Therefore, the probability density function of the CHF/HRK exchange rate returns appears to be leptokurtic, so is more peaked at the centre and has fatter tails compared to that of the normal distribution. Positive value of skewness indicates that data are skewed to the right referring to appreciation of the CHF currency against the HRK. So, following the results in Table 1, Generalized Error distribution (GED) will be used rather than the normal distribution which takes into account the phenomenon of leptokurtosis and skewness in the probability density function. Figure 2 shows daily CHF/HRK exchange rate return from January 1997 to December 2010.

It can be observed from Figure 1 showing CHF/HRK daily return series that the volatility of the return series changes with time. Furthermore, Figure 1 clearly indicates that large changes tend to be followed by subsequent large changes, and

small changes tend to be followed by other small changes. Since the time series is being observed, stationary condition of series needs to be tested. For that purpose, Augmented Dickey Fuller (ADF) unit root test was applied (see for example Dickey and Fuller, 1981; Enders, 1995). Augmented Dickey–Fuller test results are summarized in Table 2.

Table 2: Augmented Dickey–Fuller test (ADF) on the observed time series

Variable	Include test equation	Test statistics	p - value
r_t	with constant	-60.25755	0.0001
	with constant and linear trend	-60.25436	0.0000
	without constant and linear trend	-60.21537	0.0001

Source: Authors' calculation

The ADF test results in Table 2 indicate that daily exchange rate return is a stationary time series. Since the series is found to be stationary, the next step is to determine if the returns of return series can be forecasted by its own past values. Schwarz information criteria for finding best fitting ARMA model of CHF/HRK mean equation are presented in Table 3.

Table 3: Schwarz information criteria for finding best fitting ARMA model of CHF/HRK mean equation

AR/MA	0	1	2	3
0	-8,381202	-8,379134	-8,377908	-8,375970
1	-8,379058	-8,379799	-8,377797	-8,375476
2	-8,377670	-8,377588	-8,375270	-8,372882
3	-8,375778	-8,375193	-8,372898	-8,374875

Source: Authors' calculation

Following the results in Table 3, ARMA (0,0) model is found the best fitting model for forecasting the exchange rate and stock returns. Therefore, the conditional mean equation with error term following conditional heteroscedasticity process for CHF/HRK exchange return series is given by equation (2):

$$y_t = \mu_t + \varepsilon_t \quad (2)$$

After estimating the correct ARMA model, Lagrange Multiplier test (Engle, 1982) is applied to see whether any conditional heteroscedasticity (ARCH effect) exists within the model. ARCH LM test results are presented in Table 4.

Table 4: Heteroscedasticity test: ARCH LM test

F-statistic	Prob. F(1,3513)	Obs*R-squared	Prob. Chi-Square(1)
61.71317	0.0000	60.68229	0.0000

Source: Authors' calculation

ARCH LM test results in Table 4 clearly indicate heteroscedasticity of variance and significant ARCH effect at the 1% level of significance. In order to find the best-fitting model several ARCH based models will be tested and compared.

5. Methodology

Time series of foreign exchange rates often exhibit volatility clustering meaning that high volatility periods tend to be followed by high volatility periods and low volatility periods tend to be followed by low volatility periods. As a result, error terms do not have a constant variance over time and the obtained estimates are inefficient. The literature refers this phenomenon as problem of heteroscedasticity. Besides the heteroscedasticity of variance in error terms, the autocorrelation in squared returns is present. In order to resolve the problem of autocorrelation and heteroscedasticity in financial time series, Engle (1982) introduced the autoregressive conditional heteroscedasticity (ARCH) approach. Following Engle (1982), conditional variance can be modelled as a linear function of lagged squared residuals and the model of ARCH(1) process is given by equation (3):

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 \quad (3)$$

Bollerslev (1986) extended the basic ARCH model to Generalized ARCH (GARCH) and described the conditional variance by including its own lagged values and the square of the lagged values of the innovations or news. The GARCH (1,1) conditional variance specification is given by equation (4):

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (4)$$

where ω is a constant term, the ARCH term ε_{t-1}^2 is the first leg of the squared residual from the mean equation and represents shocks the volatility news from the previous period, and the GARCH term σ_{t-1}^2 represents the forecast variance from the last period. The ARCH based models are well known to capture the volatility clustering in financial series and parameter that measure the volatility clustering in GARCH model is $\alpha + \beta$. In case of $\alpha + \beta < 1$, the financial series is weakly stationary. The Threshold ARCH (TARCH) specification developed by

Glosten, Jaganathan and Runkle (1993), as well as Zakoian (1994) is employed to test for presence of asymmetric shocks impact. The TARCh model specification for the conditional variance is provided by equation (5):

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \beta \sigma_{t-1}^2 \quad (5)$$

The model is designed to capture different effects on the conditional variance of exchange rate returns from unexpected changes in the exchange rate returns given in terms of ε_t . So, the extension of GARCH model in equation (3) by including a threshold term $\gamma \varepsilon_{t-1}^2 d_{t-1}$ gives TARCh specification. In TARCh model specification, $d_t = 1$ if $\varepsilon_t < 0$, and $d_t = 0$ otherwise. In this model, an upward innovation means $\varepsilon_t < 0$ has an impact of α and downward or negative innovation $\varepsilon_t > 0$ has an impact of $\alpha + \gamma$. If $\gamma > 0$, a negative innovation increases volatility and indicate presence of leverage effect. If $\gamma \neq 0$, the influence of innovations on the series returns is asymmetric. Higgs and Worthington (2005) found that that volatility tends to rise in response to positive shocks and fall in response to negative shocks, which is an asymmetry that runs counter to the effects generally observed in financial markets. Nelson (1991) provided another ARCH based specification of the conditional variance in logarithmic form called Exponential GARCH (EGARCH) and provided by equation (6):

$$\log(\sigma_t^2) = \omega + \sum_{j=1}^q \beta_j \log(\sigma_{t-j}^2) + \sum_{j=1}^q \alpha_j \left| \frac{\varepsilon_{t-j}}{\sigma_{t-j}} \right| + \sum_{j=1}^q \gamma_j \frac{\varepsilon_{t-j}}{\sigma_{t-j}} \quad (6)$$

EGARCH specification implies that any leverage effects are exponential and the forecasts of conditional variance are non-negative. The conditional variance is represented as a function of the past standardized innovations. The form of the equation presents the conditional variance as an exponential function of the variables under consideration. In case of $\gamma_k \neq 0$ the influence is asymmetric and the presence of leverage effects is indicated by $\gamma_k < 0$. The exponential form of EGARCH ensures that unexpected shocks will have a stronger influence on the predicted volatility than in TARCh model specification. The Power ARCH (PARCh) specification developed by Ding et al. (1993) provides generalized transformation of the error term in the models. The PARCh specification is provided by equation (7):

$$\sigma_t^\delta = \omega + \sum_{j=1}^q \beta_j \sigma_{t-j}^\delta + \sum_{l=1}^p \alpha_l (|\varepsilon_{t-1}| - \gamma_l \varepsilon_{t-1})^\delta \quad (7)$$

The power parameter δ in this model specification is not imposed but estimated while threshold parameter γ is included to capture the potential existence of the asymmetry. Some special cases of PARCH model specifications includes Bollerslev (1986) model specification that sets $\delta=2$, $\gamma=0$, and the Taylor (1986) model specification that sets $\delta=1$ and $\gamma=0$. Empirical literature shows that the power term is sample dependent and in in case of foreign exchange data often amounts between unity and two (Mitchell and McKenzie, 2008). The component ARCH (CGARCH) model introduced by Engle and Lee (1999) decomposes the total conditional variance into permanent and transitory variance components by permitting transitory deviations of the conditional volatility around a time varying trend. The CGARCH specification is given by equations (8) and (9):

$$m_t = \omega + \rho(m_{t-1} - \omega) + \varphi(\varepsilon_{t-1}^2 + \sigma_{t-1}^2) \quad (8)$$

$$\sigma_t^2 - m_t = \alpha(\varepsilon_{t-1}^2 - m_{t-1}) + \gamma(\varepsilon_{t-1}^2 - m_{t-1})d_{t-1} + \beta(\sigma_{t-1}^2 - m_{t-1}) \quad (9)$$

where m_t represents time varying long run volatility. Transitory component is represented by $(\sigma_t^2 - m_t)$ that converges to zero with powers of $(\alpha + \beta)$. Permanent component that converges to ω with powers of ρ . In case when $\gamma \neq 0$ in equation (9) asymmetric effects are present and equation (9) represents asymmetric CGARCH form. In terms of criteria for selecting the best-fitting model, the Akaike information criterion (AIC) and Schwarz Criterion (SIC) are estimated and compared for all of the specified volatility models.

6. Empirical results and discussion

Following the methodology presented in Section 5, several ARCH based models are estimated, namely ARCH(1), GARCH(1,1), TARARCH(1,1), EGARCH(1,1), PARARCH(1,1), and CGARCH(1,1). The results are summarized in Table 5.

Table 5: Coefficients (p-value) for ARMA (0,0) - GARCH models of CHF/HRK daily returns

Parameter	ARCH (1)	GARCH (1,1)	TARCH (1,1)	EGARCH (1,1)	PARCH (1,1)	CGARCH (1,1)
μ	7.04E-07 (0.9867)	8.39E-06 (0.8410)	3.52E-05 (0.4020)	4.69E-05 (0.2550)	3.95E-05 (0.3465)	-1.53E-05 (0.6268)
ω	8.89E-06 (0.0000)	1.13E-07 (0.0001)	1.23E-07 (0.0000)	-0.233481 (0.0000)	3.02E-06 (0.3818)	9.82E-06 (0.0000)
ρ	-	-	-	-	-	0.990292 (0.0000)
φ	-	-	-	-	-	0.052931 (0.0000)
α	0.324162 (0.0000)	0.071301 (0.0000)	0.101728 (0.0000)	0.139699 (0.0000)	0.072749 (0.0000)	0.061300 (0.0027)
β	-	0.921528 (0.0000)	0.921686 (0.0000)	0.988944 (0.0000)	0.927980 (0.0000)	0.869702 (0.0000)
γ	-	-	-0.065374 (0.0000)	0.053517 (0.0000)	-0.321476 (0.0000)	-0.069130 (0.0019)
δ	-	-	-	-	1.439824 (0.0000)	-
AIC	-8.637735	-8.760521	-8.766266	-8.766148	-8.767356	-8.762335
SIC	-8.630721	-8.751754	-8.755745	-8.755628	-8.755082	-8.748308
ARCH - LM Test	(0.3157)	(0.0360)	(0.0009)	(0.0000)	(0.0000)	(0.0213)

Source: Authors' calculation

Diagnostic checking results through Breusch-Godfrey Serial Correlation LM Test and correlogram show no serial correlation among residuals in any of the estimated ARCH family model up to lag thirty six. Following results in Table 5, TARCH, EGARCH and PARCH specification do not eliminate ARCH effect, so competing specifications to explain CHF/HRK daily rate returns are ARCH, GARCH and CGARCH. AIC and SIC indicate CGARCH as the best-fitting model to explain CHF/HRK daily exchange rate returns.

Long run shocks come as a consequence of the situation in the economy or events such as macroeconomic factors, while short-run volatility is generated with news and announcements. σ_t^2 is stationary since $\rho < 1$ and $\alpha + \beta < 1$ and non negative as well, since $0 < \alpha + \beta < \rho < 1$, $0 < \varphi < \beta$, $\alpha > 0$, $\beta > 0$, $\omega > 0$. The asymmetric term is negative and significant suggesting higher volatility in case of CHF currency appreciation against HRK. ρ amounts 0.990292 and so m_t approaches ω very slowly. Since $\alpha + \beta < \rho$ the transitory component decays more quickly than the permanent component such that the permanent component dominates forecasts of the conditional variance in CHF/HRK daily exchange rate returns. Bošnjak et al. (2016) provided the results for EUR/HRK and USD/HRK volatility pattern behaviours. However, Bošnjak et al. (2016) did not test CGARCH model specification for the EUR/HRK and USD/HRK volatility development pattern.

Using the same data sample, Table 6 summarizes estimates for EUR/HRK and USD/HRK CGARCH models.

Table 6: Coefficients (p-value) for EUR/HRK and USD/HRK CGARCH models

Parameter	CGARCH (EUR/HRK)	CGARCH (USD/HRK)
AR(1)	-	-0.033615 (0.0148)
AR(2)	0.213751 (0.0000)	-
AR(3)	0.078609 (0.0000)	-
ω	3.50E-06 (0.3259)	5.18E-05 (0.0000)
ρ	0.997479 (0.0000)	0.996532 (0.0000)
φ	0.071222 (0.0000)	0.035168 (0.0000)
α	0.116723 (0.0001)	-0.057525 (0.0000)
β	-0.037522 (0.3358)	0.051819 (0.0003)
γ	0.429418 (0.0026)	0.651159 (0.0000)
AIC	-10.73562	-7.308002
SIC	-10.72327	-7.298394
ARCH - LM Test	(0.5265)	(0.2484)

Source: Authors' calculation

Following the results in Table 6 and results from Bošnjak et al. (2016), GARCH (2,1) and GARCH (1,1) still remain the best-fitting models for daily return volatility of EUR/HRK and USD/HRK respectively. Comparing to the results for EUR/HRK and USD/HRK provided by Bošnjak et al. (2016), here found CHF/HRK volatility pattern behaviour is completely different. The results in Table 5 show asymmetric CHF/HRK volatility pattern toward CHF appreciation with dominant long run component that calls for additional regulations of LFCC approval and special treatment of exposures arising out of long run CHF/HRK exchange rate dynamics.

7. Conclusion

There are several conclusions that can be drawn out of research presented in this paper. First, transition processes in Croatia and other Central and Eastern European countries ended with deep financial integration with the global financial market. Deep financial integration, difference in interest rates in Croatia and Switzerland, lack of regulation of credit institution and unrecognized properties of the Swiss franc resulted in significant portions of loans with the foreign cur-

rency clause to households. Second, since the Swiss franc had appreciated risk arising out of exposure to Swiss franc have started to materialize in the form of credit risk after 2010. Private individuals are exposed to Swiss franc appreciation and that has begged the question of moral hazard. Third, in order to determine the CHF/HRK behaviour pattern, several ARCH-based model are specified and tested. Evaluating the models through standard information criteria component ARCH (1,1) is found to be the best-fitting model. Asymmetric CHF/HRK volatility pattern toward CHF appreciation with dominant long run component calls for additional regulations of LFCC approval and special treatment of exposures arising out of long run CHF/HRK exchange rate dynamics. Eventually, potential future regulation should take into account long run perspective and not only the holding periods of ten days like it is often the case in financial institutions and corresponding risk management regulation standards.

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