# The effects of exchange rate uncertainty on export and import volume in Albania

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## Abstract

We investigate the effects of exchange rate uncertainty on export (import) in the context of a vector auto regression model. We measure the uncertainty of exchange rate using the GARCH model, more precisely the conditional standard deviation of the forecast error of exchange rate. We use monthly data from January 2009 to June 2017. The results suggest that exchange rate uncertainty have a negative insignificant effect on export and a positive significant effect on import.

**Keywords:** Exchange rate uncertainty, Export, Import, GARCH model, VAR model.

## Introduction

The macroeconomic effects of exchange rate uncertainty, especially on trade flows, have received considerable attention since and the adoption of floating exchange rates. In recent years, substantial empirical evidences about the impact of exchange-rate volatility on international trade were found in many previous studies (Holly, 1995; Arize, Osang, and Slottje, 2000; Cho, Sheldon, and McCorriston, 2002; Aftab and Aurangzeb, 2002; Arize, Malindretos, and Kasibhatla, 2003; Rahman and Serletis, 2009; Caporale, Ali and Spagnolo, 2015). Most of the literature on exchange rates and exchange rate uncertainty has been specialized in the area of international finance or international trade and on the effects of uncertainty on export activity foreign direct investment. To model uncertainty have been used different methods, but in the last few years the GARCH model have got a lot of popularity. In most studies, exchange rate uncertainty has had a negative impact on export activity and foreign direct investment (Ruiz, 2005).

The present paper makes contribution to the existing literature by investigating the effect of exchange rate uncertainty on export and import using vector autoregression methodology, VAR model. We use the conditional variance of a GARCH (1, 1) model to measure the uncertainty of exchange rate. We estimate the model using monthly data of nominal exchange rate of euro to Albanian Lekë, Albanian export and import. The remainder of the paper is organized as follows. In Section 2 provides a description of the econometric methodology used; Section 3 presents the data employed on this study; Section 4 display empirical results and finally in Section 5 we get the conclusions.

## Methodology

### *Unit roots*

In order to use Granger causality test we want to ensure the stationarity or weak stationarity of the time series. For this reason we first applied Augmented Dicker Fuller (ADF) test. The null hypothesis of ADF test is the existence of unit root against the alternative hypothesis of no unit root. The null hypothesis is rejected if the statistic test is greater than the critical value.

### Cointegration Test

To test for cointegration, Johansen Juselius technique was applied. Cointegration check if model reveals meaningful empirical relationship. The condition for testing of cointegration is that the series must be integrated of same order. Cointegration might be characterized by two or more $I(1)$ variables indicating a common long-run development, i.e. they do not drift away from each other except for transitory fluctuations.

Let $x$ and $y$ be two $I(1)$ processes. if there exists a parameter $b$ so that the linear combination

$$y_t - bx_t = z_t + a$$

is stationary, then $x$ and $y$ are cointegrated. Cointegration of $x$ and $y$ implies that both variables follow a common stochastic trend which can be modelled as a random walk (G. Kirchgässner, J. Wolters and U. Hassler, 2013)..

*Lemma:* If $x$ and $y$ are $I(1)$ and cointegrated, $x$ is Granger causal to $y$ and/or $y$ is Granger causal to $x$ (G. Kirchgässner, J. Wolters and U. Hassler, 2013).

### Granger Causality

According to the concept of Granger's causality test (1969, 1988), a time series $x_t$ Granger-causes another time series $y_t$ if series $y_t$ can be predicted with better accuracy by using past values of $x$.

Let $I_t$ be the total information set available at time $t$ and let $x$ and $y$ be two stationary variables. To test for simple causality from $x$ to $y$, it is examined whether the lagged values of $x$ in the regression of $y$ on lagged values of $x$ and $y$ significantly reduce the error variance. By using OLS, the following equations are estimated:

$$y_t = \alpha_{0,1} + \sum_{k=1}^{k_1} \alpha_{11}^k y_{t-k} + \sum_{k=1}^{k_2} \alpha_{12}^k x_{t-k} + u_{1,t}$$

$$x_t = \alpha_{0,2} + \sum_{k=1}^{'} \alpha_{21}^{k} x_{t-k} + \sum_{k=1}^{'} \alpha_{22}^{k} y_{t-k} + u_{2,t}$$

To test for simple causality from $x$ to $y$ an F test is applied to test the null hypothesis $H_0: \alpha_{12}^{1} = \alpha_{12}^{2} = \cdots = \alpha_{12}^{k_2} = 0$. In similar way proceed to test the causality from $y$ to $x$ (G. Kirchgässner, J. Wolters and U. Hassler, 2013).

To find out the appropriate lag length for each pair of variables we use lag order selection method.

**VAR model**

Let $X$ be a vector stochastic process. A vector autoregressive of order p can be described as

$$X_t = \delta + A_1 X_{t-1} + A_2 X_{t-2} + \ldots + A_p X_{t-p} + U_t$$

Where $A_i$ are k-dimensional quadratic matrices, $\delta$ is the vector of constant terms and U is a k-dimensional vector of residuals at time t, $E[U_t] = 0, E[U_t U_t'] = \Sigma_{uu}, E[U_t U_s'] = 0 \; for \; s \neq t$. The error correction representation of stationary VAR(p) model is

$$A_{p-1}^{*}(L)\Delta X_t = \delta - A(1)X_{t-1} + U_t,$$

where $A_{p-1}^{*}(L) = I_k - A_1^{*}L - \ldots - A_{p-1}^{*}L$. (G. Kirchgässner, J. Wolters and U. Hassler, 2013)

**Data**

The data consist of monthly nominal exchange rate (e) of Euro against Albanian Lekë, monthly consumer price index (CPI) export (E)and import (I) on Albania . The time series cover the period from January 2009 to June 2017, i.e. 105 observations for variables. Consumer Price Index (CPI) measures prices of a representative fixed basket of goods and services purchased by a typical consumer. The data sets of exchange rate are obtained from Banka of Albania, which is the monetary authority of Albania, and the data set of inflation, export and import is obtained from INSTAT (Institute of Statistics in Albania).

**Empirical analysis**

**Preliminary analysis of the data**

First we give a statistical analysis of the time series in order to show some general property of the series. As showed by table 1

Table 1

| Variable | Mean | St. Dev. | Skewness | Kurtosis | Jarque-Bera | P-value |
|---|---|---|---|---|---|---|
| Euro/All | 137.98 | 3.11 | -1.66 | 5.75 | 81.62 | 0.000 |
| CPI | 314.08 | 16.99 | -0.31 | 2.08 | 5.40 | 0.06 |
| Export | 17.76 | 4.65 | -0.65 | 2.63 | 8.15 | 0.01 |
| Import | 44.05 | 6.56 | -0.10 | 2.44 | 1.54 | 0.46 |

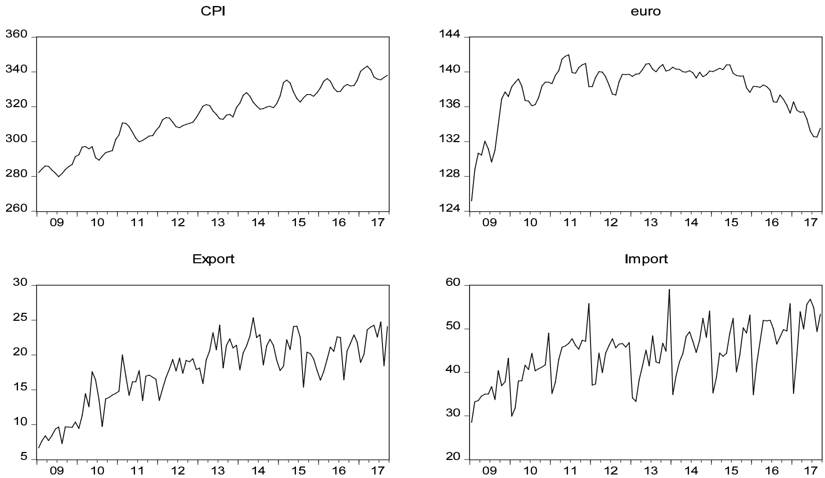

Figure 1. Graph of the time series.

Table 2

| | Euro/All | | CPI | | Export | | Import | |
|---|---|---|---|---|---|---|---|---|
| ADF test statistic | Level | First Diff. | Level | First Diff. | Level | First Diff. | Level | First Diff. |
| t-Statistic (p-value) | -2.845 (0.055) | -7.881 (0.000) | -2.936 (0.156) | -3.698 (0.027) | 1.429 (0.961) | -2.012 (0.042) | -1.410 (0.574) | -3.168 (0.025) |
| Test critical values: | 1% level | | -3.503 | | | | | |
| | 5% level | | -2.893 | | | | | |
| | 10% level | | -2.583 | | | | | |

**Measuring exchange rate uncertainty**

Before we give the empirical results it is necessary to draw an efficient measure of exchange rate uncertainty. In this paper uncertainty is peroxide by the estimated one-step ahead conditional variance from GARCH models of exchange rate. GARCH model estimate a time varying residual variance that corresponds well to the notion of uncertainty.

the process $\sigma_t^2 = a_0 + a_1 u_{t-1} + a_2 \sigma_{t-1}^2$.
The GARCH estimation of exchange rate is presented below
$e_t = 10.297 + 0.999 e_{t-1} + u_t$
and

$$\sigma_t^2 = \underset{(8.86E+14)}{0.027} + \underset{(4.32E+15)}{0.071 u_{t-1}} + \underset{(2.49E+16)}{0.863 \sigma_{t-1}^2}$$

t-statistic is display in breaches.
LB(4) =7.593(0.108), LB(8)=13.479(0.09), $LB^2$(4)=1.281(0.88), $LB^2$(8)=7.67(0.466), where LB is the Ljubian-Box test of the residual, $LB^2$ is the Ljubian-Box test of the squared residual and the p-value on the breaches.

**Effect of exchange rate on export and import.**
We use the conditional variance of exchange rate to the equation of export and import to evaluate the impact of exchange rate uncertainty over these variables.
Since the time series are integrated of order one, I(1), see table 2, except of conditional variances which is stationary, we use Johansen method to test the series for cointegrating vectors.
As we can see from table 3, Trace test suggests for too cointegration equations, but the Maximum Eigenvalue test indicate one cointegrated equation.

Table 3 Johansen cointegration test

| Cointegration Rank Test (Trace) | | | | |
|---|---|---|---|---|
| No. of CE(s) | Eigenvalue | Trace statistic | Critical value (0.05) | P-value |
| None | 0.3440 | 76.206 | 47.856 | 0.000 |
| At most 1 | 0.1869 | 33.193 | 29.797 | 0.019 |
| At most 2 | 0.1095 | 12.077 | 15.494 | 0.153 |
| Cointegration Rank Test (Maximum Eigenvalue) | | | | |
| No. of CE(s) | Eigenvalue | Max-Eigen. statistic | Critical value (0.05) | P-value |
| None | 0.3440 | 43.013 | 27.584 | 0.0003 |
| At most 1 | 0.1869 | 21.115 | 21.131 | 0.0503 |
| At most 2 | 0.1095 | 11.835 | 14.264 | 0.117 |

The normalized cointegration equation of export is
$Ex = -0.601I + 0.495e + 0.379CPI$
and the normalized cointegration equation for import is

For the export we obtain the following estimation

$$\Delta(Ex) = -0.07(\ Ex\_(-1) + 3.02Im(-1) - 0.75e(-1) - 0.92CPI(-1) + 241.06$$
$$0.56\Delta Ex(-1) - 0.35\Delta Ex(-2) - 0.36\Delta Ex(-3) + 0.12\Delta Im(-1)) + 0.11\Delta Im(-2$$
$$0.07\Delta Im(-3) + 0.19\Delta e(-1)) + 0.24\Delta CPI(-3) + 0.19\sigma_t^2$$

$R^2 = 0.51, DW = 2.019$

The conditional variance term is positive and insignificant in the export price equation, suggesting that higher conditional variability in the exchange rate reduces the exports. For the import we obtain the following estimation

$$\Delta Im = -0.68(\ Ex(-1) + 0.69Im(-1) + 0.008e(-1) - 0.29CPI(-1) + 44.03) + 0.66\Delta Ex(-1) + 0.39\Delta Ex(-2)) - 0.36\Delta Im(-1) - 0.32\ \Delta Im(-2) + 0.97\Delta e(\ -1) - 1.33\Delta CPI(-1) + 2.86 - 2.78\sigma_t^2.$$

$R^2 = 0.55, DW = 2.16$

The conditional variance term is negative and significant in the import price equation, suggesting that higher conditional variability in the exchange rate raise the import.

Table 4 display the results of Granger Causality test. As can be seen this test shows that are one way Granger causality from exchange rate uncertainty to export and import in Albania.

Table 4 Pairwise Granger Causality Test

| Null Hypothesis | Obs | F-statistic | P-value |
|---|---|---|---|
| Im does not Granger cause $\sigma_t^2$ | 103 | 2.972 | 0.055 |
| $\sigma_t^2$ does not Granger cause Im | 102 | 6.984 | 0.001 |
| Ex does not Granger cause $\sigma_t^2$ | 102 | 0.610 | 0.54 |
| $\sigma_t^2$ does not Granger cause Ex | 102 | 5.260 | 0.006 |

## Conclusions

In this paper we used econometrics methods to investigate the effects of exchange rate uncertainty on export and import for the Albania country. First, we measure the exchange rate uncertainty by using the GARCH model estimators in order to generate a conditional variance time series for the exchange rate. Our results suggest that a more volatility exchange rate does have a significant positive effect on import, but a negative insignificant effect on export.

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