Comparison of the Effects of the Volatility of the Exchange Rate on the Business Environment in Iran and Selected European Countries

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ARTICLE INFO
Article history:
Received 12 November 2014
Received in revised form 26 December 2014
Accepted 16 January 2015
Available online 18 February 2015

Keywords:
Exchange Rate Volatility, Business Environment, Panel Data.

ABSTRACT

Background: The main purpose of this paper is to compare the effects of the volatility of the exchange rate on the business environment in selected European countries and Iran for the period of 1999-2011. For this purpose, first the model of the business environment was determined and then the volatility of the exchange rate was calculated using the generalized autoregressive conditional heteroskedasticity model and then its effects on the business environment was examined using panel data. Calculations show that the volatility of the real exchange rate has a significant negative effect on the business environment in Iran and the selected European countries including Luxembourg, Portugal, Switzerland and Finland.

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INTRODUCTION

Volatility means unexpected changes. For exchange rates, these changes may be the result of various economic shocks, such as internal policies, which affect the nominal exchange rate and the level of the internal prices, thus destabilizing the real exchange rate [13].

In developing countries like Iran, macroeconomic variables such as growth, inflation and exchange rates, are usually in a state of flux. In particular, wide exchange rate fluctuations are among the characteristics of developing countries [8]. Fluctuations in exchange rate measure the strength and weakness of the currency of a country against foreign currencies. Prevention of deviation of the real value of the currency from its equilibrium leads to the reduction of disorders in other internal prices and increase in welfare and productivity [5]. Choosing appropriate exchange policies in the developing countries has always been a problem. Disputes are centered on the volatility of the exchange rates when facing internal and external shocks. Volatility of the exchange rates has a fundamental role in the country's economic behavior [15].

From 1973, when exchange rates were universally considered as floating, or managed floating, there have been attempts to identify the variables that could explain their volatility. To reach their theoretical and empirical goals, economists have concentrated on the real exchange rate. Accordingly, analysis of the behavior of the real exchange rate in any economic system is of especially great importance because determination of effective variables on the real exchange rate is helpful in economic policy making [7].

The word “business” has many definitions. In plain words, business includes the production and purchase of goods and services with the aim of selling them for profit. A business is characterized by the production and sale or transfer of goods and services for revenue, number of transactions, profit and risky activities [12].

A precise definition of business environments is not available, but a useful description is that a business and investment environment is the political, institutional and behavioral environment that affects output and economic and investment activities. The meaning of a business environment is very close to what, in economic literature, is referred to as a model institution or social foundation. Such institutions and social foundations have led economists into generating economic policies, creating jobs and opportunities to invest efficiently, thus expanding their activities [10]. In this paper, we attempt to investigate whether volatility of the exchange rate affects the business environment in Iran and selected European countries (Luxembourg, Portugal, Switzerland
and Finland). To this end, in section 2 we review studies in the field of behavior and volatility of the exchange rate, and the business environment. In section 3 we propose a model for the environment and, in section 4 we estimate its parameters. A conclusion is offered in the final section.

- **Literature:**

Several studies on the effects of volatility in the exchange rate in Iran have been carried. Barghandan and Nadjafi [2], investigated the effects of the deviation of the exchange rate on the support of the producer index in the agricultural sector. They showed that in Iran the real exchange rate deviates from its equilibrium amount and that deviation has a significant effect on the calculated value of the producer's support index as well as the market price support index. Kazerouni and Doulati [8], in their study, examined the relationship between uncertainty of the real exchange rate and private investment in Iran during 1961-2002. They showed that the effect of exchange rate uncertainty is negative on private investment in both short and the long runs. Results of co-integration are also an indication of a long run equilibrium relation between the variables. Kha' and Mousavynik [9], confirmed the opinion of Aghiyoon et al with regard to the role of financial development in the theories of exchange rate volatility on economic growth. Iran has experienced a dramatic period of financial development, and its capital market is considered one of the most developed in the Middle East. The expansionary policies have been positive on the growth of output; Mortazavi et al [72x79] examined the relationship between the parameters of the elasticity of output, and the producer market price support index. Khezry [10] examined and analyzed the most important losses incurred due to the fifth plan bill in Iran with regard to the business environment. He reached the conclusion that although policies for improvement of the business environment and easing of economic activities have been suggested in the fifth plan bill, there is an imperfect understanding of the framework of the business environment. According to the 2005 World Bank report, among the more important factors that limit the
business environment are uncertainty in policies, instability in macroeconomic policies, tax rates, political and economical corruption, the cost of obtaining credit and finance, political instability, inflation, exchange rate and crime. (World Bank, 2003). The World Bank report and extensive research on business environments show that economic variables fare better in countries which have a better business environment. Reports (domestic and foreign) and testimonies (written and oral) seem to indicate that the business environment in Iran is not quite satisfactory. Jafar-Eskandari et al.[6] recall Clarke’s opinion that “whatever that is influential on industrial units but is not part of the unit is the business environment”. They maintain that countries can be classified into three groups: a) countries with an open business environment, b) countries with a neutral business environment and c) countries with an inhibiting business environment.

There are many studies on exchange rate in the literature. Kiat[11], in his article “The effect of exchange rate and inflation on foreign direct investment and its relationship with economic growth in South Africa” showed that FDI follows economic growth, but the reverse is not necessarily true. Inflation has a negative impact, while the effect of exchange rate is debatable. He also found that while other emerging markets are actively pursuing foreign direct investment (FDI) and taking advantage of its spillover effect, South Africa is losing out on the opportunity. Omankhanlen[14], in his article, “The effect of exchange rate and inflation on foreign direct investment and its relationship with economic growth in Nigeria”, reached the same results. He concluded that FDI follows economic growth occasioned by trade openness and while inflation has no effect on FDI, exchange rate does. Wang and Barrett[17], in their article, “Estimating the effects of exchange rate volatility on export volumes”, examined and estimated the effect of exchange rate volatility on international trade flows by using Taiwan’s exports to the United States from 1989-1999 as a case study. They found that change in both the importing country’s industrial production and the expected exchange rate jointly drive trade volumes. These results differ significantly from those obtained using more conventional and restrictive modeling assumptions. Baum and Caglayan[3] in their article, “The volatility of international trade flows and exchange rate uncertainty”, showed that exchange rate uncertainty has a consistent positive and significant effect on the volatility of bilateral trade flows. These effects differ markedly for trade flows between industrialized countries and NICs, and are not mitigated by the presence of the Eurozone. Contrary to earlier findings, their results also suggest that exchange rate uncertainty does not affect the volume of trade flows of either industrialized countries or NICs.

Tims and Mahieu[16], in their article, “A range-based multivariate model for exchange rate volatility”, established a range-based multivariate model for exchange rate volatility and concluded that exchange rate news seem to be very currency-specific. The model allows them to identify which currency contributes most to both exchange rate levels and exchange rate volatilities.

Huchet-Bourdon and Korinek[4], in their article, “To what extent do exchange rates and their volatility affect trade”? They showed that trade deficits and surpluses can sometimes be attributed to intentionally low or high exchange rate levels. Their study examines the impact of exchange rates and their volatility on trade flows in China, the Euro area and the United States in two broadly defined sectors, agriculture and manufacturing and mining. They find that exchange volatility impacts trade flows only slightly. On the other hand, exchange rate levels affect trade in both agriculture and manufacturing and mining sectors but do not explain the trade imbalances in the three countries examined in their entirety.

Arize, Osang and Slottje[1], in their article, "Exchange –rate volatility and foreign trade: evidence from thirteen LDC’s", empirically investigated the impact of real exchange-rate volatility on the export flows of 13 less developed countries (LDC’s) over the quarterly period 1973-1996. The results showed that increase in the volatility of the real effective exchange rate; approximating exchange-rate uncertainty, exert a significant negative effect on export demand in each of the 13 LDC’s in both the short and the long runs. Moreover these effects may result in significant reallocation of resources by market participants.

- **The model:**

In order to investigate the effects of exchange rate volatility on the business environment, we must first estimate the parameters of model of exchange rate volatility. Hence we begin this section by estimating the pattern of exchange rate volatility using GARCH and then consider the effect of this volatility on the business environment.

The generalized auto-regressive conditional heteroskedasticity model is a generalization of the Auto-regressive conditional heteroskedasticity model.

Different models of GARCH have been recently used to estimate uncertainty. In this model the conditional variance, based on the information of the previous period and lagged prediction error changes, and this is an indication of uncertainty of the exchange rate.

The simplest model suggested for conditional variance is the ARCH (q) model suggested by Engle (2007), in which the conditional variance is the weighted average of lagged squares prediction error.
where $v_t$ is white noise.

This equation is generalized as follows:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i}$$

Where $h_t$ is the conditional variance of disturbance term $\{\epsilon_t\}$.

The most general form of conditional volatility GARCH (1, 1) is:

$$h_t = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \beta_1 h_{t-1}$$

For the GARCH (p, q) model of a higher order, the conditional variance is attainable only if the following condition holds.

$$1 - \sum_{i=1}^{q} \alpha_i - \sum_{i=1}^{p} \beta_i > 0$$

Also, to get the most appropriate ARCH or GARCH models we use the Akaike and Schwartz-Bayzin criteria.

After identification of the appropriate model for examining the volatility of the exchange rate, we seek identification of the appropriate model for the business environment so that the resulting volatility of the real exchange rate, is a variable in a GARCH model. The effects of the exchange rate volatility can then be estimated.

The models of Daft and Clarke (2003) as well as the approach of Sachs and Arthur (2001-2002) were used to model the theoretical business environment.
Fig. 2: Theoretical model of effective factors on business environment using the Clarke model

With regard to the above models, the business environment depends on several variables. In each instance, appropriate indices are designed to quantify the above model and hence estimate the final model. In a study by Moradhassel et al. (2008) for examining the effects of information and communications technology on the business environment, they proposed the following model:

$$BE_{it} = \alpha_0 + \alpha_1 ICT_{it} + \alpha_2 GOV_{it} + \alpha_3 PROP_{it} + \alpha_4 TAX_{it} + \epsilon_{it},$$

(5)

Where $BE_{it}$ is the business environment index, $ICT_{it}$ is the information and communications technology index, $GOV_{it}$ is the size of the government, $PROP_{it}$ is the legal environment and $TAX_{it}$ is the tax system (government's tax burden on the economy).

In the present study, we use the real exchange rate index instead of the information and communications technology index. Also, for the index indicating the business environment, which is an exogenous variable, we use an index called economic freedom, which is a combination of different indices used by the information bank of the Heritage Institute. Property rights are used to calculate the legal index $PROP_{it}$ and $ICT_{it}$, which is the information and communications technology index based on the index of internet penetration coefficient, specified as the number of internet users per thousand people in the country and a share of GDP expenditures. The tax index $TAX_{it}$ is used to indicate the tax system of the country. $GOV_{it}$, the index of government size, is the ratio of government expenditure to GDP. As government is one of the most important factors in determining economic activities, this variable is an indication of the prevailing economic environment of the country.

4. Model estimation:
4.1. GARCH method:

In order to estimate the pattern for exchange rate volatility we use a generalized auto-regressive conditional heteroskedasticity model known as GARCH.
Before determining a behavioral equation for the exchange rate, we first examine the stationarity of the data.

Results of the ADF test show that real exchange rate variables for Portugal and Switzerland are stationary at the 5% level.

The model for portrayal of the exchange rate behavior is obtained using the Box-Jenkins method. The models for the five countries are as follows:

\[
\text{DREX}_t = -11.469 + 0.493 \text{REX}_{t-1} - 0.103 u_{t-1} - 0.84 u_{t-2} + u_t \\
\text{DREX}_t = -0.065 - 0.512 \text{REX}_{t-1} + 0.945 u_{t-1} + u_t \\
\text{REX}_t = 88.743 + 0.868 \text{REX}_{t-1} + 0.612 u_{t-1} + u_t \\
\text{REX}_t = 100.02 + 0.406 \text{REX}_{t-1} + 0.759 u_{t-1} + u_t \\
\text{DREX}_t = -0.440 + 0.933 \text{REX}_{t-1} - 0.495 u_{t-1} - 0.496 u_{t-2} + u_t \\
\]

The results show that the exchange rate behavioral equation for Iran is of the type ARIMA (1, 2), for Luxembourg it is ARIMA (1, 1), for Portugal ARIMA (1, 1) and for Finland ARIMA (1, 2).

To check for heteroskedasticity, we use the ARCH LM Test. If the null hypothesis \( H_0 \) is rejected, we may presume that we have heteroskedasticity and we may use an ARCH or a GARCH model. The \( p \)-values are shown in Table 1.

\[
\begin{array}{|l|l|l|l|l|}
\hline
\text{Countries} & \text{Finland} & \text{Switzerland} & \text{Portugal} & \text{Luxembourg} & \text{Iran} \\
\hline
\text{P-value} & 0.0132 & 0.0016 & 0.0237 & 0.0354 & 0.0749 \\
\hline
\end{array}
\]

In fact \( H_0 \) is rejected for Iran at the level of 10% and for Luxembourg, Portugal, Switzerland and Finland at the level of 5%.

Numbers below the parenthesis in each equation show the values of the \( t \)-statistics. Models for several countries that can be used for computing the volatility of foreign exchange based on the Akaike criteria and Schwartz Bayesian criteria are shown in the following tables.

\[
\sigma^2 = 3.199843 + 0.545809 e_{t-1} + 0.377301 \sigma^2_{t-1} \\
(0.294332) (1.198431) (2.109529)
\]

In equation (11), 30199843 is the intercept. 0.545809e_{t-1} is the coefficient of resid(-1)^2 and 0.377301\sigma^2_{t-1} is the coefficient of GARCH(-1).

\[
\begin{array}{|l|l|l|l|l|}
\hline
\text{Criterion} & \text{Model1 ARCH} & \text{Model2 GARCH} & \text{Model3 GARCH} & \text{Model4 GARCH} \\
\hline
\text{Schwarz} & 10.70062 & *10.00308 & 10.53465 & 11.19712 \\
\text{Akaike} & 10.43117 & *9.688831 & 10.17551 & 10.92776 \\
\hline
\end{array}
\]

According to the results of Table 2, the appropriate model is GARCH (1,1). Results of estimation of the GARCH (1, 1) are as follows:

\[
\sigma^2 = 0.413922 + 0.277612 e_{t-1} - 0.312676 e_{t-1} + 0.877438 \sigma^2_{t-1} \\
(1.139540) (0.890603) (-0.972398) (4.082101)
\]

In equation (12), 0.413922 is the intercept. 0.277612e_{t-1} is the coefficient of resid(-1)^2 and 0.877438\sigma^2_{t-1} is the coefficient of GARCH(-1).

\[
\begin{array}{|l|l|l|l|l|}
\hline
\text{Criterion} & \text{Model1 ARCH} & \text{Model2 GARCH} & \text{Model3 GARCH} & \text{Model4 GARCH} \\
\hline
\text{Schwarz} & 4.614458 & 4.666243 & *4.555648 & 4.571637 \\
\text{Akaike} & 4.389994 & 4.396885 & *4.221398 & 4.347172 \\
\hline
\end{array}
\]

\[
\sigma^2 = 0.265899 + 0.367480 e_{t-1} + 0.500848 \sigma^2_{t-1} \\
(1.204321) (0.890603) (4.082101)
\]

We see that in equation (12) only the coefficient of \( \sigma^2_{t-1} \) is significant.

\[
\begin{array}{|l|l|l|l|l|}
\hline
\text{Criterion} & \text{Model1 ARCH} & \text{Model2 GARCH} & \text{Model3 GARCH} & \text{Model4 GARCH} \\
\hline
\text{Schwarz} & 5.265899 & 5.367480 & *5.304321 & 5.203854 \\
\text{Akaike} & 5.043706 & 5.100848 & 4.993252 & 4.981662 \\
\hline
\end{array}
\]
\[
\sigma^2 = -0.007944 + 0.354079 e_{t-1} - 0.554517 e_{t-2} + 1.163494 \sigma^2_{t-1} \\
(-0.020350) (0.716689) (-0.954110) (2.794503) \tag{13}
\]

We see that in equation (13) only the coefficient of \(\sigma^2_{t-1}\) is significant.

Table 5: Selection of the model for Switzerland based on model selection criteria:

<table>
<thead>
<tr>
<th>CRITERION</th>
<th>MODEL 1 ARCH</th>
<th>MODEL 2 GARCH</th>
<th>MODEL 3 GARCH</th>
<th>MODEL 4 GARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHWARZ</td>
<td>5.991434</td>
<td><strong>5.821512</strong></td>
<td>5.991651</td>
<td>6.108453</td>
</tr>
<tr>
<td>AKAIAKE</td>
<td>5.769242</td>
<td><strong>5.54881</strong></td>
<td>5.680581</td>
<td>5.886261</td>
</tr>
</tbody>
</table>

\[
c^2 = 17.60917 + 0.653161 e_{t-1} - 0.971840 \sigma^2_{t-1} \\
(2.673478) (1.909692) (-10.10551) \tag{14}
\]

We see that in equation (14) only the intercept is significant.

Table 6: Selection of the model for Finland based on model selection criteria:

<table>
<thead>
<tr>
<th>CRITERION</th>
<th>MODEL 1 ARCH</th>
<th>MODEL 2 GARCH</th>
<th>MODEL 3 GARCH</th>
<th>MODEL 4 GARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHWARZ</td>
<td>6.305387</td>
<td>6.273033</td>
<td>6.382736</td>
<td>6.373878</td>
</tr>
<tr>
<td>AKAIAKE</td>
<td>6.036029</td>
<td><strong>6.598783</strong></td>
<td>6.023592</td>
<td>6.104521</td>
</tr>
</tbody>
</table>

\[
s^2 = 21.78162 + 0.523222 e_{t-1} - 0.738832 \sigma^2 \\
(2.478983) (2.314021) (-1.443275) \tag{15}
\]

We see that in equation (15) the intercept and the coefficient of resid \((-1)^2\) are significant.

4.2 - The panel data method:

An appropriate equation for examining the effect of the exchange rate volatility on the business environment in Iran and in selected European countries is as follows:

\[
\text{BE}_{it} = \alpha_0 + \alpha_1 \text{uncr}_{it} + \alpha_2 \text{gov}_{it} + \alpha_3 \text{prop}_{it} + \alpha_4 \text{tax}_{it} + \epsilon_{it}, \tag{16}
\]

Where \(\text{BE}_{it}\) is the business environment index, \(\text{uncr}_{it}\) is real exchange rate volatility, \(\text{gov}_{it}\) is the government size, \(\text{prop}_{it}\) is the legal environment index and \(\text{tax}_{it}\) is the tax system index.

Using the GARCH method, first the exchange rate volatilities for the five countries under study are obtained and entered into the business environment function as variables. The panel method is then used to examine the effect of the exchange rate volatility on the business environment.

According to Chow test the fixed effect method is applicable. The results of which are shown in table 7.

Table 7: Results obtained from Chow test

<table>
<thead>
<tr>
<th>P-value</th>
<th>d.f.</th>
<th>Statistic</th>
<th>Effects Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0475</td>
<td>4,56</td>
<td>2.571987</td>
<td>Cross-section F</td>
</tr>
<tr>
<td>0.0270</td>
<td>4</td>
<td>10.962668</td>
<td>Cross-section Chi-square</td>
</tr>
</tbody>
</table>

Now, using the test for correlated random effects (Hausman test) it is clear that the model has fixed effects: (Table 8)

Table 8: Results obtained for examining the fixed and random effects

<table>
<thead>
<tr>
<th>P-value</th>
<th>d.f.</th>
<th>Chi-Sq. Statistic</th>
<th>Test Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0358</td>
<td>4</td>
<td>10.287949</td>
<td>Cross-section random</td>
</tr>
</tbody>
</table>

The results of the Panel test are shown in Table 9.

Table 9: Results obtained from the panel data method for estimation of the business environment in Iran and selected European countries

<table>
<thead>
<tr>
<th>P-Value</th>
<th>t-Statistics</th>
<th>Coefficient</th>
<th>Independent</th>
<th>Dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0921</td>
<td>-1.714</td>
<td>-0.087</td>
<td>1.96e-09</td>
<td>0.7829</td>
</tr>
<tr>
<td>0.7829</td>
<td>0.277</td>
<td></td>
<td>gov</td>
<td>Government's size</td>
</tr>
<tr>
<td>0.7810</td>
<td>-0.279</td>
<td>-0.337</td>
<td>prop</td>
<td>Legal environment</td>
</tr>
<tr>
<td>0.0089</td>
<td>-3.504</td>
<td>-2.355</td>
<td>tax</td>
<td>Tax index</td>
</tr>
<tr>
<td>0.7%</td>
<td>R-Squared</td>
<td>5</td>
<td>No. of countries</td>
<td></td>
</tr>
</tbody>
</table>

We see that real exchange rate volatility has a significant negative effect (at the significance level) on the business environment and this shows that as the real exchange rate volatility increases, the business environment
index decreases. The tax system index also has a significant negative effect but the effect of government size is positive. The effect of legal environment is insignificant.

Conclusion:
In this study the effect of exchange rate volatility in Iran and selected European countries were examined. To this end, first the real exchange rate volatility in Iran and in selected European countries was estimated using the GARCH method and then the value was entered into the business environment function, and the effects of these fluctuations on the business environment were identified using the panel data method. The results obtained show that in all cases the size of the government has a positive effect on the business environment. Also, the legal index has a negative but insignificant effect on the business environment. The tax system index has negative but significant effect on the business environment. Moreover, real exchange rate volatility has a negative but significant effect on the business environment. This shows that the effect of exchange rate volatility on the business environment is not related to the degree of development of the countries. Therefore to have desired business environment this is a variable we need to control and, if possible, minimize.

REFERENCES

APPENDIX:

Appendix 1: Stationarity test of the real exchange rate: Dickey Fuller’s Augmented Test (ADF):

<table>
<thead>
<tr>
<th>COUNTRIES</th>
<th>IRAN</th>
<th>LUXEMBOURG</th>
<th>PORTUGAL</th>
<th>SWITZERLAND</th>
<th>FINLAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-Statistics at 5%</td>
<td>-1.456657</td>
<td>-2.516761</td>
<td>-4.107092</td>
<td>-3.767221</td>
<td>-1.133174</td>
</tr>
<tr>
<td>t-Statistics in differenced</td>
<td>-4.535175</td>
<td>-5.819202</td>
<td>-</td>
<td>-</td>
<td>-5.745575</td>
</tr>
<tr>
<td>Stationarity</td>
<td>I(1)</td>
<td>I(1)</td>
<td>I(0)</td>
<td>I(0)</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

Appendix 2: ARCH LM TEST for Iran:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Prob. f(1,31)</th>
<th>prob. chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>f-statistic</td>
<td>3.397463</td>
<td></td>
<td>0.0749</td>
</tr>
<tr>
<td>obs*r-squared</td>
<td>3.259434</td>
<td></td>
<td>0.0710</td>
</tr>
</tbody>
</table>

Appendix 3: ARCH LM TEST for Luxembourg:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Prob. f(1,31)</th>
<th>prob. chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>f-statistic</td>
<td>4.888739</td>
<td></td>
<td>0.0345</td>
</tr>
<tr>
<td>obs*r-squared</td>
<td>4.095237</td>
<td></td>
<td>0.0340</td>
</tr>
</tbody>
</table>

Appendix 4: ARCHLM TEST for Portugal:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Prob. f(1,31)</th>
<th>prob. chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>f-statistic</td>
<td>5.639028</td>
<td></td>
<td>0.0237</td>
</tr>
<tr>
<td>obs*r-squared</td>
<td>5.093834</td>
<td></td>
<td>0.0240</td>
</tr>
</tbody>
</table>

Appendix 5: ARCHLM TEST for Switzerland

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Prob. f(1,31)</th>
<th>prob. chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>f-statistic</td>
<td>0.0016</td>
<td>11.94647</td>
<td>9.242609</td>
</tr>
<tr>
<td>obs*r-squared</td>
<td>0.0024</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix 6: ARCHLM TEST for Finland

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Prob. f(1,31)</th>
<th>prob. chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>f-statistic</td>
<td>6.916285</td>
<td></td>
<td>0.0132</td>
</tr>
<tr>
<td>obs*r-squared</td>
<td>6.019509</td>
<td></td>
<td>0.0141</td>
</tr>
</tbody>
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