Araştırma Makalesi
(Research Article)

Ege Üniv. Ziraat Fak. Derg., 2015, 52 (1): 85-92
ISSN 1018 – 8851

Gökhan ÇINAR [1]
Adnan HUSHMAT [2]
Ferrruh IŞIN [1]

Relationship Between Exports Of Processed Agricultural Products and Real Exchange Rate Shocks: The Case Of Turkey

İşlenmiş Tarım Ürünleri İhracatı ve Reel Dövüz Kuru Şokları İlişkisi : Türkiye Örneği

[1] Department of Agricultural Economics, Ege Üniversity, 35100 Izmir /Turkey
[2] Department of Business Administration, Antalya International University, 07058 Antalya/Turkey
e-mail:gokhan.cinar@ege.edu.tr

Alınış (Received): 02.09.2014 Kabul tarihi (Accepted): 04.02.2015

Key Words:

Exports, Processed Agricultural Products, Real Exchange Rate Shocks, VAR model

ABSTRACT

This study is performed to present the effects of real exchange rate shocks on exports of processed agricultural products in Turkey. Although there are a lot of studies on this topic, but none of them has focused solely on the processed agri-products. As processed agri-products are getting more popular, with a more focused approach this study will not only enrich the literature, but also help policy-makers in devising policies. Vector Autoregressive (VAR) model is used in this study. The findings are interpreted according to the impulse-response analysis and variance (forecast error) decomposition results. The results indicate that there is a significant relationship between real exchange rates and exports of processed agricultural products. This relationship is positive during the first quarter. However, later on, it becomes negative with a downward slope. On the other hand, the shocks of real exchange rate can explain only %0.2-0.7 of prediction error variance for exports of processed agricultural products. The findings can be useful in policy making.

Anahtar Sözcükler:

İhracat, İşlenmiş tarım ürünleri, Reel döviz kuru şoku, VAR model

ÖZET

Bu çalışma reel döviz kurunda oluşan şokların Türkiye'de işlenmiş tarım ürünleri ihracatı üzerine etkilerini ortaya koyabilmek için yapılmıştır. Bu konuda yapılmış birçok çalışma olmasına rağmen, bunların hiçbiri sadece işlenmiş tarım ürünlerine odaklanmamıştır. İşlenmiş tarım ürünlerine odaklanmış bu çalışma sadece literature zenginleştirmeyecek, aynı zamanda politikalar oluşturulması için politika yapanlara yardımcı olacaktır. Bu çalışmada VAR modeli ile kullanılmıştır. Bulgular; Etki-Tepki ve Varyans Ayrıştırma testi sonuçlarına göre yorumlanmıştır. Sonuçlar reel döviz kurları ve işlenmiş tarım ürünleri ihracatı arasında anlamlı bir ilişki olduğunu göstermektedir. Bu ilişki işlenmiş ürünlerde ilk üç aylık dönem için pozitif yönde olmaktadır. Ancak etki daha sonraki aylarda azalan eğilimli olarak devam etsede anlamını yitirmektedir. Öte yandan reel döviz kurlarında oluşan şoklar işlenmiş tarım ürünleri ihracatı öngörü hata varyansının ancak yaklaşık %0.2-0.7'ini açıklayabilmektedir. Bulgular politika yapımında yararlı olabilir.

INTRODUCTION

Agriculture based industry uses agri-products as raw material and process it to make finished goods having different attributes and qualities. This industry has given birth to the need of different processing procedures, storage methods and packing techniques. In the developed countries of the world, the most important sector during their transition from an agricultural economy to industrialization was this agri-based industry. This gave rise to the need of devising a formal policy for this sector at government level. Successful implementation of these policies will, not only, make the farmers financially strong, decrease the chances of famine and protect the consumers from

high prices but also increase trade and create employment opportunities.

In 1996, with the enactment of Customs Union Agreement (1/95 of the Association Council Decision), a custom union was formed between Turkey and the EU. In this agreement, agriculture products were excluded from the union whereas processed agri-products were included in it. According to this, processed agri-products are the ones that are not included in the agri-products list of the Roman Agreement; and consist of basic agri-products (like cereals, milk, sugar etc.). Chocolates, candies, baby foods, margarine, biscuits, pasta, ice-cream and fast foods are some of the examples. As a result of technological developments in food sector of Turkey, export oriented production has been started in this sector.

In 2000, the total agriculture exports of Turkey was $ 3.8 billion whereas, in 2012,with an increase of 4.15 times , it had reached to $16 billion. In 2000, the total agriculture imports were $4.1 billion whereas, in 2012, with an increase of almost 4 times, it had reached to $16.3 billion. These numbers show that Turkey is an import-oriented country (Figure 1).

Moreover, in 1994, the export volume of processed agri-products was $1.5 billion, whereas, in 2013, it was $9.3 billion, an increase of 5.86 times. In 2013, the import volume of these products was $3.8 billion. Furthermore, the rate of increase of the imports is much lesser than the rate of increase of the exports. Hence, in the sector of processed agri-products, Turkey is an export-oriented country (Figure 2).

Figure 1. Trade volume of total agriculture products

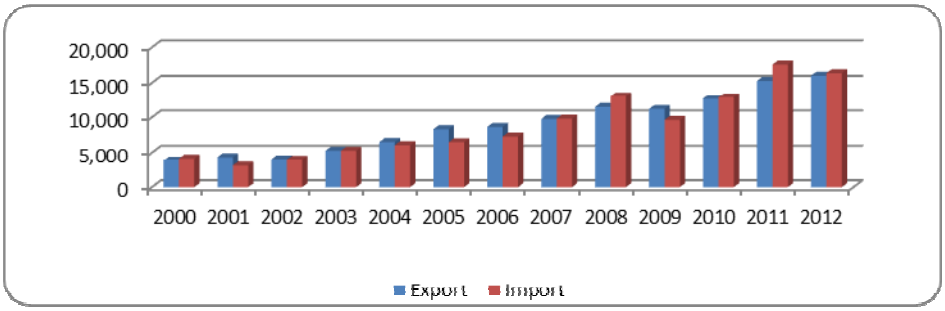
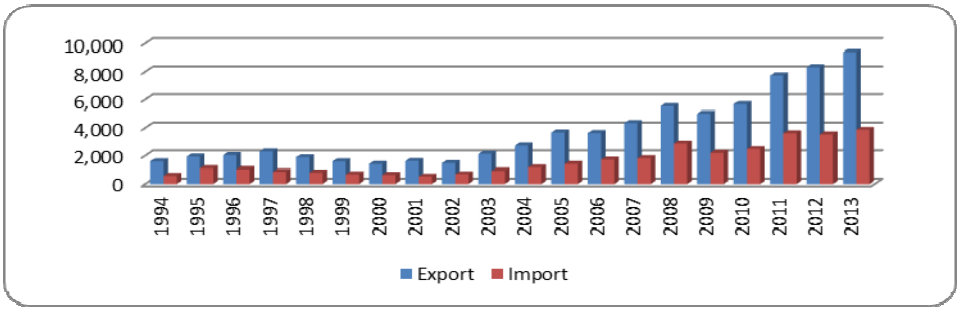


Figure 2. Trade volume of processed agri-products



Because of the biological structures, the agri-products that can't be stored for a long period, can be stored much longer after processing. Thus, the processed agri-products prevent losses; and increased stock levels bring stability in the trade. However, there are also other factors like income elasticity, trade restrictions, quotas that can effect trade. One of the most important factors is exchange rate volatility. It can effect the macroeconomic stability in developing countries more severely than developed countries. It is one of the basic factors that determine the competitive ability of a country in international market (Yılmaz and Kaya, 2007).

The purpose of this study is to analyze the impact of exchange rate shocks on agricultural trade in Turkey. Most of the previous studies in this area took both processed and unprocessed agri-products. The uniqueness of this study comes from the use of

processed agricultural products category only. BEC-Level 3 categorization is used. Total processed products from the product group code of 121/122 are used; and the effect of exchange rate volatility on processed agri-products is analyzed.

This was a brief introduction. In the second part, some literature review is given. In the next part, methodology is explained. Later on, findings and some discussion are provided. In the last part, a few concluding remarks are given.

PREVIOUS STUDIES

Globalization has made the world economies more sensitive to external factors. Integration among the countries has increased interdependence. Factors like inflation, interest rates, exchange rates, international capital mobility are in close relation with each other and this relation has increased the complexity of the world economy. These factors have become core issues for an economy, since unexpected changes in these variables can have considerable effects on the economic activity. Especially, the profitability and competitiveness of the international firms can be effected seriously due to the sudden changes in these factors. That's why all the stakeholders want to know whether there is significant high volatility in the markets or not, if there is then what is its degree and risk level, and how can they protect themselves.

The major part of financial volatility comes from exchange rate risk (Seyidoğlu, 2003). The volatility in exchange rate is one of the most important factor effecting international trade volume and quotas, both of them are important especially for developing countries. However, the effect of the changings in real exchange rate on foreign trade cannot be determined truly because of the delayed impact of imports on exchange rates (Durusoy and Tokatlıoğlu, 1997; Ay and Özşahin, 2007). This situation forced many researchers to work in this area.

In the field of agriculture economics, most of the studies that have analyzed exchange rate volatility and foreign trade relationship used all the exports or imports of a country. Pick (1990) found, there is a negative impact of exchange rate risk on the agricultural trade of USA with developing countries. Cho et. al. (2002) developed a model that included real exchange rate instability and found that the effect of exchange rate volatility on agriculture sector is far more serious than on other sectors. Kandilov (2008) extended the study of Cho et. al. (2002) and also took into account export subsidies. It resulted that the effect of exchange rate volatility is more on the exports of developing countries. The findings of Wang and Barret (2007) were in favor of a negative relation between exchange rate volatility and agricultural exports. Baek and Koo (2008) detected the effect of macro-economic variables on US agriculture trade balance in the long run. Erdem et. al. (2010) analyzed the trade relations between Turkey and its 20 trading partners in the light of exchange rate volatility. Awokuse and Yuan (2006) formed panel data set for more than 49 import oriented countries and found the impact of exchange rate volatility on US poultry exports. May (2007) analyzed the effect of exchange rate on the exports of five important agriculture products and found the influence of exchange rate on export volume. Bonroy et. al. (2007) studied the effect of exchange rate volatility on pork meat trade between US and Japan. Their findings showed that exchange rate doesn't effect the trade alone. Mehare and Edriss (2013) analyzed the impact of exchange rate volatility on coffee exports using ARDL model. The results showed the negative impact of exchange rate shocks in short run and insignificant in long run. Besides all of the above, there are also other studies that analyze the effect of price volatility in futures market, transportation cost and exchange rate volatility on agricultural trade (Kawai and Zicha, 1986; Goodwin and Schroeder, 1991; Haigh and Holt, 2000; Li, *et. al.*, 2006; Zhang *et al*, 2010; Karemera, *et. al.,* 2011; Nazlıoğlu and Erdem, 2011; Erdal *et.al.,*2012; Sheldon, *et al.*, 2013). The impact of exchange rate volatility on exports volume depends on time period, country and product group (Bügük, *et.al*, 2003; Grier and Smallwood, 2007; Kandılov 2008). Hence, in the literature, there isn't any common opinion on it.

In short, the factors like level of technological advancement of a country, product type, test procedure, methodology and data (period, frequency etc.) may effect the findings. So the findings of one study may not support the findings of the others. In contrast to the previous studies, this study, analyzes the relation between processed agri-products and exchange rate volatility with a wider and comprehensive outlook.

METHODOLOGY

Monthly data between 1988:1 and 2012:12 is used in this study. Real exchange rates data is taken from

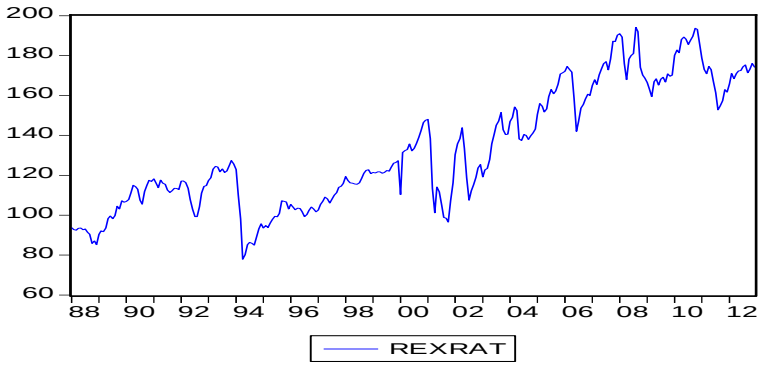
the database of Central Bank of Turkey (TCMB). The data for the exports of processed agricultural products is obtained from Statistics Department of Turkey (TÜİK). In order to obtain real values, this data series is adjusted for inflation.

Real Effective Exchange Rate Indices (1995=100) are real effective exchange rate index series, calculated for countries (Belgium, Germany, Spain, France, Switzerland, the Netherlands, Italy, UK, USA, Japan, Sweden, Austria, Canada, Korea, Iran, Brazil, Greece…) in the light of IMF definition. It uses wholesale prices to calculate national and international price indices. An increase in the index means increase in real value of Turkish Lira (REXRAT) and vice versa (Figure 3).

$$REXRAT = \prod_{j=1} \left[\frac{P_i R_i}{P_j R_j} \right]^{W_{ij}}$$

Here Pi shows CPI (Consumer Price Index) of Turkey at time i, R_i is the dollar value of TL(Turkish Lira), P_j depicts the price index of country j, R_j shows dollar value of the currency of country j and W_{ij} is a weight of country j for Turkey.

Figure 3. The changings in real exchange rate of Turkey over a time period



After making seasonal adjustments , unit root tests are conducted to check the stationarity of the series. Based on ADF (Augmented Dickey-Fuller) unit root test, the stationary series are obtained at $rdk_t \sim I(1)$, $isih_t \sim I(2)$. As the series are stationary at different degrees, it is unfeasible to do cointegration test (Alptekin, 2009). Hence, standard VAR model is used to conduct the study. Eviews-7 is used to analyze the data.

FINDINGS and DISCUSSION

Generally, a reduced-form demand function, derived from micro economics theory, is used to measure the effect of exchange rate instability on trade (Anderson and Garcia, 1989; Cushman, 1983; Hooper and Kohlhagen, 1978; Pick, 1990; Frank, 1991). Nowadays, time series models like VAR, GARCH, SWARCH and Error-Correction are also being used to measure this volatility (Korary and Lastrapes, 1989; Kroner and Lastrapes, 1993; Klein, 1990; West and Cho, 1995; Susmel, 2000; Sun and Zhang, 2003; Hsing, 2004; Kasman and Kasman 2005; Güloğlu and Akman, 2007; Chit, et.al, 2010). This study is based on Vector Autoregressive (VAR) model. In contrast to simultaneous equation system, where it is important to determine whether a variable is endogenous or exogenous, VAR model takes all the variables as endogenous (Satman, 2010).

VAR model is used to detect causality between non-stationary and non-cointegrated variables, whereas, VECM (Vector Error Correction Model) is used to find causality between non-stationary but cointegrated variables (Yavuz, 2006). As the variables used in this study are non-stationary and non-cointegrated, VAR model is used to analyze the relationship between them. VAR model can be represented as following (Kadılar 2000):

$$y_t = \sum_{i=0}^{k} A_i \Gamma_{t-i} + C u_t, \qquad t = 1,2,...T \qquad (1)$$

In the equation 1, T represents number of observations; *(A_i)* shows matrix of size *(dxd)* containing coefficients of variable d at time t; *(u_t)* shows residuals vector of size *(dx1)*; *(C)* shows a matrix of size *(dxd)* containing error coefficients of vector *(Γ)*and *(k)* shows lag structure.

Table1. Determination of VAR lag-structure

Lag	Loglikelihood	LR	FPE	AIC	SC	HQ
0	-6303.189	NA	2.67e+16	43.49958	43.82778	43.63106
1	-6248.698	103.3647	1.89e+16	43.15256	43.53126*	43.30427
2	-6239.603	17.12750	1.82e+16*	43.11755*	43.54673	43.28948*
3	-6238.776	1.546254	1.86e+16	43.13935	43.61903	43.33151
4	-6234.704	7.555427	1.86e+16	43.13886	43.66903	43.35125
5	-6230.451	7.834628	1.86e+16	43.13712	43.71778	43.36974
6	-6224.299	11.24685*	1.83e+16	43.12233	43.75348	43.37517
7	-6223.920	0.687344	1.88e+16	43.14722	43.82887	43.42029
8	-6221.346	4.634575	1.90e+16	43.15702	43.88916	43.45032

It is clear from Table 1; FPE (Final Prediction Error), AIC (Akaike), SC (Schwarz) ve HQ (Hannan Quinn) information criterias identify first and second lag. Using first lag structure, autocorrelation is found in the series. Hence second lag is preferred. Using this lag structure, the stability of VAR model is tested using the following tests.

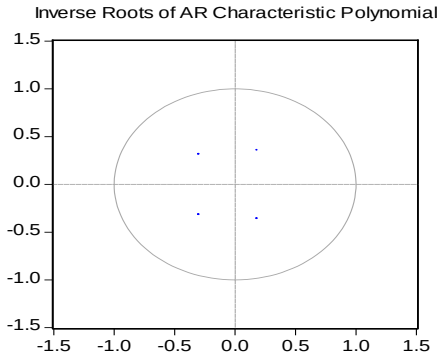
The VAR model is checked for autocorrelation problem using LM (Lagrange Multiplier) test. It showed no autocorrelation. The results of the test are given in table 2.

Table 2. Autocorrelation LM Test

Lags	LM-Stat	Prob.
1	7.335220	0.1192
2	11.19457	0.0245
3	8.192957	0.0848
4	7.151626	0.1281
5	5.477203	0.2417
6	11.27269	0.0237
7	3.021766	0.5542
8	1.952525	0.7445
9	4.528419	0.3392
10	10.70233	0.0301
11	3.605074	0.4621

Figure 4 shows that the inverse roots of AR characteristics polynomial are inside the unit circle. According to this, no modulus value is outside the reference interval. These result shows that our VAR model is stationary and stable.

Figure 4. Inverse Root of AR Characteristic Polynomial



Infinite lagged Vector Moving Average (VMA) can be obtained from stationary VAR model as follows:

$$yt+s- Et(yt+s) = \sum_{i=0}^{s-1} \psi_i u_{t+s-i} \quad (2)$$

Here, impulse response functions can be found as follows:

If $\Gamma(L)\text{-}1\Psi(L)=I$, then $(I-\Gamma 1L-\Gamma 2L2-\ldots..-\Gamma pLp)$

$(I+\Psi 1L+\Psi 2L2+\Psi 3L3+\ldots\ldots)=I$

and if coefficient of L is made zero on the basis of stationarity condition

$\Psi 2=\Gamma 1\Psi 1+\Gamma 2$ at this point coefficient matrix of impulse response function for s period can be calculated as

$\Psi s=\Gamma 1\Psi s\text{-}1+\Gamma 2\Psi s\text{-}2+\ldots\ldots\Gamma p\Psi s\text{-}p$ $s=1,2\ldots(\Psi 0=Ik$ ve $\Psi s=0$ $s>p)$.

Figure 5. Impulse Response Analysis

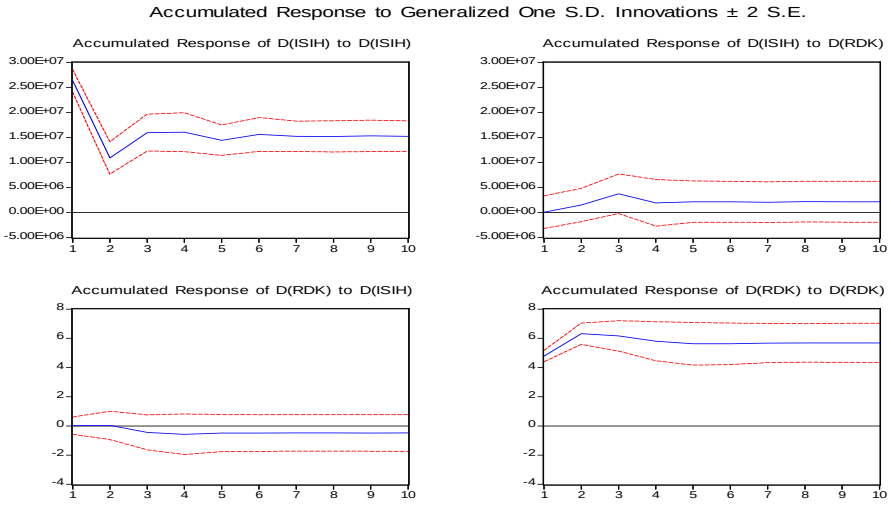


Figure 5 shows the accumulated response of each variable to its own shocks and to the shocks of other variable. The results show, there is significant interaction between real exchange rates and the exports of processed agri-products. The shocks in real exchange rate have a positive effect on the exports of processed agri-products during the first three months. Later on it loses its significance. It means there is a short run effect. This result supports the results of the previous studies (Cho et al., 2002; Kandilov, 2008; Erdal, et.al., 2012). Moreover, there are some studies that contradict with these results (Mohammad and Zulkornain, 2010; Mehare and Edriss, 2013). This result complies with the theory. Since according to trade theory, in developing countries, characteristics like technological advancements, type and quality of exportable goods effect the exports differently as a result of exchange rate volatility (Singer, 1950).

In the next step of this study, variance decomposition is obtained from forecasted residuals. It can be obtained as follows:

If $\Psi l, m$ is an element of Ψi matrix, forecasted error variance of k_{ts} variable can be calculated as:

$$Yk,t+s- Et(yk,t+s) = \sum_{i=0}^{s-1}(\Psi_{k,1}(i)u_{1,t+s-i}+\ldots\Psi_{k,K}^{(i)u_{1,t+s-i}}(i)u_{K,t+s-i})$$

$$\sigma_k^2(s)=\sum_{i=0}^{s-1}(\Psi_{k1}^2(i)+\ldots..+\Psi_{kK}^2(i)) = \sum_{j=1}^{K}(\Psi_{kj}^2(0)+\ldots..+\Psi_{kj}^2(s\text{-}1))$$

In this formula, the term $(\Psi_{kj}^2(0)+\ldots..+\Psi_{kj}^2(s\text{-}1))$ can be taken as the contribution of jth variable to the forecasted error variance of kth variable. As each shock in VAR model equations is related to the respective endogenous variable, this term will give the contribution of shock of each variable to the

forecasted error variance of k_{ts} variable. Based on this it can be said that the variance decomposition is an important tool to know that the shocks in a variable explain which of the variables, present in the model, more than the others.

The findings of this study show, in the first month, the shocks in real exchange rate are unable to explain the volume of processed agri-products exports. But, in the next two months, they are able to explain only 0.2% to 0.7% forecasted error variance of it (Table 3). So the effect of shocks in exchange rate on the exports of processed agri-products is very weak. These findings support the previous studies (Aristotelous, 2001; Sivri and Usta 2001). Demand elasticity of agri-products is low. That's why it is unexpected that the price changings will effect the demand immediately. However, if a product is storable and used as input, exchange rate volatility may effect the exports differently. Hence, it can be said that the findings of this study are in accordance with the theory.

Table 3. Variance Decomposition

Period	S.E.	D(ISIH)	D(RDK)
1	26346319	100.0000	0.000000
2	30561014	99.76938	0.230620
3	31056517	99.25547	0.744526
4	31109870	98.91603	1.083974
5	31152597	98.91331	1.086694
6	31173998	98.91478	1.085217
7	31176192	98.91386	1.086140
8	31176463	98.91223	1.087766
9	31176707	98.91216	1.087843
10	31176821	98.91216	1.087840

CONCLUDING REMARKS

Nowadays, one of the important discussions among economists and policymakers is about the intervention in exchange rates by the central bank in order to control foreign trade deficit. The relation between exchange rate shocks and foreign trade is important for policy-makers, so that they may devise their policies accordingly. It's also important for exporters so that they may use appropriate risk management tool. The purpose of this study is to analyze the relationship between real exchange rate and the export volume of processed agricultural products in Turkey. Turkey is following a free-float exchange rate system under limited intervention The results show, there is a significant effect of real exchange rate volatility on export volume of processed agri-products. However, this effect is very limited. It effected positively; but it lasted for only three months. This effect ranged from 0.2% to 0.7%. Later on, it became insignificant. Here it's difficult to explain the changings in the export volume of processed agri-products with the help of real exchange rate shocks. This is what is expected by the theory. Hence, structural changings will effect the exports more as compared to sudden shocks. It can also be said, the intervention in exchange rate by the government to increase exports of processed agri-products will not produce significant results. This is because of low demand elasticity of agri-products. Therefore, in order to have a rapid increase in the exports of agri-products, market research is needed to expand the market size. Alternative markets should be discovered. With the help of these structural changes, a more stable and rapid growth is possible.

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