Department of Agricultural Economics
Faculty of Agriculture – Cairo University
University street, Giza, Egypt
PO : 12613

Futures and spot prices nexus of Egyptian Wheat: multivariate volatility approach

Dr. Osama Ahmed

Dr. Fadi Abdelradi

Introduction: Overview

- Egypt is considered a net importer of food grains, which makes it vulnerable to international markets food price volatilities.

Introduction: Overview

- Wheat is key stable food to household economies in Egypt, since most Egyptian households are net buyers of wheat products and rely heavily on imports to meet consumption needs.

Introduction: Overview

- There is a large literature studying the spot-futures relationship (Giot, 2003; Garcia and Leuthold, 2004; Hernandez and Torero, 2010).

Introduction: Overview

- The causal relation between futures-spot prices is referred to as the price discovery function, which identifies the flow of information between the futures and spot markets.

Introduction: Overview

- The empirical literature supports (Yang et al., 2001; Hernandez and Torero, 2010), in general, that futures prices lead spot prices (i.e. spot prices are often discovered in the futures markets).
- Other studies have concluded that spot prices lead futures prices (Kuiper et al. 2002, Mohan and Love 2004).

Introduction: Objective and contribution

- **The objective**
  - The objective of this paper is to make a better understanding about link between U.S. CBOT wheat futures and Egyptian wheat spot prices.

Introduction: Objective and contribution

The contribution of this work to the literature is twofold;

– First, it focuses on Egypt. From the recent literature, it is clear that the focus is on the two main markets in the world: the US and EU. Conversely, African markets in general and Egyptian markets in particular studies are scarce.

– Second, in contrast to the predominant literature, not only we do assess price level links, but also assess price volatility spillovers.

Introduction: Wheat industry in Egypt

- Egypt is considered the largest wheat producer in Africa representing 35.6% of the total wheat production with an estimate of 9.3 MMT (Million Metric Tons) in 2014.

Introduction: Wheat industry in Egypt

- The milling industry is public and private.
- The public sector milling industry produces about 70% of (82% high extraction flour) and 30% produced by the private sector, which goes for baking of subsidized “Baladi” bread from the domestic wheat.

Introduction: Wheat industry in Egypt

- The imported wheat is used to produce the (72% and 76% flour extraction) using 17 mills for food processing plants.

Introduction: Wheat industry in Egypt

- Egyptian Wheat imports are expected to reach 11 MMT in 2016/17 compared to 10.6 MMT in 2015/16 with the largest exports of wheat to Egypt coming from Russia with around 7 MMT.

Data

- The empirical application aims at assessing the volatility spillovers between weekly CBOT futures prices (P_f) and Egyptian spot prices (P_s) of wheat. Both prices are expressed in US dollar per ton.

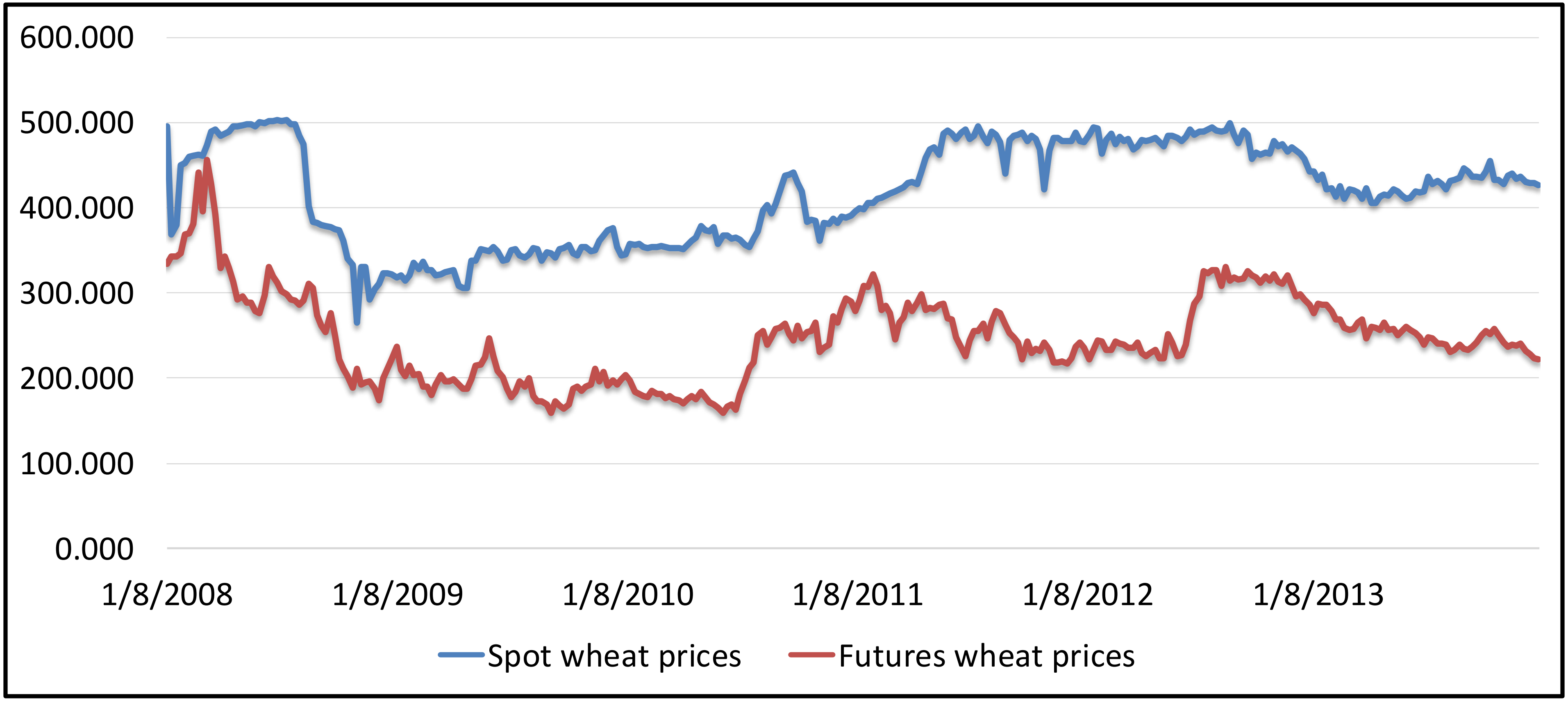
Data

- The study period is January 2008 to December 2013 which yielding 312 observations.

Data

- The period of analysis is of interest, as it includes the first and second wave of the Egyptian revolutions and is likely to reflect the impacts of the political and economic instability.
- For this reason, the model will be checked for stability in the conditional mean and variance.

Data



600.000
500.000
400.000
300.000
200.000
100.000
0.000
1/8/2008
1/8/2009
1/8/2010
1/8/2011
1/8/2012
1/8/2013
Spot wheat prices
Futures wheat prices

Data

- It is relevant to indicate that during the analyses period Egypt imported wheat from the United States (US) with the total amount of 3.3 million tons, 2 million from France, 7 million tons from the Russian federation and 2 million tons from Romania.

Methodology: Market efficiency hypothesis

- Logarithmic transformations of the prices are used in the empirical analysis.
- The two series were tested for unit roots using standard augmented Dickey and Fuller and KPSS. The tests confirm that the two series have a unit root.

Methodology: Market efficiency hypothesis

Unit root testing		
	Futures Price	**Spot Price**
Augmented Dickey-Fuller test **(p-value)**	**-1.196** **(0.213)**	**-0.355** **(0.521)**
KPSS test **(p-value)**	**0.572***** **(0.010)**	**0.579***** **(0.010)**

Methodology: Market efficiency hypothesis

Summary statistics for first differenced logged prices		
	Future Prices	**Spot Prices**
Mean	**-0.001**	**-0.001**
Standard Deviation	**0.037**	**0.051**
Skewness	**-1.751**	**0.143**
kurtosis	**5.314****	**3.622****
Jarque-Bera statistic	**6.076****	**6.611****
ARCH LM statistic	**34.197****	**58.328****
Number of observations	**312**	

Note: **indicates rejection of the null hypothesis at the 5% significance level.

Methodology: Market efficiency hypothesis

- Long-run links between the two prices are assessed using the co-integration tests proposed by Johansen (1988).

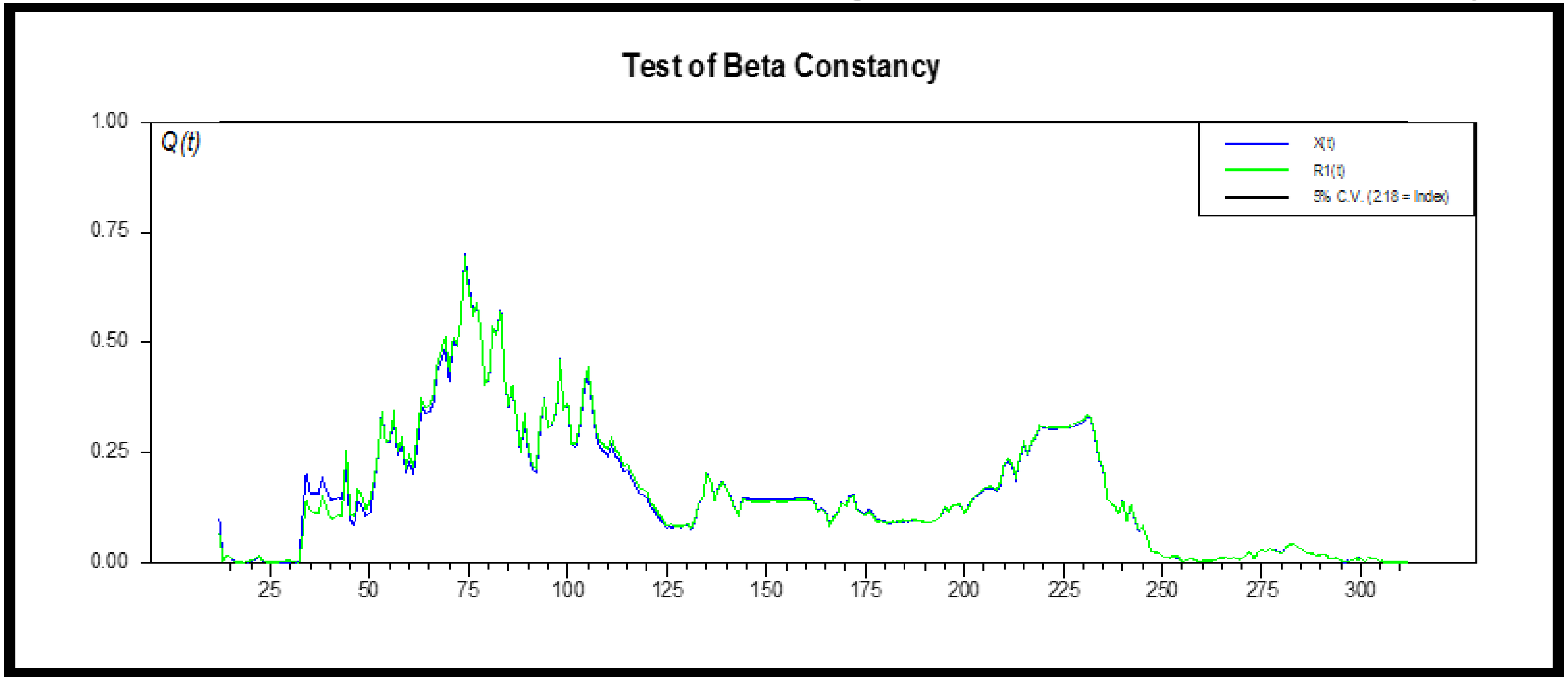
Co-integration relationship $P_s = 1.778^{**} + 0.777^{**} P_f$

(0.607) (0.110)

Long-run market efficiency ($\alpha = 0, \beta = 1$), CHISQR(1) = 2.341 (0.126)

Methodology: Market efficiency hypothesis

- Beta test for the null of constancy of the co-integration parameters shows that no structural breaks affect the co-integration relationship



Methodology: Market efficiency hypothesis

- GARCH models have been devised to capture such volatility behaviour, that express current volatility as a function of lagged volatilities and past market shocks.

Methodology: Market efficiency hypothesis

- **GARCH models are usually composed of two sub-models.**

1. **The conditional mean that captures prices in levels.**
2. **The conditional volatility that represents price volatility patterns.**

- **The conditional mean and variance models in this paper are estimated in one step using Maximum Likelihood (ML).**

Methodology: Market efficiency hypothesis

- The conditional mean is specified as a VECM following von Cramon-Taubadel (1998) which allows to test asymmetric price transmission (APT), which characterizes both short-run and long-run price dynamics of non-stationary and co-integrated data.

Methodology: Market efficiency hypothesis

- The conditional variance model follows the specification of Baba-Engle-Kraft-Kroner (BEKK)-GARCH Model.

Methodology: Conditional mean and variance

- The co-integration model

$$P_{st} = \alpha + \beta_1 P_{ft} + \varepsilon_t$$

- The conditional mean

$$\Delta P_t = \alpha + \varphi_p^{+} \varepsilon_{t-1}^{+} + \varphi_p^{-} \varepsilon_{t-1}^{-} + \sum_{j=1}^{k} \Gamma_j \Delta P_{t-j} + u_t$$

- The conditional variance

$$H_t = CC' + A' u_{t-1} u'_{t-1} A + B' H_{t-1} B$$

Results: Conditional Mean

Conditional mean equations $\begin{pmatrix}\Delta P_{st}\\ \Delta P_{wt}\end{pmatrix} = \begin{pmatrix}\varphi_1\\ \varphi_3\end{pmatrix}\varepsilon^{+}_{t-1} + \begin{pmatrix}\varphi_2\\ \varphi_4\end{pmatrix}\varepsilon^{-}_{t-1} + \begin{pmatrix}\beta_{11} & \beta_{12}\\ \beta_{21} & \beta_{22}\end{pmatrix}\begin{pmatrix}\Delta P_{st-1}\\ \Delta P_{ft-1}\end{pmatrix} + \begin{pmatrix}\gamma_{11} & \gamma_{12}\\ \gamma_{21} & \gamma_{22}\end{pmatrix}\begin{pmatrix}\Delta P_{st-2}\\ \Delta P_{ft-2}\end{pmatrix} + \begin{pmatrix}u_{1t}\\ u_{2t}\end{pmatrix}$

φ_i	**j=1**	**j=2**
	-0.006(0.013)	**-0.024**(0.010)**
	0.047(0.030)	**0.061**(0.020)**
β_{1i}	**-0.201**(0.059)**	**0.018(0.019)**
β_{2i}	**0.168**(0.073)**	**-0.014(0.057)**
γ_{1i}	**-0.083*(0.042)**	**0.035*(0.016)**
γ_{2i}	**0.122(0.082)**	**0.001(0.053)**

Hosking multivariate Q(11) Statistic = 57.76

Multivariate ARCH LM test = 73.67***

LM test of short-run efficiency (β_{ij}= γ_{ij}= 0) = 24.047***

Results: conditional Variance

Conditional volatility equations $\Omega = \begin{pmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{pmatrix} \begin{pmatrix} c_{11} & c_{21} \\ 0 & c_{22} \end{pmatrix} + \begin{pmatrix} a_{11} & a_{21} \\ a_{12} & a_{22} \end{pmatrix} \begin{pmatrix} u_{1t-1}^2 \\ u_{2t-1}^2 \end{pmatrix} \begin{pmatrix} u_{1t-1}^2 & u_{2t-1}^2 \end{pmatrix} \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} +$

$\begin{pmatrix} b_{11} & b_{21} \\ b_{12} & b_{22} \end{pmatrix} \begin{pmatrix} h_{11t-1} & h_{12t-1} \\ h_{21t-1} & h_{22t-1} \end{pmatrix} \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}$

	i=1	*i*=2
c_{1i}	0.014(0.002)	
c_{2i}	-0.001(0.003)	-0.000(0.009)
a_{1i}	0.808***(0.133)	-0.158(0.110)
a_{2i}	0.042(0.035)	0.315***(0.061)
b_{1i}	0.444***(0.080)	0.388***(0.097)
b_{2i}	-0.032*(0.018)	0.936***(0.021)

LR test for the null that parameters in matrices A and B = 11823.423***

Nyblom (1989) fluctuation joint test = 4.269

Log-Likelihood of the one-step estimation of VECM and BEKK-GARCH = 1241.1800

Results: Conditional variance equations

$$h_{11} = 2.07e-04 + 0.197^{***} h_{11t-1} + 0.001\, h_{22t-1} - 0.028\, h_{12t-1} + 0.653^{**} u_{1t-1}^2 + 0.002\, u_{2t-1}^2 + 0.068\, u_{12t-1}$$

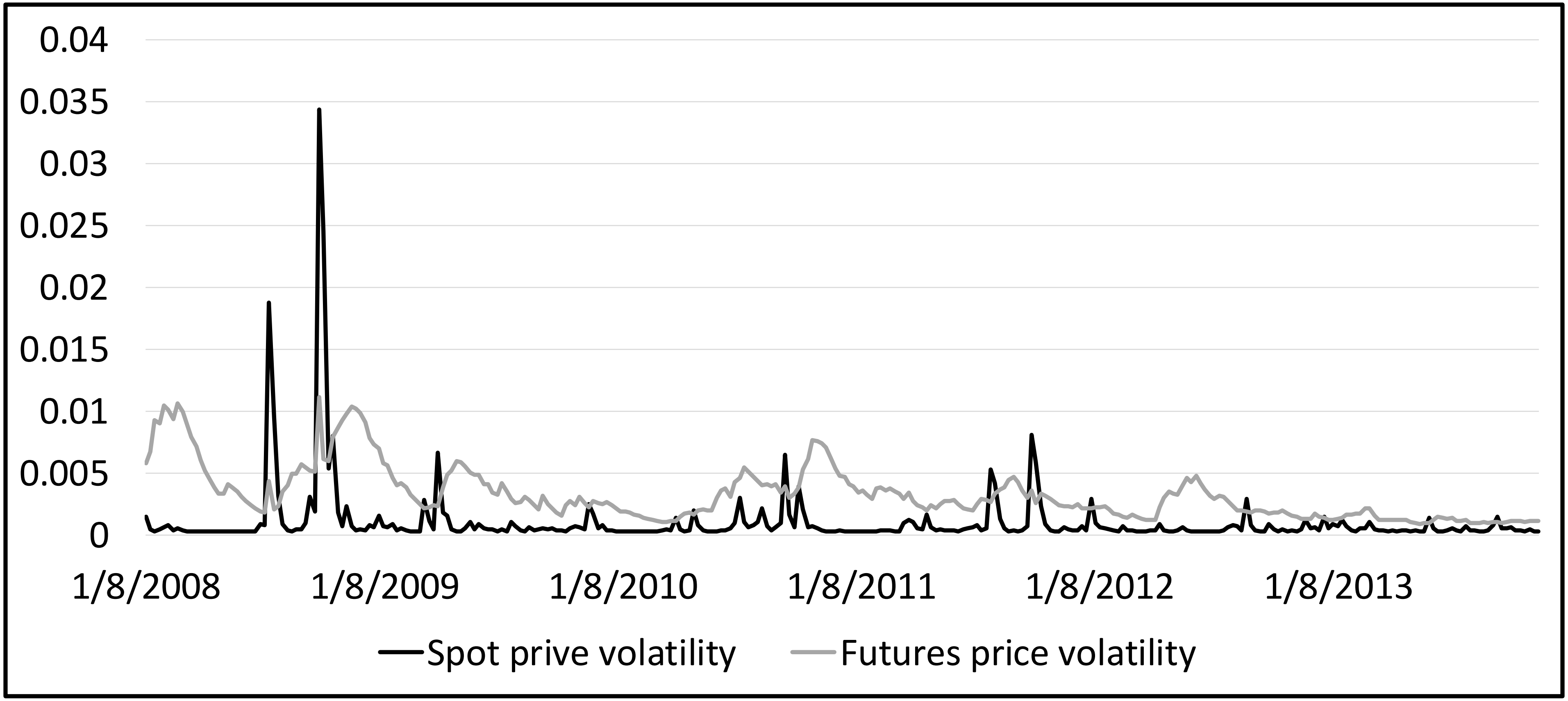
$$h_{22} = 0.000 + 0.151^{***} h_{11t-1} + 0.876^{***}\, h_{22t-1} + 0.727^{***} h_{21t-1} + 0.025\, u_{1t-1}^2 + 0.099^{***} u_{2t-1}^2 - 0.099\, u_{12t-1}$$

h_{11} spot price variance, h_{22} futures price variance.

The standard errors of the estimated parameters are obtained by means of first order Taylor series expansion of the function around its mean (the so called delta method)

*** (**) [*] denotes statistical significance at the 1 (5) [10] % level

Predicted volatilities



Policy implications

- The Egyptian spot and CBOT futures prices are found to respond to asymmetric deviations from the long-run disequilibrium where speed of adjustment to negative shock is higher and statistically significant compared with positive shocks.
- Spot price volatility was not affected by futures price volatilities and this can be attributed to the subsidy program that the government is adopting for wheat, which smooths this spillover effects.
- Increasing the cultivated area of wheat in Egypt to decrease dependence on imports and increasing food security, additionally, minimize the subsidy bill for wheat.

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