PRICE VOLATILITY INFLUENCE ON AGRICULTURAL INCOME INSTABILITY

by

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Abstract

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In the paper I investigate how different price shocks, world and domestic, influence the stability of farmers' income in Ukraine. For this purpose I computed the coefficient of variation (CV) of income, using approach developed by Rapsomanikis and Sarris (2005) which combines prices variability of crops cultivated with income structure of farmers. This framework allows evaluating the impact of price shocks on agricultural producers' profits. The results show that CV's varies for different groups of firms depending either on type and region of location of an enterprise. Investigating the sources of income instability, I have found that it is caused mostly by the domestic factors. Trade liberalization would just slightly decrease agricultural income uncertainty.

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GLOSSARY

Income instability – variation of farmer's income from year to year or within a year (www.wikipedia.org)

C h a p t e r 1

INTRODUCTION

In the light of globalization, developing and emerging economies are confronted with a range of vitally important problems. On the one hand, the opening of borders promises them international capital inflow and experience; on the other hand, it enlarges these countries dependence on global situation, increases exposure to world price shocks and decreases the opportunities for protection of domestic producers. One of the questions related to this: does trade and price liberalization add to domestic households' income uncertainty?

For Ukraine, the task of investigating world prices influence on households' income is extremely important considering the next accession of Ukraine to World Trade Organization (WTO). The accession supposes tariffs to be reduced and gradually removed which would pass new challenges and risks to domestic players of such industries as metallurgy, machinery, energy, light and food industries.

The thesis concentrates exactly on influence of global trade liberalization on agricultural producers' income.

First, income from farm jobs is the main source of living for rural population that reduces during years but still accounts 32% (Site of State Statistic Committee (15.09.2006)) of total population and most drastically contributes to number of poor people as average wage of farmers is the lowest among all kinds of economic activity (by twice as less depending on region (Site of State Statistic Committee (06.09.2006)). Income instability makes agricultural households more uncertain, decreasing investments and agricultural sector development. This uncertainty makes people to be less assured in their future, making living in village not attractive and leading to individual's flow-out from rural regions which in turn drives to substantial production decreasing in rural regions,

Second, the revenues from agricultural sector are one of the significant sources of GDP and export performance (10% and 5% respectively (Site of State Statistic Committee (02.10.2006)). Thus, agricultural price volatility is not desirable thing as farmer's underperformance would be reflected on prosperity of the whole economy.

Besides, agriculture activity faces, much more frequently then some other sectors of economy, a lot of non-market (for example, land ownership government policy or high rural young labor force migration) related fluctuations. Agricultural prices have frequent fluctuations which bring uncertainty and farmers have to operate with indecision. Moreover, nowadays weather becomes even more unpredictable because of dramatic changes in climate. Adamenko (2004) showed that in Ukraine for the period 1999-2003 frequency of appearance of such unfavorable weather conditions for harvest as drought, hail, flood increased much comparing to previous 50 years.

WTO accession foresees admittance on commodity and service markets; thus, we may expect that Ukraine will become more a active player in international trade and, correspondingly, will be subjected to increasing importance of global events. One of the essential questions here is: how liberalization, openness to world market and shocks on it will influence price volatility on Ukrainian agricultural market and income stability of different agricultural producers. Will they face with more price uncertainty or not?

Some authors have already investigated consequences of trade liberalization for Ukraine. Sagidova (2004) evaluated price transmission gains from the world to the Ukrainian grain market; Sidorov (2005) examined WTO accession impact on poverty in Ukraine. It is not, however, clear how new conditions, increased exposure to international market will affect on domestic price instability, whether they make farmer's income more uncertain or not.

In my thesis, I will investigate consequences of access expansion to Ukrainian market of world agricultural producers for domestic price stability and agricultural producers' income variation. First, I will run autoregressive model (VAR) (I expect that Ukrainian prices have influence on the world prices) for each culture price to estimate elasticities of transmission of world prices to domestic prices and to compute conditional variances and covariances through variance decomposition. Then, I will find income variances and coefficients of variation (CV) of income, using calculated elasticities and the data of farmers' income structure; and evaluate them in order to investigate to what extent increased exposure to international prices may influence national producer income stability.

For the research, I will use monthly 1998-2005 data on prices for main agricultural products (barley, corn, wheat, sugar beets and sunflower seeds). Domestic prices for these products are gathered by the analytic centre of "Ukragroconsult" (www.ukragroconsult.com). International prices are gathered by IFC (www.ifc.org). Annual income structure of Ukrainian agricultural producers is presented in special statistic form 50-SG, which have been giving by agricultural producers to state statistical bodies.

As a result, I expect to find to what degree prosperity of different groups of national agricultural producers depends on their production price volatility, namely, how and what shocks, domestic or world, especially in view of forthcoming WTO accession, more or less, influence on farmers' income volatility.

The rest of the thesis is organized as follows. Chapter 2 deals with theoretical and empirical issues concerning causes and effects of market volatility on agricultural household's income. In Chapter 3 the theoretical framework is given. Data description can be found in Chapter 4. Chapter 5 provides empirical results and policy implications. Chapter 6 contains conclusions.

Chapter 2

LITERATURE REVIEW

Any economic activity is accompanied by a huge number of uncertainties. Risk factors vary from price vagueness to problems with suppliers. Agriculture is one of the businesses which is mostly exposed to different market and non-market fluctuations. Harwood (nd) defines following sources of risk for households: production or yield risk, price or market risk, institutional risk, human or personal risk and financial risk. Existence of these risks implies appearance of various shocks which may harmfully influence on agricultural producers, increasing uncertainty and leading to great variation of farms' income from year to year.

Importance of income stability is emphasized by Mishra at al. (2002) who stress: "The economic well-being of farm household is influenced by variability of its income, which can hamper its ability to maintain consumption and accumulate wealth".

However, Girao at al. (1974) comparing two groups of farmers in Minnesota with different level of income variability (farmers were divided by coefficients of variation of income) empirically show that income instability does not matter for consumption. However, investment is influenced by income uncertainty. Evaluating income variation level impact on consumption, the authors use 5 different models and conclude that income instability have little impact on consumption behavior. For example, all models estimate small difference in long-run marginal propensity to consume for two groups. As for investment, the authors analyze estimates from two alternative measures of investment: total fixed investment and investment in machinery and equipment. Both models show, for example, that saving impact is larger for stable group which means that investment is less responsive to saving for farmers in unstable group.

But adverse impact of risk factors on income stability may be eliminated or reduced by implementation of different measures, farmers have developed a lot of strategies of managing risks they face. According to Harwood (nd), agricultural producers use diversification in order to reduce risk. It includes income diversification, namely participating in more than one activity; crop diversification, as growing various crops. Also, farmers conclude different types of contracts, such as future options contracts and production contracts which guarantee them earnings in the future. One of the most effective and very often used means of risk management is financial instruments – insurance, credit and leasing inputs. But householders may have problems with these methods to implement as diversification can be limited due to climatic or market conditions and financial instruments may be not accessible because of not developed financial markets as we observe in Ukraine.

Carter (1997) distinguishes covariate and idiosyncratic shocks which add to farmers' economic uncertainty. Idiosyncratic shocks are that shocks that influence on particular household e.g. illness, crop reduction. In developing countries, almost all farms especially small producers are exposed to such crop or income shocks. However, adverse impact of idiosyncratic shocks on wealth and particularly income stability can be eliminated by applying different measures.

Kochar (1995), analyzing agricultural farmer's income in India, shows that households are relatively well protected from idiosyncratic shocks. Risk associated with such shocks can be reduced by investment into more income stable but low-yield agricultural techniques rather than more profitable but less stable in returns agricultural investments. One more way of managing such shocks is increase market hours of work.

Farmers also need to deal stands with covariate shocks which bring damage to all farmers in a whole economy or even larger region, such as weather and price fluctuations. Risks of such shocks cannot be fully removed by methods described above as they demand special programs of the government and its support. Agriculture, perhaps, the only one activity which depends from weather at such great extent as it does. Weather unpredictability causes great yield variation from year to year leading to income instability; because of this uncertainty households cannot efficiently allocate resources when deciding how much to consume, save and invest.

Rozenzweig and Binswanger (1993) investigate empirically how rainfall frequency in rural India affects the wealth of agricultural producers with different types weather risk. They conclude that weather is crucial exogenous part of risk for farmers to analyzed. It is one of the factor that mostly adds to output instability, that is, increases income instability. As weather is spatially covariant risk it is hard for households to apply protective actions against it and they have to change their ex ante production decisions which leads profit and welfare losses.

Besides, weather is one of the main reasons for appearing another covariate shocks, namely price shocks. Jabara and Thompson (1982) emphasize that uncertainty with price on international market especially concerns agricultural commodities due to weather factor. Dramatic changes in weather conditions cause production shocks, positive or negative, leading to substantial price fluctuation in particular economy or even all over the world. But it is difficult to say whether it brings net loss of profit and correspondently welfare because, especially in terms of world economy, somebody gains, somebody loses from anticipated price shock.

Fafchamps (2000) discusses the consequences of price instability for farmers in developing countries. He emphasizes in developing countries, households are much less protected from price variation, especially exporters from world price fluctuations. Developed countries e.g. European Union insulate their farmers, triggering various support programs or subsidizing them during periods of unfavorable market conditions. Also, price risk affects agricultural producers in two ways: directly, increasing or decreasing their output profits and indirectly, influencing the whole economy. For developing countries, this indirect impact is much larger as their young economies are very vulnerable to different shocks. The author analyzes the results for the agricultural producer's revenues of appearance price shock in the economy without international trade. He shows that with existence of downward sloping demand for agricultural products, negative production shock caused by bad harvest and resulted in supply decrease will be compensated by price increase and farmers will not suffer from profit fall. Increase in supply leads to decrease in prices but in case of non-stochastic unit elastic demand drop in profit will be zero. Another deal with international trade, as one country may experience good harvest another – may not. For these countries, price shock going after production shock is exogenous as it is not correlated with their output and they suffer from it because lower prices decrease their profits. However, the lucky country may gain from trade as it compensates drop in price by larger volumes of sales.

There is large number of papers devoted to the consequences of trade liberalization for country's growth rate, investment, producer's welfare etc. For example, Blake, Mckay and Morrisey (2001) investigate the impact of trade liberalization on Uganda agricultural producers using General Equilibrium model. They find that expanded trade openness will have overall positive effect, make agricultural prices to rise and increase farmer's welfare. Comparing results of this and another articles, one may conclude that impact for every country is unique and to the great extent depends on special conditions which exist in every particular economy especially on government policy. Choosing optimal system of tariffs and subsidies government may avoid detrimental effect of world shocks on economy (Reynolds (1963); Lankosky (1997); Aiello (2003); Sugiyarto, Blake, Sinclair (2003)), but insufficiently considered interventions for some sectors may add even more to domestic price instability than international shock (World Bank(2005)). However, undesirable effect might happen after negative price shock even if policy is recognized as appropriate (Dehn (2000)).

However, much less researches investigate how trade liberalization may influence farmer's income stability whether increased exposure to world price shocks add to their income uncertainty or not.

Rapsomanikis and Sarris (2006), using microeconomic approach, try to find out how will change farmer's income stability after increased trade openness for different groups of households in Ghana, Peru and Vietnam. They compute household's income variances and coefficients of variation which allow to indicate the level of income variability and to capture whether it depends on the world or domestic price shocks. They find that influence of international prices on income is small and the main source of income instability is domestic prices.

Also, I would like to consider papers which analyze the effects of trade liberalization on Ukraine.

Sagidova (2004) investigates the possible affect of world grain prices on Ukrainian grain prices. She estimates the level of integration between the world grain market and Ukrainian grain market through mechanism transmission. The author finds how fast the world prices will be transmitted to the domestic market, speed of adjustment to equilibrium or, by other words the level of absorption of future world shocks by the Ukrainian economy. The results show that integration is insufficient and limited as 87.5% of the potential shock will be absorbed during 8 month whereas in the world practice time needed for this is about 6 month.

Sydorov (2005) estimates poverty effects in Ukraine after WTO accession. The examines tariff reduction impact on household's income using

Computable General Equilibrium model. His main result is that 10% decrease in tariff will reduce overall poverty.

C h a p t e r 3

METHODOLOGY

As my research is focused on investigating of variation agricultural firm's income I need the exact formula for the coefficient of variation (CV) of income. I will use the empirical framework developed by Rapsomanikis and Sarris (2006). Consider the following expression for normalized deviation of total income from its mean (under the assumption that the quantities produced by the firm in period t are independent of the prices faced by the firm in the same period):

$$\hat{Y} \equiv \frac{Y - E(Y)}{E(Y)} = \alpha \frac{Y_\alpha - E(Y_\alpha)}{E(Y_\alpha)} = \alpha \frac{\sum_i P_i Q_i - E(\sum_i P_i Q_i)}{E(\sum_i P_i Q_i)} =$$

$$= \alpha \frac{\sum_i P_i Q_i - \sum_i \overline{P_i Q_i}}{\sum_i \overline{P_i Q_i}} = \alpha \left[\sum_i s_i (\Delta p_i \Delta q_i + \Delta p_i + \Delta q_i) \right] \quad , \qquad (1)$$

where Y_α – agricultural part of income,

α - share of agriculture in the total firm's income,

s_i - average shares of each agricultural product *i* in agricultural income,

q_i - normalized quantity of product *i* produced (the normalization is made by dividing the amount Q produced in any period by the average value of production)

p_i – normalized price of product *i* (which is defined as the price P of the product in a period divided by the average value of price)

Given (1), the square coefficient of variation can be written as:

$$CV^2(Y) = \alpha^2 \sum_i \sum_j s_i s_j E[(\Delta p_i \Delta q_i + \Delta p_i + \Delta q_i)(\Delta p_j \Delta q_j + \Delta p_j + \Delta q_j)] \quad (2)$$

Assuming normality of prices and quantity term, the terms that may be included into expression (1) are those which contain of even number in the products of the price and quantity terms. So (2), may rewritten as:

$$CV^2(Y) = \alpha^2 \sum_i \sum_j s_i s_j E[(\Delta p_i \Delta p_j \Delta q_i \Delta q_j + \Delta p_i \Delta p_j + \Delta p_i \Delta q_j + \Delta p_j \Delta q_i + \Delta q_i \Delta q_j)] \quad (3)$$

Coefficient of variation of income is just the square root of (3)

Let's denote by σ_i the coefficient of variation of production of the *i*th crop produced by the firm, by $\varkappa_{ij}$ the correlation coefficient between the production of the *i*th crop and the *j*th other crop produced by the firm, by v_i^w the coefficient of variation of the world price of the *i*th product, by ϱ_{ij} the correlation coefficient of world prices of the *i*th and *j*th products (if they are tradable), by v_i the coefficient of variation of the random component u_{it} of the domestic price of the *i*th product, and by ψ_{ij} the correlation coefficient between the random components u_{it} of the domestic prices of the *i*th and *j*th products.

The terms in (3) can be evaluated as follows:

$$E(\Delta p_i \Delta p_j \Delta q_i \Delta q_j) = (\varphi_i \varphi_j \rho_{ij} v_i^w v_j^w + \psi_{ij} v_i v_j) k_{ij} \sigma_i \sigma_j \quad (4)$$

$$E(\Delta p_i \Delta p_j) = \varphi_i \varphi_j \rho_{ij} v_i^w \, v_j^w + \psi_{ij} v_i v_j \quad (5)$$

$$E(\Delta p_i \Delta q_j) = 0 \quad (6)$$

$$E(\Delta q_i \Delta q_j) = k_{ij} \sigma_i \sigma_j \quad (7)$$

The parameter φ can be interpreted as the elasticity of transmission of world price to domestic price (prices are in logarithms) and shows to which extent the domestic and the world prices are integrated. Generally, by Law of One Price (Granger (1969), Engle and Granger (1987)) the relationship between domestic crop price P_{it}^{d} and world crop price P_{it}^{w} with transfer costs c is the following:

$$P_{it}^{d} = c + P_{it}^{w} \tag{8}$$

If such link between two prices, exists markets are considered as integrated but this case rarely occurs. But if the probability distributions of the two prices were found to be independent, then one may say that there is no market integration and no price transmission.

Empirically, this relationship may be defined by the following specification:

$$p_{it}^{d} = \alpha_i + \varphi_i p_{it}^{w} + u_{it} \tag{9}$$

where

p_{it}^{d} – domestic price of crop i,

p_{it}^{w} – international price of crop i,

φ_i - transmission coefficient,

u_{it} - error term.

So, by this equation, in the long-run in presence of tradability and transfer costs crop prices in the domestic market are defined by the world prices. Calculation of φ_i allows to compute CV of income for different groups of firms and to determine how they are exposed to different price shocks. Also, putting φ_i equal to zero it is possible to capture the factors which take place only on the domestic market such as production. And if contrary to this situation φ_i is set equal to 1 and variance of domestic error term equal to zero it will stimulate circumstances when the domestic prices are equal to the world prices or by the words to get situation when domestic firms are exposed to the world price shocks.

In the empirical applications, (9) can be extended to multivariate case or to Vector Autoregressive model (VAR), assuming that domestic and international prices time series are generated by stochastic process and their series are stationary.

Generally, a VAR model describes the evolution of a set of *n* variables measured over the same sample period (t = 1, ..., T) as a linear function of only their past evolution. The variables are collected in a $n \times 1$ vector y_t, which has as the i[th] element $y_{i,t}$ the time t observation of variable y_i

A (reduced) j-th order VAR, denoted *VAR(j)*, is

$$y_t = c + a_1 y_{t-1} + a_2 y_{t-2} + \ldots + a_j y_{t-j} + \varepsilon_t,$$

where c is a $n \times 1$ vector of constants (intercept), a_i is a $n \times n$ matrix (for every i = 1, ..., j) and ε_t is a $n \times 1$ vector of error terms called impulses or innovations satisfying:

$E(\varepsilon_t)$ =0 - every error term has mean zero;

$E(\varepsilon_t \varepsilon`)$ = Ω - the contemporaneous covariance matrix of error terms is Ω (a $n \times n$ positive definite matrix);

$E(\varepsilon_t \varepsilon_{t-k}^{`})$ =0 - for any non-zero k — there is no correlation across time; in particular, no serial correlation in individual error terms. The k-periods back observation y_{t-k} is called the k-th lag of y.

Usually, VAR is constructed for models with two or more variables with one equation for each variable in which current observation of each variable depends on its own lags and lags of other variables. Each variable affects another, so in VAR there is no need to distinguish between exogenous and endogenous variables. VAR can be estimated by OLS equation by equation which is consistent as $\varepsilon^{`}$s are assumed to be independent of the history of y.

VAR for prices will be the following:

$$p_{it}^{d} = c_1 + \sum_{j=1}^{k} a_{11,j} p_{it-j}^{d} + \sum_{j=1}^{k} a_{12,j} p_{it-j}^{w} + \varepsilon_{it}^{d} \tag{10}$$

$$p_{it}^{w} = c_1 + \sum_{j=1}^{k} a_{21,j} p_{it-j}^{w} + \sum_{j=1}^{k} a_{22,j} p_{it-j}^{d} + \varepsilon_{it}^{w} \tag{11}$$

where a's are parameters and ε's are error terms.

Parameters' and errors' estimation allows to forecast and to compute future means and variances of the prices. Assuming that economic agents behave according to VAR predictions both interrelated and separate impact of international and domestic price volatility on domestic price can be evaluated. Also, Granger causality test (Granger (1969)) which examines whether the lags of one variable enter into the equation of another variable can show presence (absence) of dependence between international and domestic prices. Let's assume, for example, that domestic price p_{it}^{d} does not Granger cause international price p_{it}^{w} but at the same time p_{it}^{d} depends on p_{it}^{w}. This means that impulses of the former are dependent and some share of volatility in the domestic price belongs to the shocks in world price and not conversely. This relationship has the following view:

$$\varepsilon_{it}^{d} = \varphi_i \varepsilon_{it}^{w} + \omega_{it};$$

where

φ_i is price elasticity and can be interpreted as in (9);

ω_{it} is part of a domestic price shock caused not by changes in the world price;

Contrasting to elements in (10) and (11), in this equation ε_{it}^{w} and φ_i have zero mean and constant variance.

Chapter 4

DATA DESCRIPTION

The data set that empirical investigation of this paper is based on contains economic activities of agricultural firms from all regions of Ukraine. The data comes from the statistical form 1-agreeculture collected by the State Statistics Committee.This content gives a possibility to divide the sample by territory belonging in order to determine special conditions of working in some region. Totally, there are five large regions: west (Chernivets'ka oblast', Ivano-Frankivs'ka oblast', Khmel'nyts'ka oblast', L'vivs'ka oblast', Rivnens'ka oblast', Ternopil's'ka oblast', Volyns'ka oblast', Zakarpats'ka oblast'), North (Zhytomyrs'ka oblast', Chernihivs'ka oblast', Kyivs'ka oblast', Sums'ka oblast'), Centre (Vinnyts'ka oblast', Cherkas'ka oblast', Poltavs'ka oblast', Kirovohrads'ka oblast', Dnipropetrovs'ka oblast'), East (Kharkivs'ka oblast', Luhans'ka oblast', Donets'ka oblast') and South (Khersons'ka oblast', Mykolaivs'ka oblast', Zaporiz'ka oblast', Odes'ka oblast', Avtonomna Respublika Krym). The number of firms is 10,000. The indicators of interest are total firm's gain and sales proceeds from each crop produced for the period of 4 years, beginning in 2002 and ending in 2005, that allows to capture the share of agricultural activity and portion of each culture in total income. According to this information, firms are divided depending on this share in total revenue. Also, firms are classified in the three groups depending on the size: small, medium and large. As criterion for the selection, the quantity of assets in money terms serves.

For estimating of price transmission coefficients , correlation coefficients and variances, monthly data on domestic crop (wheat, barley, sunflower, corn, sugar beet) prices are used gathered by the analytic centre of

"Ukragroconsult" (www.ukragroconsult.com) and given by the Institute for Economic Research and Policy Consulting (www.ier.kiev.ua) for the period 1998-2005, 96 observations in all. The prices are in US dollars per ton. International prices data is obtained from IMF survey (www.imf.org).

Table 4.1. Summary statistics for corn prices

Variable	Obs	Mean	Std. Dev.	Min	Max
World	96	135.3646	20.579	102	190
Domestic	96	125.2813	46.727	59	246

Table 4.2. Summary statistics for barley prices

Variable	Obs	Mean	Std. Dev.	Min	Max
World	96	92.4791	13.8655	71	121
Domestic	96	85.6875	26.3704	41	137

Table 4.3. Summary statistics for wheat prices

Variable	Obs	Mean	Std. Dev.	Min	Max
World	96	98.04167	11.1430	75	133
Domestic	96	90.82292	32.2699	50	184

Table 4.4. Summary statistics for sugar prices

Variable	Obs	Mean	Std. Dev.	Min	Max
World	96	65.3854	5.7553	56	78
Domestic	96	47.625	10.2907	26	83

Table 4.5. Summary statistics for sugar prices

Variable	Obs	Mean	Std. Dev.	Min	Max
World	96	222.3333	81.42283	116	408
Domestic	96	255.7083	175.6159	105	1183

C h a p t e r 5

EMPIRICAL RESULTS

Obtaining of the results consists of three steps: VAR estimation and price specification computation; calculation of the income structures and production specifications of the firms; computation of the final results.

Step 1

At this step, I estimated VAR models for each price series and calculated price specification (coefficients of variations, correlation) needed for computing coefficients of variation of income.

VAR estimation

First, in order to get transmission coefficient for every crop I have to estimate VAR model for these products. However, to be used in VAR model price series should be stationary. To check for stationarity, I used Dickey-Fuller (DF) test of presence of a unit root. If the value of DF statistics (Tau-statistics) is more than the critical value it shows the presence of a unit root and a series is not stationary. In the opposite case, a price series is stationary. But if price series is not stationary in levels, it only means that prices are not integrated of the same order and taking logarithms and differences may make them stationary. Then, for series being stationary I defined how many lags VAR model for each crop contains, estimated the models (regressions (10) and (11) in the methodology part), tested for stability, autocorrelation and Granger causality. Test results for each crop are presented in Appendixes A-E. If everything was clear I predicted residuals for each regression. The model for every product contains the two regressions. The first regression determines how domestic price depends on its own lags and the lags of the world price, the second regression defined the same for the world price. So, for each crop I got two series of residuals and then regressed residuals from the equation for domestic price on residuals from the equation for the world prices by the expression (12) in the methodology part. The result is price transmission coefficient estimation.

Now, let's consider VAR model for every crop separately.

Barley

Tau-statistics is less than critical values, thus I reject hypothesis about presence of unit root and I conclude that process is non-stationary. Therefore, logarithms of prices are taken which, however, are also nonstationary, but differences pass the test for stationarity. Model with differences of logarithms has three lags. Also, the eigenvalues lie inside the unit circle, thus, VAR model satisfies stability condition. Granger causality test shows that domestic price does not help to predict the world price; however, the world price Granger causes the domestic price. Testing for autocorrelation, I do not reject H_o at 5% significance level of no autocorrelation (P-value are large). Coefficient of price transmission is calculated regressing residuals from the equation for domestic prices on residuals from the equation for the world prices is in the the table 5.1:

Table 5.1. Transmission coefficient for barley prices

Coefficient, φ	P-value
0.049	0.830

The result shows that it is not statistically different from zero that probably means: the lags in the world price for barley have no essential influence on lags of the domestic price.

Corn

For this crop, price series in levels, both the world and domestic, are not stationary. DB statistics shows that I have to take the first differences. First differences of logarithms of corn prices do not have a unit root, so I can use it in calculations. VAR model for this product has two lags. Test for stability shows that characteristics roots are smaller than one in absolute value, so the system is stable. Test for Granger causality shows that world price influences on the domestic and vice versa. Testing for autocorrelation, I do not reject H_o at 5% significance level of no autocorrelation (P-value are large). Estimated price transmission coefficient (Table 5.2) is insignificant. This result implies that lags in the world price have no effect on lags in the domestic price.

Table 5.2. Transmission coefficient for corn prices

Coefficient, φ	P-value
0.044	0.832

Sugar beets

Testing for unit root presence, I conclude that series in levels are not stationary. Therefore, I took first differences of logarithms which, as DF test shows, pass test for stationarity. Estimated model contains 1 lag. Testing for stability, I inferred that series are stable because all characteristic roots are smaller than one in absolute value. Test for Granger causality shows that both domestic and world price have an impact on each other. Testing for autocorrelation, I do not reject H_o at 5% significance level of no autocorrelation (P-value are large). Price transmission coefficient (Table 5.3.) is not statistically different from zero, thus, the world price lags do not influence on the domestic price lags.

Table 5.3. Transmission coefficient for sugar beets prices

Coefficient, φ	P-value
-0.7676	0.108

Sunflower seeds

Test for staionarity shows that series are not stationary. However, first differences of logarithms do not have a unit root. The VAR model specification contains two lags. Test for stability shows that characteristics roots are smaller than one in absolute value, so the system is stable. Test for Granger causality shows that world price influences on the domestic and vice versa. Testing for autocorrelation, I do not reject H_o at 5% significance level of no autocorrelation (P-value are large). Price transmission coefficient (Table 5.4.) is not statistically different from zero, the world price lags do not influence on the domestic price lags.

Table 5.4. Transmission coefficient for sunflower seeds prices

Coefficient, φ	P-value
-0.039	0.900

Wheat

Testing for unit root presence, I conclude that series in levels are not stationary. DB statistics shows that I have to take the first differences. First differences of logarithms of wheat prices do not have a unit root, so I can use it in calculations. VAR model for this product has two lags. Test for stability shows that characteristics roots are smaller than one in absolute value, so the system is stable. Test for Granger causality shows that both domestic and world price have an impact on each other. Testing for autocorrelation I do not reject H_o at 5% significance level of no autocorrelation (P-value are large). Price transmission coefficient (Table 5.5.) is not statistically different from zero, the world price lags do not influence on the domestic price lags.

Table 5.5. Transmission coefficient for wheat prices

Coefficient, φ	P-value
0.095	0.601

In Table 5.6. calculated coefficients of variation of the world prices and random components of the domestic prices are presented. CV is computed as a ratio of the standard deviation to the mean. Random components are estimated from the regression (9) of the methodology part.

Table 5.6. CV's of world prices and random components of the domestic prices

Crop	CV(world)	CV(random)
barley	0.150	0.063
corn	0.114	0.064
sugar beeets	0.087	0.067
sunflower seeds	0.366	0.436
wheat	0.152	0.164

The table shows the largest variability exhibits prices of sunflower seeds.

Step 2

At this step I computed income structures (more specifically, share of every crop in firm's income) and production specification for each group (coefficients of variation (CV) of production, correlation coefficients between productions of different products) of the firms.

Share of every crop in firm's income is computed as a ratio of income from a culture production to a total income of a firm. Average shares for every group are presented in the Table 5.4.

Table 5.7. Average shares of income (percent)

Firm type	Small	Medium	Large
Region		West	
barley	21.85	21.58	20.83
corn	9.48	8.68	11.06
sugar beets	23.48	23.10	22.95
sun seeds	6.13	7.95	9.75
wheat	37.33	36.52	32.54
Region		North	
barley	23.52	22.86	21.00
corn	17.22	18.38	19.27
sugar beets	20.56	20.96	21.05
sun seeds	6.28	6.68	7.52
wheat	28.95	28.56	28.38
Region		Centre	
barley	16.11	15.99	14.27
corn	15.32	15.52	18.47
sugar beets	20.84	20.58	20.24
sun seeds	21.83	21.30	21.00
wheat	25.51	24.90	24.67
Region		East	
barley	13.96	13.87	12.87
corn	6.02	7.10	7.82
sugar beets	14.06	14.42	17.00
sun seeds	33.45	32.08	31.27
wheat	31.29	31.00	30.85
Region		South	
barley	14.66	14.61	14.48
corn	7.41	8.72	9.09
sugar beets	10.64	11.58	11.70
sun seeds	30.39	29.90	29.53
wheat	35.18	34.19	33.84

The table shows average share of income for the period of four years from cultivation of five crops for each group. Analyzing region differences, it is clear that in the West the main income sources for the enterprises are cultivation and selling of sugar beets and wheat, in the North such role belongs to barley and wheat, in the Centre almost equal shares (totally 66%) of income bring to farmers three crops: sugar beets, sun seeds and wheat, in the East the most significant parts of income have such cultures as sun seeds and wheat (totally 65%), the same situation as in the East is observed in the South but in this region average share of barley increases but share of sugar beets decreases. So, in almost each region wheat ranks very important role in income structure of the farmers, in four regions (North, West, Centre and South) it constitutes the largest fraction of enterprise income. Also, in each region (except Centre), besides wheat, some other crop amounts the significant part of income. For the West this is sugar beet, for the North it is barley, for the East and the South such crop is sunflower seed. This culture may be indicated as product of specialization for some particular region.

Analysis of the table in the context of firm size shows that shares of product of specialization decrease with increase of firm size and shares of non-specialization products, correspondingly, rise. This means that large firms in Ukraine use strategy of income diversification (they, however, have more possibilities for this) in order to reduce risk of bad harvest.

Calculated CV's of production are presented in the Table 5.5. For distributions of positive-valued random variables, it allows comparison of the variation of populations that have significantly different mean values (wikipedia.org). By other words, CV computation gives possibility to evaluate how production of every crop varies from year to year for each group.

Table5.8. Firm's production CV's

Firm type	Small	Medium	Large
Region		West	
barley	0.088	0.037	0.085
corn	0.307	0.321	0.498
sugar	0.137	0.240	0.530

sun seeds	0.386	0.276	0.169
wheat	0.409	0.406	0.488
Region	North		
barley	0.079	0.084	0.067
corn	0.229	0.089	0.509
sugar	0.149	0.057	0.282
sun seeds	0.320	0.433	0.384
wheat	0.559	0.551	0.585
Region	Centre		
barley	0.155	0.145	0.216
corn	0.243	0.227	0.419
sugar	0.392	0.245	0.397
sun seeds	0.282	0.271	0.355
wheat	0.612	0.614	0.630
Region	East		
barley	0.196	0.192	0.171
corn	0.451	0.392	0.406
sugar	0.219	0.226	0.243
sun seeds	0.132	0.154	0.204
wheat	0.498	0.500	0.564
Region	South		
barley	0.401	0.363	0.408
corn	0.426	0.441	0.441
sugar	0.398	0.305	0.254
sun seeds	0.260	0.227	0.286
wheat	0.555	0.565	0.554

Analysis of this table allows to determine production of which crops varies greatly from year to year or, by other words, which cultures add to income uncertainty due to production shocks most significantly and which regions are exposed to these shock to great extent comparing with other regions. So, for all regions and firm groups the most unpredictable is cultivation of wheat.

Step 3

After computation of all components (formulas (4)-(7) in the methodology part) needed for coefficient of variation calculation, at this step I have to get the final results of the paper. The average CV's of income are presented in the table 5.6.

Table 5.9. CV's of agricultural income

Firm type	Small	Medium	Large
Region	West		
Actual income CV's due to price and production shocks	6.8	11.19	20.53
Agricultural income CV's due to domestic market and production shocks	4.91	9.95	19.83
Simulated Agricultural income CV's due to world prices and production shocks	5.84	10.35	20.01
Region	North		
Actual income CV's due to price and production shocks	5.32	6.01	18.36
Agricultural income CV's due to domestic market and production shocks	3.04	3.98	17.75
Simulated Agricultural income CV's due to world prices and production shocks	4.42	5.07	18.01
Region	Centre		
Actual income CV's due to price and production shocks	6.34	10.58	20.93
Agricultural income CV's due to domestic market and production shocks	4.12	8.76	20.00
Simulated Agricultural income CV's due to world prices and production shocks	4.18	8.81	20.01
Region	East		
Actual income CV's due to price and production shocks	12.24	10.85	16.20
Agricultural income CV's due to domestic market and production shocks	9.50	7.72	14.28
Simulated Agricultural income CV's due to world prices and production shocks	9.14	7.32	14.00
Region	South		
Actual income CV's due to price and production shocks	11.27	8.43	16.61
Agricultural income CV's due to domestic market and production shocks	8.27	3.96	14.72
Simulated Agricultural income CV's	8.12	3.71	14.63

due to world prices and production shocks			

First, I would like to mention that my results may slightly underestimate truth CV's of income as I do not use in my research data on crops (buckwheat, pea, soy bean etc.), which constitute share of farmer's income less than 1%.

The obtained results show that actual CV's of agricultural income in Ukraine range from not significant (5%) to relatively large (20%). It means that some firms' profits varies from year to year by 5% and some have variability of income of 20%. The pattern demonstrates that index depends on the size of a firm. In each region, a group with the largest firms possesses the highest coefficient of variation. The fact that larger firms face with higher income uncertainty may be explained by the results from the table 5.4. According to them, large firms diversify their income so as to reduce price and production risks. However, results show that diversification does not work in Ukraine because such firms have higher income volatility. Also, such output may be explained by absence of appropriate infrastructure in Ukraine. Very often, agricultural firms, especially large, have no suitable place where to save production and vehicles to deliver it to a buyer. These imperfections force them to sell production right away after harvest at low price accepting conditions of a contract of a buyer or to run a risk of having spoiled production in the future. Comparing regions, I conclude that enterprises in the East and South are more than others exposed to price and production volatility. As on average significant share of income of the firms in these regions constitute wheat and sun seeds (Table 5.4.), so, these cultures more than others add to income instability. Also, production CV's of wheat are high but sun seeds CV's are low, it means that large share of shocks from wheat is due to production shocks but sun seeds price shocks have more adverse effect. Enterprises in other region have about equal CV's of income.

For all regions and farms' groups, the results designate that about all income instability firms suffer is caused by the domestic factors, price and production shocks. It means that government policy, system of donations and price support aimed to stabilize prices and production on the agricultural market has no desirable effect.

Results of simulation the situation when Ukrainian farmers are fully exposed to the world price shocks show that for all regions and groups income instability slightly decreases. It means that integration of the Ukrainian agricultural market with the world would decrease income uncertainty of farmers, stabilize prices and smooth production shocks.

Chapter 6

CONCLUSIONS

The paper was devoted to the investigation of the issue of price volatility impact on farmers' income. To be more precise, the research tried to answer the question of which price shocks, domestic or world, income stability of Ukrainian agricultural producers is influenced by and whether increased exposure to the world markets will reduce or make higher income uncertainty.

In the investigation, the explicit formula for income variance computation is used. In the formula, production specifications and income structures of the agricultural producers are combined with price transmission coefficients and other price specification of the crops. Price transmission coefficients are estimated for every by VAR model. The main finding of the VAR estimation is that for each culture there is no essential relationship between lags of the domestic price and lags of the world price. Also, the formula gives possibility to simulate situation when firms are exposed to domestic shocks or situation when enterprises are directly exposed to the world price shocks. In order to capture specific region and firm characteristics, data set of enterprises is divided by regional belonging and by firm size, depending on the amount of assets. Then, the average coefficient of variation for each group is computed.

In Ukraine, the actual coefficient of variation of income for agricultural producers varies from 5% to 20% which relatively large range, as 5% is not essential index but 20% is rather significant. These results, however, do not contradict to the results of previous investigations.

Income variability increases with size of a firm. As the largest firms more often than other types use diversification strategy the results conclude that in Ukraine diversification does not help farmers to reduce income instability. In the context of region differences firms in the East and South more than others suffer from income instability. As significant share of firms' income belong to wheat and sun seeds, price and production shocks of these crops significantly add to income instability.

In Ukraine, for all groups of farmers the origin of almost all income variability are domestic factors. The reasons of this fact are small from the world to domestic price transmission and not effective price stabilization policy of the Ukrainian government concerning the agricultural market.

Market liberalization would slightly decrease income uncertainty of agricultural producers. Increased exposure to the world markets with nonexistence of efficient price stabilization policy may be expressed into decline of income instability.

The results of the paper can have some important policy implications to the Ukrainian government:

- stabilization and support policy should be reviewed, direct donation mechanism should be replaced by the policy which has long-run prospective (infrastructure creation etc.), direct instruments of price stabilization existing now should be replace by those which promote competition on the market;

- government support should be concentrated on large firms, in the South and in East, as such type enterprises and firms in these region more than others suffer from income uncertainty;

In further research it would be interesting to compute coefficients of variations in other former Soviet Union countries and to compare them with the results of the paper. Also, it would be useful to evaluate income instability after market liberalization which is expected following WTO accession.

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APPENDIX A TEST RESULTS OF BARLEY PRICES

Checking difference of logarithm of domestic price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	---------- Interpolated Dickey-Fuller --------- 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-7.870	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Checking difference of logarithm of domestic price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	---------- Interpolated Dickey-Fuller --------- 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.711	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Defining the number of lags

Selection order criteria
Sample: 6 96 Number of obs = 91

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	227.072				.000024	-4.94664	-4.92438	-4.89145
1	239.781	25.418	4	0.000	.00002	-5.13805	-5.07126*	-4.97249*
2	242.997	6.4314	4	0.169	.00002	-5.12081	-5.00949	-4.84489
3	249.916	13.839*	4	0.008	.000019*	-5.18497*	-5.02913	-4.79868
4	251.095	2.357	4	0.670	.00002	-5.12296	-4.92259	-4.62631

Endogenous: D.ln_d D.ln_w

Exogenous: _cons

Checking for staility

Eigenvalue stability condition

Eigenvalue	Modulus
.4478689 + .6306974i	.773541
.4478689 - .6306974i	.773541
.4860138	.486014
-.3092807	.309281
-.2561715 + .1490877i	.296397
-.2561715 - .1490877i	.296397

All the eigenvalues lie inside the unit circle
VAR satisfies stability condition

Checking for autocorrelation

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	1.3314	4	0.85602
2	0.7344	4	0.94702

H0: no autocorrelation at lag order

Checking for Granger causality

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
D_ln_d	D.ln_w	15.02	3	0.002
D_ln_d	ALL	15.02	3	0.002
D_ln_w	D.ln_d	2.5615	3	0.464
D_ln_w	ALL	2.5615	3	0.464

APPENDIX B TEST RESULTS OF CORN PRICES

Checking difference of logarithm of domestic price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-7.519	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Checking difference of logarithm of world price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-7.496	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Defining the number of lags

Selection order criteria
Sample: 6 96 Number of obs = 91

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	221.296				.000028	-4.81969	-4.79743*	-4.76451*
1	226.481	10.371*	4	0.035	.000027	-4.84575	-4.77896	-4.6802
2	230.589	8.2144	4	0.084	.000027*	-4.8481*	-4.73679	-4.57218
3	231.795	2.4119	4	0.660	.000029	-4.78669	-4.63085	-4.40041
4	233.206	2.8229	4	0.588	.00003	-4.7298	-4.52943	-4.23315

Endogenous: D.ln_d D.ln_w
Exogenous:_cons

Checking for staility

Eigenvalue stability condition

Eigenvalue	Modulus
.2505507	.250551
.2179618	.217962

All the eigenvalues lie inside the unit circle
VAR satisfies stability condition

Checking for autocorrelation

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	7.9673	4	0.09278
2	9.2603	4	0.05491

H0: no autocorrelation at lag order

Checking for Granger causality

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
D_ln_d	D.ln_w	.12256	1	0.726
D_ln_d	ALL	.12256	1	0.726
D_ln_w	D.ln_d	.00488	1	0.944
D_ln_w	ALL	.00488	1	0.944

APPENDIX C TEST RESULTS OF SUGAR PRICES

Checking difference of logarithm of domestic price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-9.031	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Checking difference of logarithm of world price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-8.416	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Defining the number of lags

Selection order criteria
Sample: 6 96 Number of obs = 91

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	318.821				3.2e-06*	-6.9631*	-6.94084*	-6.90792*
1	319.855	2.0672	4	0.723	3.5e-06	-6.8979	-6.83111	-6.73235
2	321.071	2.4319	4	0.657	3.7e-06	-6.83672	-6.7254	-6.5608
3	322.238	2.3347	4	0.674	3.9e-06	-6.77446	-6.61862	-6.38817
4	323.241	2.0052	4	0.735	4.2e-06	-6.70858	-6.50821	-6.21193

Endogenous: D.ln_d D.ln_w
Exogenous: _cons

Checking for staility

Eigenvalue stability condition

Eigenvalue	Modulus
.1020888	.102089
.08497342	.084973

All the eigenvalues lie inside the unit circle
VAR satisfies stability condition

Checking for autocorrelation

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	5.0543	4	0.28177
2	2.6556	4	0.61701

H0: no autocorrelation at lag order

Checking for Granger causality

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
D_ln_d	D.ln_w	.64884	1	0.421
D_ln_d	ALL	.64884	1	0.421
D_ln_w	D.ln_d	.03019	1	0.862
D_ln_w	ALL	.03019	1	0.862

APPENDIX D TEST RESULTS OF SUNFLOWER SEEDS PRICES

Checking difference of logarithm of domestic price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-9.751	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Checking difference of logarithm of world price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-7.228	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Defining the number of lags

Selection order criteria

Sample: 6 96 Number of obs = 91

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	135.629				.000182	-2.9369	-2.91463*	-2.88171*
1	139.402	7.5456	4	0.110	.000183	-2.9319	-2.86511	-2.76635
2	144.302	9.8015*	4	0.044	.000179*	-2.9517*	-2.84038	-2.67578
3	145.749	2.8927	4	0.576	.00019	-2.89557	-2.73973	-2.50929
4	149.543	7.5884	4	0.108	.000191	-2.89105	-2.69068	-2.3944

Endogenous: D.ln_d D.ln_w

Exogenous: _cons

Checking for staility

Eigenvalue stability condition

Eigenvalue	Modulus
.2858723	.285872
-.0318384	.031838

All the eigenvalues lie inside the unit circle
VAR satisfies stability condition

Checking for autocorrelation

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	9.3794	4	0.05228
2	9.7929	4	0.04407

H0: no autocorrelation at lag order

Checking for Granger causality

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
D_ln_d	D.ln_w	.4123	1	0.521
D_ln_d	ALL	.4123	1	0.521
D_ln_w	D.ln_d	.34302	1	0.558
D_ln_w	ALL	.34302	1	0.558

APPENDIX E TEST RESULTS OF WHEAT PRICES

Checking difference of logarithm of domestic price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	---------- Interpolated Dickey-Fuller --------- 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.217	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Checking difference of logarithm of world price for a unit root

Dickey-Fuller test for unit root Number of obs = 94

	Test Statistic	---------- Interpolated Dickey-Fuller --------- 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-8.161	-3.518	-2.895	-2.582

MacKinnon approximate p-value for Z(t) = 0.0000

Defining the number of lags

Selection order criteria
Sample: 6 96 Number of obs = 91

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	221.158				.000028	-4.81665	-4.79439	-4.76147
1	235.179	28.042*	4	0.000	.000022*	-5.03689*	-4.97011*	-4.87134*
2	236.445	2.5331	4	0.639	.000024	-4.97682	-4.8655	-4.7009
3	238.736	4.5822	4	0.333	.000025	-4.93926	-4.78342	-4.55297
4	241.089	4.7048	4	0.319	.000025	-4.90305	-4.70268	-4.4064

Endogenous: D.ln_d D.ln_w
Exogenous: _cons

Checking for staility

Eigenvalue stability condition

Eigenvalue	Modulus
.4460849	.446085
.1874392 + .2556638i	.317013
.1874392 - .2556638i	.317013
-.2693172	.269317

All the eigenvalues lie inside the unit circle
VAR satisfies stability condition

Checking for autocorrelation

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	4.4844	4	0.34440
2	2.9131	4	0.57246

H0: no autocorrelation at lag order

Checking for Granger causality

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
D_ln_d	D.ln_w	7.0286	2	0.030
D_ln_d	ALL	7.0286	2	0.030
D_ln_w	D.ln_d	4.4596	2	0.108
D_ln_w	ALL	4.4596	2	0.108