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Price Transmission Channels of Energy and Exchange Rate on Food Sector: A Disaggregated Approach based on Stage of Process

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Abstract

The recent concurrent surges of food and energy prices renew our interest on the vulnerability of food system to sudden changes in the energy sector. Unlike previous studies focusing on the impacts of a single energy price on food sector, this study explores such dependency utilizing various food and energy prices classified by stage of processing. Based on the method proposed by Toda and Yamamoto(1995) and Dolado and Lütkepohl(1996) of Granger causality tests, we identify how the movements of the exchange rate and the various energy prices affect on the food prices from farmers to consumers.

Key Words : Energy price, Exchange rate, Food price, Price transmission Channels, Processing stages of food. Granger causality test
JEL Codes : Q40, Q10

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Ⅰ. Introduction

The United States(U.S.) economy heavily depends on energy consumption. The overall food system, from farmers to consumers, is not an exception[1). Despite such dependency of the food system on energy consumption, the energy price usually had been relatively low enough not to raise public concerns, except the oil price surge in the early 1970s and 1980s. For example, oil prices were roughly $20 per barrel during most of the 1990s and energy costs were smaller share of production costs and consumer budget than 1970s-80s(Bernanke, 2004).

However, the heavy dependency of the food system on the energy sector is demonstrated through the consequence vulnerability of the food system to sudden changes in the energy sector in several occasions. Especially the recent food inflation phenomenon raised public concerns with the almost simultaneous surge of energy price as the main factor for such food price hike(e.g., Abbott, Hurt, and Tyner 2008) and several studies have been conducted in this respects based on assumed causal structures. However, causal structures need to be

1) According to the Earth Policy Institute, the U.S. food system uses over 10 quadrillion Btu(10,551 quadrillion Joules) of energy each year, which is as much as France’s annual energy consumption and comprises about 10% of the total U.S. energy consumption (Murray, 2005). In addition to the agricultural production, the overall food processing and distribution systems also heavily rely on the energy sector. For example, Heller and Keoleian(2000) suggest that almost 41% is used in the processing and distribution system (14% goes to food transport, 16% to processing, 7% to packing, and 4% to food retailing) and 32% is used to home refrigeration and preparation, while approximately 21% of the total energy consumption in the food system is used in agricultural production.

inductively inferred for empirical investigations for such arguments and the detailed information of linkage channel among energy and food prices need to be empirically identified for figuring out possible countermeasures[2].

Various studies are conducted to examine the effect of energy price fluctuation on the economy. In the literature on the nexus between oil price and macroeconomy, numerous studies provide empirical evidences that rising oil prices slow economic growth and stimulate inflation, and also identify various channels through which energy price fluctuations affect the overall economy (e.g., Brown and Yücel 2002, Jones, Leiby, and Paik 2004 and references in there). For example, Hamilton(1983) demonstrated that oil price shock had proceeded all but one recession in the terms of Granger causality[3].

In the study regarding the impact of energy price on the agricultural sector, Hanson, Robinson, and Schluter(1993), among others, use Computable General Equilibrium(CGE) model to analyze the direct and indirect cost linkages among three energy sectors(crude oil and gas, petroleum refining, and electric and gas utilities) and various agricultural production and processing sectors. Under the scenario that the high oil price results in a depreciation of the dollar, which in turn stimulates agricultural exports[4], they show that the rising energy and agricultural prices result in the increased consumer food prices. In the investigation on price linkage of oil and commodity prices, Baffes(2007) find that the price indexes for fertilizer and food commodities exhibit the highest pass-through of oil price changes among the various non-energy commodity

2) The disaggregate approach taken this study can be important if we are to prepare countermeasure plans for each processing stage for the possibile price hike.

3) Hamilton(1983)'s such findings made a definitive contribution to expanding researchers' attention to the entire period beyond several occasions of oil price shocks.

4) Hanson, Robinson, and Schluter(1993) use such scenario as a plausible assumption without empirical investigation. Thus we still need the empirical study for the detailed transmission channels among energy and food prices with the exchange rate.

indexes, based on annual data from 1960 to 2005.

In this study, we aim to identify the transmission mechanism of energy prices on overall food prices. For that purpose, three kinds of energy prices and four different kinds of food prices are adopted based on the stage of process(SOP) system classified by the Bureau of Labor Statistics(BLS). The main motivation to utilize the SOP system is that diverse kinds of energy can affect the overall food system at various stages in a number of different ways[5].

Our approach is distinct from previous literature in several ways. and may contributes the literature on price linkages between energy and food sectors First, while previous studies focused on the single measure of energy price such as the crude oil price, this study uses diverse energy prices classified by the SOP system of producer price index(PPI) incorporating crude, intermediate, and finished stages. By using more disaggregated information than previous literature, we can obtain more detailed information on the energy-food price transmission mechanism.

Second, we explore the effects of energy price on the overall food sectors, covering processing and distributional systems not only the agricultural production, focused in the previous studies. The SOP system is further extended to integrate consumer price index(CPI) for food at home to examine the recent food inflation phenomenon at retail level. The use of broad food prices from crude, intermediate, finished, and retail stages allow us to investigate whether the recent food inflation is derived by the cost-push(e.g., Engel 1978) or

5) For example, the 34% of energy use in agricultural production is directly consumed as diesel and gasoline by farm vehicles for planting, tilling, and harvesting. On the other hand, the 35% is indirectly used in the form of fertilizer and pesticides, which are manufactured from natural gas and petroleum(Murray 2005). Beyond agricultural production, food processing and packing sectors use 23% of various kinds of energy consumed in the food system as the proliferation of processed food with small packages requires various energy consumptions.

demand-pull mechanism(e.g., Granger, Robinsons and Engle 1986).

Third, our analysis incorporates the exchange rate in analyzing the relationship between energy and food prices. Under the global economy, it is plausible that the high oil price can result in depreciation of the U.S. dollar, which in turn stimulate agricultural exports and hence boost food prices(e.g. Hanson, Robinson, and Schluter 1993). It is also observed that the depreciation of the U.S. dollar is one of key factors contributing to the recent food inflation (e.g. Abbott, Hurt, and Tyner 2008). By incorporating the exchange rate, we can further investigate whether the exchange rate affects the energy price due to denomination effect of the U.S. dollar(e.g., Zhang, Fan, Tsai, and Wei 2008) or vice versa because of the impact of the energy price on current account (e.g., Chen and Chen 2007).

Finally, we utilize more robust method of the Granger causality test than the usual multivariate VAR approach used in the previous studies by adopting the method proposed by Toda and Yamamoto(1995) and Dolado and Lütkepohl (1996)(TYDL). The recent time-series studies(e.g., Yamada and Toda 1998, Giles and Mirza 1999, and Clarke and Mirza 2006) demonstrate robustness of the TYDL approach over a wide range of stationary, near-integrated, and cointegrated systems, compared to some drawbacks of the vector error correction model(VECM) or fully modified VAR methods, when the research objective is not detecting the presence/absence of unit roots or possible long-run(cointegrating) relationships.

In the following Empirical Procedure section, the Toda and Yamamoto(1995) and Dolado and Lütkepohl(1996)(TYDL) method is discussed with the description of data used in this study. In Empirical Results section, empirically inferred transmission channels from energy to food with exchange rate is provided. The results are discussed in terms of the price transmission mechanism within the food system and linkages of energy prices and exchange rate. The final section provides summary of overall findings with some concluding remarks for the future study.

Ⅱ. Empirical Procedure

1. Econometrics Considerations

The Granger causality(Granger 1969) is the most common concept for causality analysis in literature. For example, Hamilton(1983) established relationships between energy price and macroeconomic variables based on the Granger non-causality(GNC) test. There have been three approaches to implement GNC test, depending on time-series properties of variables: a VAR model in the level data(VARL), a VAR model in the first-differenced data (VARD), and a vector error correction model(VECM).

However, the non-stationary properties such as unit roots and cointegration can result in statistical complications for testing GNC. Under some conditions, the VARL can involve a singular covariance matrix that may result in a non-standard asymptotic null distribution(e.g., Toda and Phillips, 1993) and the Least Square regression involving variables with unit roots may give rise to a spurious regression(e.g., Granger and Newbold 1974). When the series are cointegrated, the VARD may be misspecified as potential causality from the long-run relationship and thus some forecastability or Granger causality from one variable to the other is ignored(Engel and Granger 1987).

In this respect, the VECM is frequently used when cointegration is suspected. However, (i) GNC test in VECM involves the nonlinearity, where represents cointegrating vector and captures the speed of adjustment to such long-run relationship, and (ii) the asymptotic distribution of test statistics can be non-standard and may involve nuisance parameters unless the data meet the certain rank condition of submatrices in the cointegration space, which is not always satisfied under the null hypotheses(Toda and Phillips 1993)[6].

To address this issue, Toda and Yamamoto(1995) and Dolado and Lutkepohl (1996)(TYDL) demonstrate that (i) given the nonstandard asymptotic properties of the test statistics are due to the singularity of the asymptotic distribution of the LS estimator, the main issue is to find alternative, which result in a nonsingular asymptotic distribution of the relevant estimator to overcome the complicated nonstandard limiting properties and (ii) the singularity in a nonstationary system can be removed by fitting a augmented VARL model. Its order exceeds the true order by the highest degree of integration in the system as follows:

$$(5)\quad Z_t = c + \sum_{i=1}^{k} \Phi_i Z_{t-i} + \sum_{j=1}^{d} \Phi_{k+j} Z_{t-k-j} + \epsilon_t, \qquad H: R_M(\Phi_1, \ldots, \Phi_k) = 0$$

where k is the true lag length, d is the maximal order of integration among variables in the system, $vec(.)$ represents to stack the row of a matrix in a

6) Toda and Phillips(1993) suggest a sequential test procedure involving non-stationary, cointegration, and rank condition of certain submatrices in the cointegration space. However, such pretesting strategy has unknown overall properties with generally low statistical power, can leave the possibility to chose the inappropriate model for GNC test and lead to the misleading conclusion for GNC. Such possibilities are demonstrated by several simulation studies(e.g., Yamada and Toda 1998, Giles and Mirza 1999, Clarke and Mirza 2006).

column vector, R_M is the appropriate selection vector corresponding to a specific GNC hypothesis and Z_t is vector of exchange rate and disaggregated energy and food prices based on the SOP system[7].

Although there exist efficiency and power loss by augmenting extra lags, recent simulation studies(e.g., Yamada and Toda 1998, Giles and Mirza 1999, Clarke and Mirza 2006) demonstrate that (i) the TYDL method is better control the type I error probability than other methods based on the VARL, VARD, and VECM, (ii) the power loss in the TYDL approach is relatively minor for moderate and large sample sizes, and (iii) the TYDL approach results in a consistent performance over a wide range of systems, including stationary, near-integrated, and cointegrated systems, even for the mixed integrated systems. Consequently, the recent time-series literature(e.g., Yamada and Toda 1998, Giles and Mirza 1999, Clarke and Mirza 2006) recommends to use the TYDL approach, when the research objective is not detecting the presence(or absence) of unit roots or possible long-run(cointegrating) relationships.

In this study, we aims to infer detailed transmission channels among energy and food prices based on the Granger causality test of the possible cointegrated VAR models with I(0) /I(1) variables of food and energy prices with exchange rate. Thus the mentioned advantages of TYDL model over other Granger causality test models is utilized in this study, given that this study does not pursue to investigate the possible long-run cointegrating relationships,

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7) TYDL further prove that (iii) the hypothesis can be tested based on asymptotic χ^2 distribution by using modified Wald statistics while ignoring the coefficient matrix of the augmented lag in the estimated equation, which is a zero matrix by assumption, and (iv) it is valid to use the commonly used lag length selection procedure such as the general-to-specific method, based on sequential Likelihood Ratio(LR) test.

2. Data Description

To trace the impacts of various energy prices on the food prices at different stages of process, we collect several monthly price indexes based on the SOP system from January 1998 to July 2008: the PPI indexes of crude energy goods(denoted by CE), intermediate energy goods(IE), finished energy goods (FE), crude foodstuffs and feedstuffs(CF), intermediate foods and feeds(IF), and finished consumer foods(FF), and Consumer Price Index of food at home(HF).

According to BLS, the coverage of each index is as follows: crude petroleum, natural gas, coal, etc. for CE; diesel fuel, industrial natural gas, commercial electric power, etc. for IE; gasoline, residential natural gas, residential electric power, etc. for FE; wheat, corn, soybeans, fluid milk, etc. for CF; flour, prepared animal feeds, fluid milk products, etc. for IF; pork, dairy products, processed fruits and vegetables, etc. for FF. The CPI index for food at home represents the food price at retail level, which encompasses the similar product coverage of PPI index for the finished food. All data are seasonally adjusted and log transformed. The real effective exchange rate variable(ER) from International Monetary Fund(IMF) is also incorporated to investigate the claimed nexus of exchange rate with energy and/or food prices as discussed.

Ⅲ. Empirical Results

1. Preliminary Analysis

The main objective of this study is to understand how various energy prices affect the food prices at different stages of process, not vice versa. In addition, to avoid the multicollinearity problem among three kinds of energy prices and to address the degree-of-freedom issue in the multivariate Granger causality test framework, we develop three cases of granger causality test model among ER, CF, IF, FF, FF, HF, and one of CE, IE, and FE for each case. The case I incorporates relationship between the crude energy price and the crude, intermediate, finished food price indexes and exchange rate variable. And the case II(and III) encompasses the relationship between the intermediate(finished) energy price index with the common variables of the food prices at various stages of process and the exchange rate.

Following Toda and Yamamoto(1995), the general-to-specific method, based on sequential Likelihood Ratio(LR) test, is applied to determine appropriate lag length. For the case I, the hypothesis test of reduction of lag length from 3 to 2 results in a LR test statistic of 53.56 with a p-value of 0.03, while those from 2 to 1 are 85.10 and 0.00, respectively. Diagnostic statistics of the Lagrange Multiplier(LM) test for the absence of auto-correlation in residual show that the p-value of LM test for order 1(and 2) are 0.32(and 0.05) for the two lag length VAR specification. For the case II(and III), the LR test statistic is 47.00 with p-value 0.10(45.87 with 0.13) for lag length reduction from 3 to 2, while those from 2 to 1 are 87.35 and 0.00(83.43 and 0.00), respectively. The p-values of LM tests against order 1 and 2 are 0.20 and 0.13(0.49 and 0.14) for two lag length specification in the case II(and III). These results suggest that lag length of two is appropriate for the subsequent analyses without concern for the autocorrelation problem for all the three cases.

2. Price Transmission Mechanism within the Food System

Based on the above preliminary results, the Granger non-causality(GNC) tests are conducted based on the TYDL method, using the two lag length specification and assuming maximum integration order(d) of one. The modified Wald statistics and p-values are reported in Tables 1, 2, and 3 for cases I, II, and III, respectively. The identified causal flows in Granger sense in Tables 1, 2, and 3 are summarized in the corresponding Figures 1, 2, and 3.

In addition, the overall causal structure we might draw from the overall results of three cases is recapitulated in Figure 4. In Figures 1-4, each(and dotted) arrow represents the identified causal flow at least 5%(and 10%) significant level in Granger sense, given that the p-value of less than 5% indicates rejection of the null hypothesis of Granger non-causality at the 95% confidence level.

The identified price transmission mechanism within the food system is quite robust with regard to the variations among the three cases. The crude(and finished) food price Granger causes the intermediate food(home food) price at the 1% significance level. Despite the absence of causal link between the intermediate food and the finished food prices, the causal flow from crude to finished food prices and causal relationship from intermediate to home food prices connect the overall cost-push mechanism at least 6.1% significance level[8].

Such results can be explained by the facts that the intermediate stage is defined as residuals after defining the crude and finished stage(BLS 2008). As Gaddie and Zoller(1988) pinpoint, part of output at a given stage of process can be used by stages of process beyond the next sequential stage of process (skip mechanism in SOP system), since the complicated industrial relationships preclude the clear division of goods into three stages. Considering such aspects, the non-robust results of the demand-pull mechanism from the intermediate to crude food prices can be also explained, given that causal relationship is statistically significant only at the 9.9% significant level in the case I.

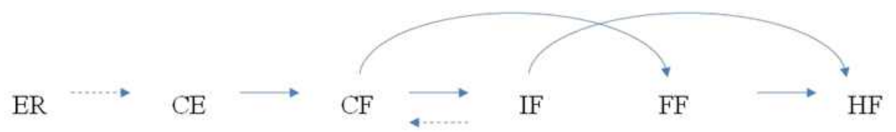
8) Although the Granger causality is the most common concept for causality analysis in literature and used in this study, there exist conceptual difference between the philosophical notion based on manipulation and the statistical concept based on predictability and thus we need to be cautions against over-interpreting the empirical results based on the Granger causality concept. For example, the causal direction form crude(and finished) to intermediate(home) food prices inferred here only suggest the cost-push mechanism in terms of Granger causality concept.

Table 1. Modified Wald Test Result for Case I

Dependent Variable	CE	CF	IF	FF	HF	ER
CE	- -	1.354 0.508	1.096 0.578	2.150 0.341	2.822 0.244	5.464* 0.065*
CF	8.661** 0.013**	- -	4.629* 0.099*	0.762 0.683	0.454 0.797	1.576 0.455
IF	1.998 0.368	1.532*** 0.003***	- -	1.134 0.567	1.551 0.460	0.563 0.755
FF	2.222 0.329	5.610* 0.061*	3.660 0.160	- -	0.834 0.659	1.825 0.402
HF	3.445 0.179	2.834 0.242	11.566*** 0.003***	28.921*** 0.000***	- -	1.894 0.388
ER	3.720 0.156	0.348 0.840	0.771 0.680	0.096 0.953	0.452 0.798	- -

Note: 1) CE, IE, FE, CF, IF, FF, HF, and ER denote the PPI index of crude energy and intermediate energy, finished energy, crude foodstuffs and feedstuffs, intermediate foods and feeds, and finished consumer foods, and CPI indexes of food at home, and Exchange Rate, respectively.
2) The asterisks of ***, **, and * represent statistically significant at 1, 5, and 10 %, respectively. For each cell, first and second number is and corresponding p-value, respectively.

Figure 1. Price Transmission Mechanism for Case I



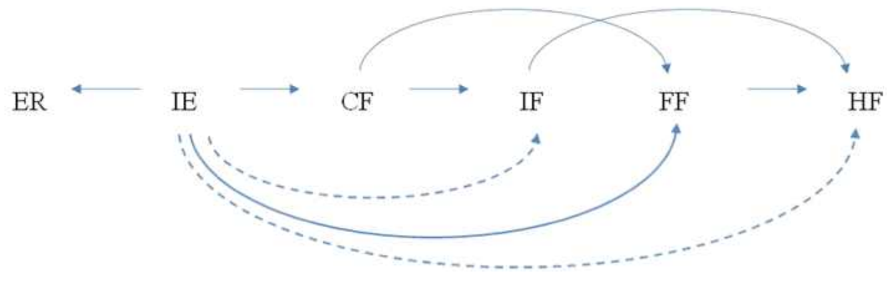
Note: see note in Table 1 and refer Table 1 for a specific significant level. Each(and dotted) arrow represents the identified causal flow at least 5%(and 10%) significant level in Granger sense.

Table 2. Modified Wald Test Result for Case II

Dependent Variable	IE	CF	IF	FF	HF	ER
IE	- -	0.362 0.834	0.720 0.698	0.533 0.766	0.174 0.916	1.583 0.453
CF	10.730*** 0.005***	- -	4.311 0.116	0.295 0.863	0.511 0.774	1.257 0.533
IF	5.535* 0.063*	10.976*** 0.004***	- -	0.744 0.689	2.013 0.365	0.769 0.681
FF	6.286** 0.043**	6.173** 0.046**	3.846 0.146	- -	1.073 0.585	0.246 0.536
HF	5.442* 0.066*	1.960 0.375	10.619*** 0.005***	27.967*** 0.000***	- -	1.718 0.424
ER	8.807** 0.012**	0.333 0.846	1.030 0.597	0.136 0.934	0.213 0.899	- -

Note: 1) CE, IE, FE, CF, IF, FF, HF, and ER denote the PPI index of crude energy and intermediate energy, finished energy, crude foodstuffs and feedstuffs, intermediate foods and feeds, and finished consumer foods, and CPI indexes of food at home, and Exchange Rate, respectively.
2) The asterisks of ***, **, and * represent statistically significant at 1, 5, and 10 %, respectively. For each cell, first and second number is and corresponding p-value, respectively.

Figure 2. Price Transmission Mechanism for Case II



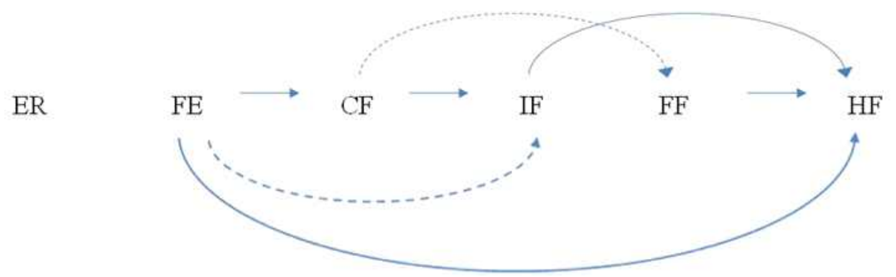
Note: see note in Figure 1 and refer Table 2 for a specific significant level.

Table 3. Modified Wald Test Result for Case III

Dependent Variable	FE	CF	IF	FF	HF	ER
FE	- -	0.493 0.782	0.703 0.704	0.386 0.824	0.703 0.704	1.520 0.468
CF	6.685** 0.035**	- -	4.396 0.111	0.302 0.860	0.591 0.744	1.281 0.527
IF	4.878* 0.087*	10.608*** 0.005***	- -	0.805 0.669	2.364 0.307	1.019 0.601
FF	3.972 0.137	5.724* 0.057*	3.927 0.140	- -	0.910 0.635	1.662 0.436
HF	7.473** 0.024**	2.321 0.313	11.787*** 0.003***	28.485*** 0.000***	- -	2.470 0.291
ER	3.264 0.196	0.212 0.899	0.871 0.647	0.087 0.958	0.178 0.915	- -

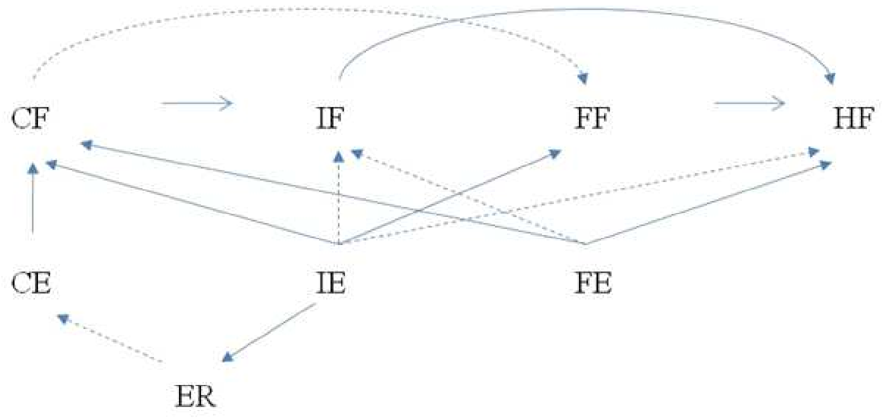
Note: 1) CE, IE, FE, CF, IF, FF, HF, and ER denote the PPI index of crude energy and intermediate energy, finished energy, crude foodstuffs and feedstuffs, intermediate foods and feeds, and finished consumer foods, and CPI indexes of food at home, and Exchange Rate, respectively.
2) The asterisks of ***, **, and * represent statistically significant at 1, 5, and 10 %, respectively. For each cell, first and second number is and corresponding p-value, respectively.

Figure 3. Price Transmission Mechanism for Case III



Note: see note in Figure 1 and refer Table 3 for a specific significant level

Figure 4. Overall Inferred Price Transmission Mechanism



Note: see note in Figure 1 and refer Table 1-3 for a specific significant level.

The identified cost-push transmission mechanism summarized in Figure 4 is consistent to several studies(e.g., Boyd and Brorsen 1985, Goodwin and Holt 1999, and Goodwin and Harper 2000), which show the price transmission mechanism from farm to wholesale to retail market for a specific commodity such as pork or beef. On the other hand, our results, based on broad food price indexes beyond a specific commodity, identify more detailed price transmission channels and reveal the cost-push mechanism along the sequential stages of process with some skip mechanisms. These finding can contribute to understand the recent food inflation phenomenon, by providing empirical evidences of the notion that the increase of farm commodity prices is large enough to affect retail food prices, despite the small portion of agricultural commodity values in retail food prices(e.g., Abbott, Hurt, and Tyner 2008).

3. Linkages of Energy prices and Exchange rate

The effects of the energy price and exchange rate on the food price at the retail level are another common aspect to the various analyses for the recent food inflation, as discussed. In this respect, our results provide empirical evidences such that (i) the crude energy price Granger causes the crude food price at about 1% significance level(Table 1), (ii) the intermediate energy price causes the crude food price at the 1% significance level, the finished food price at the 5% significance level, and the intermediate and home food prices at the 10% significance level(Table 2), (iii) the finished energy price leads the crude and home food prices at the 5% significance level and the intermediate food price at the 10% significance level(Table 3).

The results are consistent with the previous findings(e.g., Reed, Hanson, Elitzak, and Schluter 1997, Baffes 2007) for the heavy dependence of food sector on energy consumption. The crude, intermediate, and finished energy prices significantly affect the crude food price at least 3.5%(1.3%, 0.5%, and 3.5%, respectively) significance level, whose effects are transmitted to all the food prices at the various stages of process through the cost-push mechanisms within the food system(Figure 4).

In addition, our results further identify the heterogeneous paths of energy and food price linkages at various stages of process. The intermediate(finished) energy price Granger causes the finished(home) food price at the 4.3%(2.4%) significance level, which are analogical to the forward sequential input-output relationship in the SOP system. The complex interdependencies and/or the difficulties in defining the intermediate stage also results in the impacts of the intermediate energy price on the intermediate and finished food prices and the effects of the finished energy price on the intermediate food price(Figure 4).

With the multifarious causal relationships between energy and food prices, the results also show that the intermediate energy price Granger causes the exchange rate at the 1.2% significance level, while the crude energy price is caused by the exchange rate at the 6.5% significance level(Table 1 and 2). The identified linkages of exchange rate with energy and/or food prices provide additional empirical evidence to understand the recent food inflation phenomenon. For example, Abbott, Hurt, and Tyner(2008) argue that the depreciating dollar is related with the over half of the crude oil price increases, because most commodities such as crude oil are denominated in the U.S. dollars, but are purchases in the local currency. They further claim that the link between the U.S. dollar and commodity prices is more important than many other studies imply, since the high oil prices can bring expanding current account deficits, which in turn bring depreciating currency especially when the large trade deficits exist. Our findings are also consistent with previous literature on the nexus of energy price and the exchange rate(e.g., Amano and Norden 1998, Chaudhuri and Daniel 1998, and Chen and Chen 2007). For example, Chen and Chen(2007) show that the real oil prices contribute significant forecasting power for real exchange rate movements based on the panel cointegration analysis.

Ⅴ. Summary

This study explores the price transmission channels of energy prices and exchange rate on food prices. Unlike previous studies focusing on the impacts of a single energy price such as crude oil price, our analysis is based on the disaggregated information based on the various stage of process(SOP). By utilizing the TYDL method of Granger causality tests, we identify how the movements of the exchange rate and the various energy prices affect on the food prices at different stages of process from farmers to consumers.

The overall findings can be summarized as follows. First, the crude(and finished) food price Granger causes the intermediate food(retail food) price. The causal flow from crude(and intermediate) to finished(home) food prices connects the overall cost-push mechanism, despite the absence of causal link between the intermediate and the finished food prices. Overall results provide detailed information on price transmission channels and reveal the cost-push mechanism along the sequential stages of process with some skip mechanisms.

Second, the crude, intermediate, and finished energy prices significantly affect the crude food price, whose effects are transmitted to all the food prices at the various stages of process through the cost-push mechanisms within the food system. In addition, we identify the heterogeneous paths of energy and food price linkages at various stages of process. The intermediate(and finished) energy price Granger causes the finished(retail) food price, which are analogical to the forward sequential input-output relationship in the SOP system.

Finally, with the multifarious causal relationships between energy and food prices, the identified linkages of exchange rate with energy and/or food prices provide additional empirical evidence to understand the recent food inflation phenomenon. The intermediate energy price Granger causes the exchange rate, while the crude energy price is caused by the exchange rate. For example, Abbott, Hurt, and Tyner(2008) argue that the depreciating dollar is related with the over half of the crude oil price increases, because the crude oil is denominated in the U.S. dollars. They also claim that the high energy prices can bring expanding current account deficits, which in turn bring depreciating currency especially when the large trade deficits exist. In this respect, our findings provide empirical evidences of causal mechanisms among the causes of the recent surge of food prices identified by previous studies, contributing to understand how the recent food inflation phenomenon happens.

Given that the surge of energy price is considered as the main factor for the recent food inflation, this study aims to empirically identified the causal direction and structures among various energy and food prices and exchange rate. We hope the results of this study provides a starting points for the future directions of further studies[9] such as to empirically measure the magnitude of causal linkages among energy and food prices and to more fully investigate causal relationships by incorporating export food prices and other related variables.

접수일(2012년 10월 30일), 게재확정일(2012년 12월 4일)

9) As mentioned in footnote 8, the Granger causality is the statistical concept based on predictability and different from the philosophical notion based on manipulation. Thus alternative empirical approach for inductive causal inferences based on manipulation and considering the effects of unobserved variables need to be also pursued in the future studies(see Kwon, D.H. and Bessler, D.A. 2011)

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요 약

식품부문에 대한 에너지와 환율의 가격전달경로: 가공단계에 따른 세부적 인과구조분석

권대흠*· 구원회**

최근에 발생한 에너지와 식료품의 동시적 가격급등현상으로 인해 에너지 부문의 급격한 변화가 식품가격에 어떻게 영향을 미치는가에 대한 관심이 높아졌다. 이 연구에서는 그랜져 인과관계 개념을 바탕으로 에너지 가격과 환율이 식품가격에 영향을 주는 인과구조를 실증적으로 밝히고자 하였다.

이전의 연구와 달리 분석대상변수의 시계열적 특성에 영향을 덜 받는 Toda and Yamamoto(1995) and Dolado and Lütkepohl(1996)의 그랜져 인과관계 검증 모형을 도입하였다. 또한 에너지와 식품 각각의 가공단계별(Stage of Processing) 가격자료를 활용함으로써 에너지와 식품 각각의 단일 가격자료만을 분석한 선행연구 보다 더욱 상세한 인과구조분석을 수행하였다.

주요 단어 : 에너지 가격, 환율, 식품가격, 가격전달경로, 가공단계별 분석, 그랜져 인과관계
경제학문헌목록 주제분류 : Q40, Q10

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