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Investigation of asymmetric impulse responses between average consumption propensity and average food consumption propensity of household in Korea

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Abstract: Average consumption propensity (ACP) and average food consumption propensity (AFCP) are important indices for implementing macroeconomic and food policies. The present paper investigates the existence of asymmetric responses of ACP and AFCP to positive and negative shocks of each series in Korea. According to the estimation results of the Structural Vector Autoregression (SVAR) model, ACP and AFCP are analysed to have asymmetric responses to negative and positive shocks, regardless of whether the shock is imposed on the own or on the other series. The derived absolute values of the responses indicate that ACP is more influenced by AFCP, which implies that a shock on AFCP is more permanent than one on ACP. The responses of ACP and AFCP appear to be lower during the period after 1998 when the Asian financial crisis occurred. This implies that not only food consumption, but also overall consumption of households became stabilised after the Asian financial crisis.

Keywords: food consumption; household expenditure; Structural Vector Autoregression model

Many studies have been conducted on the factors affecting expenditure on food (Becker 1976; Blaylock and Smallwood 1986; McCracken and Brandt 1987; Blisard and Blaylock 1993; Bansback 1995; Blisard 2001; Dickinson et al. 2003; Stewart et al. 2004; Gheblawi and Sherif 2007; Smith et al. 2014; Zezza et al. 2017). From these previous studies it is well known that food expenditure differs due to demographic and socio-economic factors of a consumer or household. However, there are few studies that have investigated the factors influencing the share of expenditure within household income. To fill this gap, the present paper investigates a different aspect of food consumption targeting expenditure share and its trend, changing patterns, and responses to shocks.

Expenditure share can be analysed in terms of the proportion of expenditure for a specific purpose or commodity within the total consumption expenditure, which is a typical approach taken by empirical methodologies such as the Almost Ideal Demand System (AIDS) model (Deaton and Muellbauer 1980). On the other hand, it is also possible to analyse the consumption expenditure for a particular purpose (or a commodity) as the ratio of household income, which is the approach to be followed in the present study.

The most important factor influencing consumption expenditure is income; therefore, its impacts must be eliminated if we want to examine the structural changes in the expenditure for a specific purpose (or a commodity). Analysing expenditure as a dependent variable by including income as one of the important explanatory variables in a regression is one way to eliminate its impacts. On the other hand, if we construct the dependent variable in the form of the ratio of expenditure to household income, it could be another way to achieve that result. The present study adopts

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the latter methodology which has not been applied yet to previous empirical studies on food consumption.

The expenditure divided by income is called "the average consumption propensity" (ACP). Therefore, for example, if the average consumption propensity is calculated to be 30%, this means that 30% of income tends to be used for consumption expenditure. Since the income is equivalent to consumption expenditure plus savings (the remaining income not spent on consumption), we can calculate average savings propensity by subtracting ACP from one. Consumption expenditure includes the spending for items such as clothing, entertainment, transportation, and food which is one of the most important items. Therefore, if the consumption propensity is divided by each expenditure purpose, average clothing consumption propensity, average entertainment consumption propensity, average food consumption propensity (AFCP), can be calculated. Since the whole consumption expenditure includes food expenditure, the present study aims to investigate the relationship between ACP and AFCP. In particular, the present study attempts to analyse which factors, among the ACP and AFCP, have a relatively larger impact on the other.

ACP is one of the important indices for macroeconomic policy in the context that household consumption is one of the driving forces of economic growth, thus economic growth is largely dependent on ACP (Kim and Rho 2017). On the other hand, if AFCP (the share of food expenditure within the disposable income) is high, it means that households spend relatively more on food, thus policy interest in food prices such as price stabilization receives more attention (Lee et al. 2007; Lee et al. 2016). This is the reason why AFCP has become an important index for the government's food policy.

This study analyses the relationship between ACP and AFCP by developing a Structural Vector Autoregression (SVAR) model and applies it to Korea. The model developed in this study enables to test whether the responses to an impulse are asymmetric or not, which allows us to investigate whether the shock is relatively permanent or temporary. Korea is one of the very good options of countries to study consumption pattern which is closely related to income changes. Korea has shown very rapid economic growth and, at the same time, has been exposed to a financial crisis; thus its consumers' income change appears to be very dynamic. As a result, overall consumption patterns such as food consumption propensity have changed greatly in Korea.

Figure 1 shows quarterly data on ACP and AFCP of households in Korea, the target country of the analysis of the present study. One of the features in Figure 1 is that ACP and AFCP fluctuate on a quarterly basis. That is, ACP is the highest in the first quarter over the entire data period, and AFCP is the highest in the fourth quarter. Since consumption expenditure includes the expenditure on food, ACP is always greater than AFCP. The gap between the ACP and the AFCP has increased over the last 35 years as depicted by Figure 2. This can be interpreted to mean that consumers have increased spending on other purposes than food. We can check this manifestly

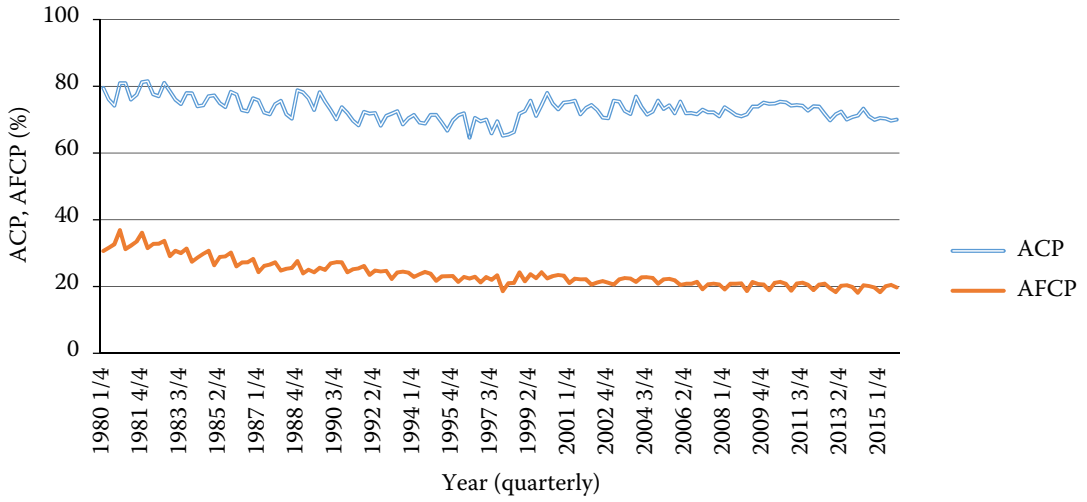

Figure 1. Trends in average consumption propensity (ACP) and average food consumption propensity (AFCP) of Korean Households (quarterly)

Source: Statistics Korea (2018)

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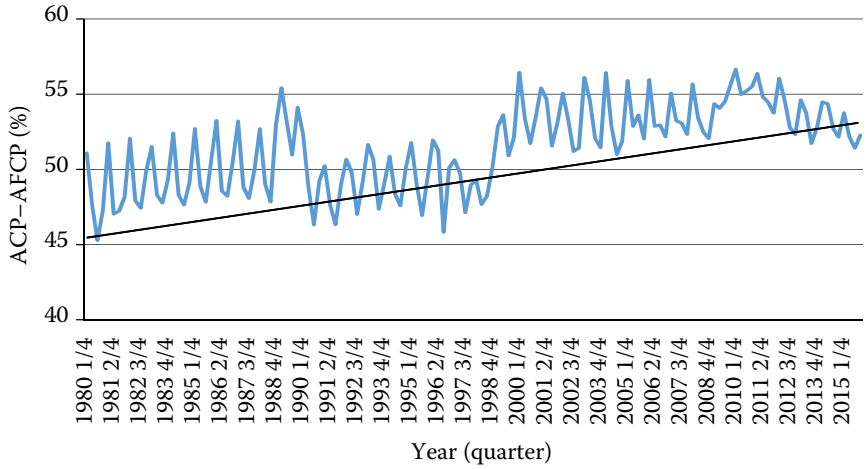

Figure 2. Gap between average consumption propensity (ACP) and average food consumption propensity (AFCP) of Korean Households (quarterly)

Source: Statistics Korea (2018)

by investigating the statistics for Korean household expenditure. The average annual growth rate of consumption expenditure during the last 35 years is calculated to be 7.76% while that of food consumption expenditure is 6.79%. Since the income of Korean household has risen by 8.61% annually, which is greater than the growth rates of consumption and food consumption expenditures, both ACP and AFCP show decreasing trends. However, decreasing trend of ACP is lower than that of AFCP, therefore the gap between ACP and AFCP has widened over time.

Another characteristic that can be seen in Figure 1 is that there was a structural break in 1998 for both ACP and AFCP. 1998 was the year when the Asian financial crisis occurred. This crisis was a big shock to the economy of Korea and the consumption was also greatly influenced, therefore structural change like the one shown in Figure 1 is observed.

The AFCP shows an overall tendency to decrease, while the ACP decreased until the first quarter of 1998, but it has remained stagnant since then, remaining above 70%. In this regard, we can raise some issues. If the spending on other uses increased although the expenditure on food declined, the ACP would have increased or at least remained at the same level despite the decline of the AFCP. The trend in Figure 1, at least during the period after 1998, may suggest that the decreased spending on food (i.e. a negative shock on AFCP) could have been compensated by the increased expenditure (i.e. the positive response of ACP) on other uses. Or conversely, the increased expenditure (i.e. a positive shock on ACP) on other uses could have been mitigated by the decreased spending on food (i.e. a negative response of AFCP). On the other hand, during the period before 1998, the decreased food spending (i.e. a negative shock on AFCP) could have resulted in the decrease in the expenditure on overall consumption (i.e. a positive response of ACP), since both ACP and AFCP decreased in this period. However, these issues need to be tested through elaborate econometric analyses. The developed econometric model in the present paper enables us to perform the analyses that fit to investigatation of these issues.

In this paper, based on the discussed characteristics of the two time-series data, I test three hypotheses. The first hypothesis is that the responses of ACP and AFCP to positive and negative shocks of each series are asymmetric. If this hypothesis is accepted, we can say that negative and positive shocks are not equivalently influencing. The second hypothesis is that responses to a shock on one series are different from the ones to a shock on the other series. This hypothesis is set for investing the question of "Which one can we treat as a more permanent shock?" If the responses to a shock on one series persist longer, we can conclude that there exists an asymmetry in terms of duration of the responses, therefore the shock on one series is permanent, relatively to the other. The third hypothesis is that asymmetry structures differ across the periods before and after the Asian financial crisis. As discussed, the financial crisis of 1998 had a strong impact on the income and expenditure in Korea, therefore it would be very interesting to investigate a different aspect of the response structures in the two sub periods. In order to test these three hypotheses, the asymmetric impulse response model is applied.

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The investigation of the impulse responses can be analysed by formulating a single equation; however, in this study, I use the Structural Vector Autoregression (SVAR) method proposed in Lee (2010).

THEORETICAL MODEL

Consider an AR(P) vector autoregression model:

$$Y_t = A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \varepsilon_t,\ E(\varepsilon_t) = 0,\ V(\varepsilon_t) = \Sigma \qquad (1)$$

where Y_t is a vector that includes average consumption propensity (ACP; ACP_t) and average food consumption propensity to consume ($AFCP$; $AFCP_t$) such that $Y_t = [ACP_t AFCP_t]'$ at time t; A_p is the parameter matrix corresponding to the variables of which lag order is P; $E(\varepsilon_t)$ is a mean for error term vector ε_t; and $V(\varepsilon_t)$ is a variance-covariance matrix of error terms.

Equation (1) can be converted into Equations (2–3):

$$\left[I - A(L)\right] Y_t = \varepsilon_t \qquad (2)$$

$$Y_t = \left[I - A(L)\right]^{-1} \varepsilon_t \qquad (3)$$

where L is a lag operator; I is identity matrix of rank 2; and $A(L) = A_1 L - A_2 L^2 - \ldots - A_p L^p$. Then Equation (3) can be rewritten as Equation (4).

$$Y_t = \left[I - A(L)\right]^{-1} \varepsilon_t = C(L) e_t \qquad (4)$$

where the disturbances (i.e. vector e_t) are orthonormalised such that $V(e_t) = I$.

Following Amisano and Giannini (1997), estimates of the parameter matrix $C(L)$ are obtained by formulating Equation (5):

$$C^0 e_t = \varepsilon_t. \qquad (5)$$

Combination of Equations (4–5) yields $C(L) = \left[I - A(L)\right]^{-1} C^0$, where estimates of $A(L)$ can be obtained by estimating the vector-autoregressive (VAR) model Equation (1). Therefore, derivation of $C(L)$ only requires the estimates of:

$$C^0 = \begin{bmatrix} c_{11}^0 & c_{12}^0 \\ c_{21}^0 & c_{22}^0 \end{bmatrix}.$$

We obtain $C^0 C^{0'} = V(\varepsilon_t) = \Sigma$ by taking variance of Equation (5), and the elements of variance-covariance matrix Σ can be calculated from the residuals after estimating the Equation (1). However, diagonal elements in Σ are the same, thus only three restrictions are obtained from Σ which implies that we need an additional restriction for identifying four elements in C^0.

Following Lee (2010), I stipulate the restriction of $c_{11}^0 = -c_{12}^0$. This restriction implies that same magnitude of positive and negative shocks on ACP are imposed. On the other hand, the restriction of $c_{21}^0 = -c_{22}^0$ implies that same magnitude of positive and negative shocks on AFCP are imposed.

DATA AND ESTIMATION RESULTS OF VAR MODEL

Data for the analyses are obtained from the "Survey on Household Expenditure" collected by Statistics Korea (2018). Data period for both ACP and AFCP is from the first quarter of 1980 to the fourth quarter of 2015. Before constructing the SVAR model, unit root tests for both time series are performed and the test results indicate that ACP and AFCP are both stationary time series. Another preliminary test of lag order choice is performed, too. AIC (Akaike Information Criterion) is lowest when the lags of up to 5 prior periods are included, therefore AR(5) model is estimated as a base equation.

Table 1 shows the estimation result of the base VAR model. To reflect the nature of quarter data, dummies of $D1$ (first quarter), $D2$ (second quarter) and $D3$ (third quarter) are included as explanatory variables. For capturing the decreasing trend of the series, time trend is included. For both ACP and AFCP, the decreasing trends appear to be flattened since 1990, although it is more apparent in case of ACP; therefore, $D90$ (dummy which is 1 from 1990) is also included in the explanatory variables. As indicated in Table 1, two more dummy variables of $D98$ (dummy which is 1 from 1998) and $D08$ (dummy which is 1 from 2008) are included to reflect the impacts of Asia financial crisis and the international financial crisis initiated by the subprime mortgage incident in the U.S.. All the dummy variables are estimated to be significant at 95% or higher, except for $D1$ and $D90$ for AFCP and $D1$, $D2$ and $D3$ for ACP.

DERIVED ASYMMETRIC IMPULSE RESPONSES

To analyse the asymmetric impulse responses, I first estimate the SVAR model for the entire period and examine the structure of responses. This analy-

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Table 1. Vector-autoregressive model estimation results

	ACP_t	$AFCP_t$
Constant	9.6919 (3.55816)	40.9737 (6.43945)
$AFCP_{t-1}$	0.6834 (6.80580)	0.3923 (1.67226)
$AFCP_{t-2}$	0.1408 (1.44506)	–0.2856 (–1.25507)
$AFCP_{t-3}$	–0.2163 (–2.19657)	–0.1949 (–0.84690)
$AFCP_{t-4}$	0.4502 (4.60675)	0.0551 (0.24125)
$AFCP_{t-5}$	–0.2033 (–2.24228)	0.1361 (0.64265)
ACP_{t-1}	–0.1406 (–3.29675)	0.2167 (2.17472)
ACP_{t-2}	–0.0120 (–0.27678)	0.0740 (0.73084)
ACP_{t-3}	0.0978 (2.27670)	0.0436 (0.43481)
ACP_{t-4}	–0.0026 (–0.06015)	0.4010 (4.04967)
ACP_{t-5}	–0.0146 (–0.36367)	–0.3042 (–3.23756)
*D*1	–0.6116 (–1.49174)	1.1131 (1.16216)
*D*2	1.6151 (3.24767)	1.7393 (1.49716)
*D*3	0.9652 (2.36524)	–0.8888 (–0.93230)
Time (time trend)	–0.0364 (–4.27841)	–0.0503 (–2.53511)
*D*90 (dummy which is 1 from 1990)	0.2649 (1.00273)	–1.3532 (–2.19278)
*D*98 (Asia final crisis dummy)	1.4565 (4.37620)	4.2130 (5.41887)
*D*08 (subprime mortgage crisis dummy)	0.8938 (3.25104)	1.2895 (2.00774)
R-squared	0.9749	0.8128

t-values are in the parentheses; ACP_{t-i} – average consumption propensity at time *t*–*i*; $AFCP_{t-i}$ – average food consumption propensity at time *t*–*i*; *D*1, *D*2 and *D*3 – first, second and third quarter of the year, respectively

Source: author's own estimation

sis is designed to test the first (which is equivalent to the research question "Are the responses of ACP and AFCP asymmetric to the positive and negative shocks of each series?") and second (which is equivalent to the research questions "Which one is more influenced by the shock of other series?" or "Which one can we treat as a more permanent shock?") hypotheses in the present study.

The second analysis is performed by estimating the SVAR model via dividing the period before and after 1998 and investigating the impulse responses. This analysis is designed to test the third hypothesis (which is equivalent to the research question "Are asymmetry structures different across the periods before and after the Asian financial crisis?").

Impulse responses from whole sample

Figures 3–4 show the responses of ACP and AFCP to a negative and positive ACP shocks. As indicated, there are clear asymmetric responses of ACP to a positive and negative own (i.e. ACP) shocks in Figure 3. For example, at period 1, the response of ACP to a negative shock is greater than the one to a positive shock. The same phenomena are observed at periods 5 and 9. On the other hand, the response of ACP to a positive shock is greater than the one to a negative shock at periods 2, 3, 4 and 7.

Figure 4 also shows the asymmetric responses of AFCP to a positive and negative ACP shocks. At initial periods, responses of AFCP are positive regardless of whether ACP shocks are positive or negative. Until period 10, responses of AFCP to a negative ACP shock are greater than those to a positive ACP shock, except for periods 4, 7 and 8. This implies that AFCP tends to respond more to a negative ACP shock than to a positive ACP shock. In other words, AFCP is influenced more when ACP decreases than when ACP increases.

Figures 5–6 show the responses of ACP and AFCP to a negative and positive AFCP shocks. As shown in Figure 5, there is a clear asymmetric response of ACP to positive and negative AFCP shocks. In other words, there is no period where responses of APC to negative and positive AFCP shocks are the same. At initial periods, the pattern of responses is similar to Figure 4: responses of ACP are positive regardless of whether AFCP shocks are positive or negative. Until period 10, responses of ACP to negative AFCP shocks appear to be greater than those to positive AFCP shocks at periods 1, 2, 5, 6 and 9. The comparison of Figures 4 and 6 suggests an important economic implication. At all periods, the absolute values of the responses in Figure 4 are greater than those in Figure 5.

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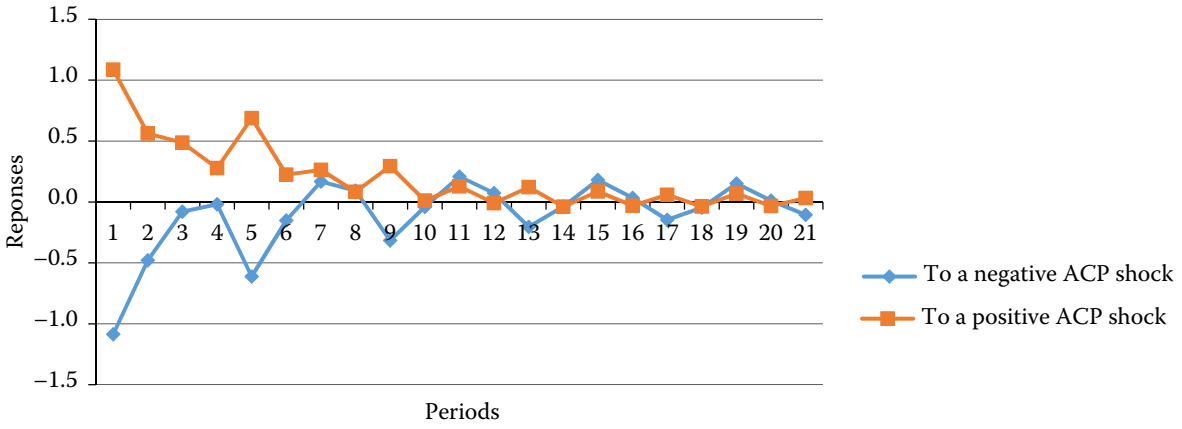

Figure 3. Responses of average consumption propensity (ACP) to a positive and negative ACP shocks (whole sample)

Source: author's own derivation

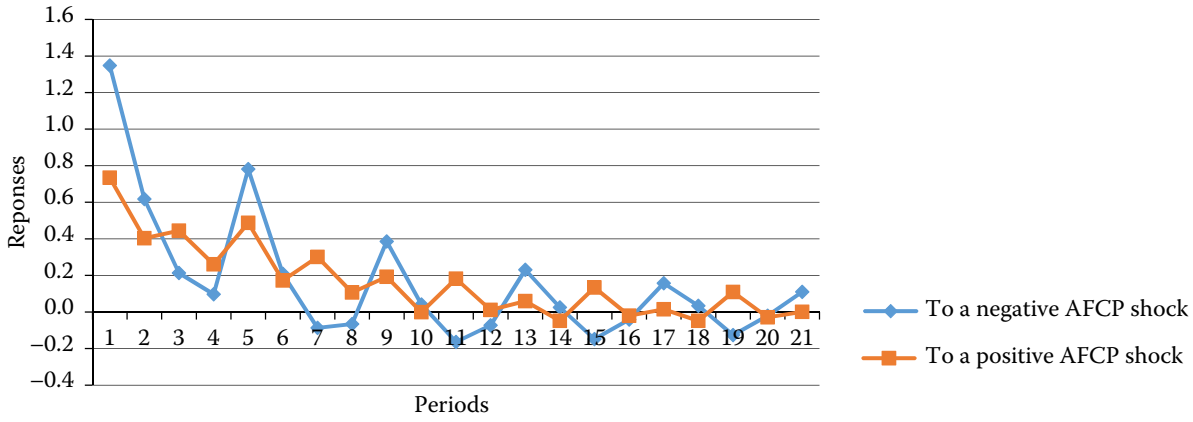

Figure 4. Responses of average consumption propensity (ACP) to a positive and negative average food consumption propensity (AFCP) shocks (whole sample)

Source: author's own derivation

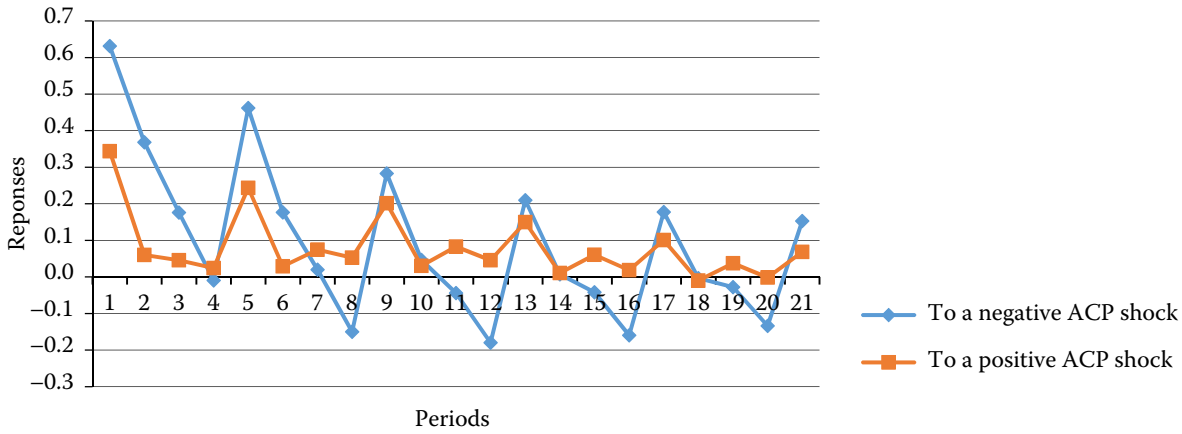

Figure 5. Response of average food consumption propensity (AFCP) to a positive and negative average consumption propensity (ACP) shocks (whole sample)

Source: author's own derivation

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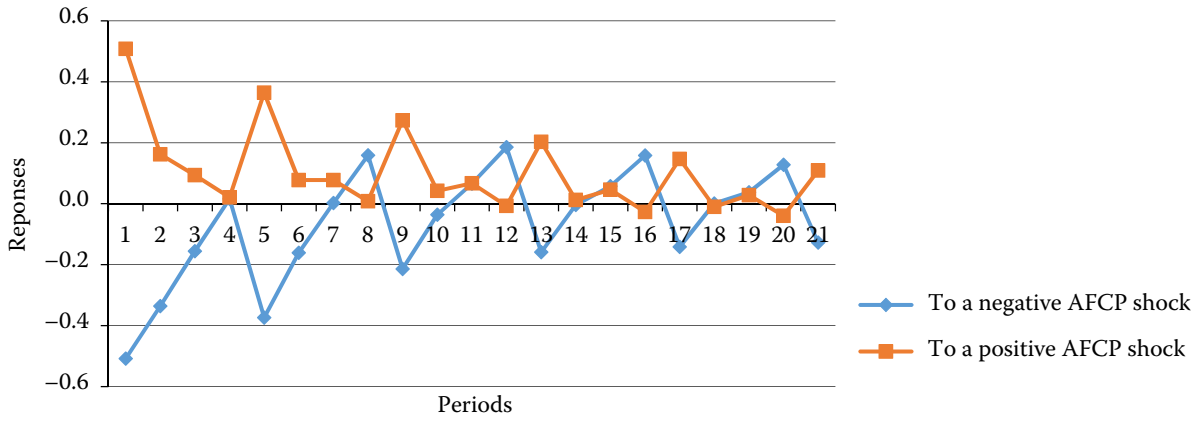

Figure 6. Response of average food consumption propensity (AFCP) to a positive and negative AFCP shocks (whole sample)

Source: author's own derivation

This provides the answer to the second hypothesis of this paper. In other words, ACP is more influenced by AFCP, therefore we can conclude that a shock on AFCP is more permanent than one on ACP.

We can also find obvious asymmetric responses of AFCP to positive and negative own (i.e. AFCP) shocks. In all periods, the responses of AFCP to positive AFCP shocks are different from the ones to negative AFCP shocks. Throughout the Figures 3–6, we can find asymmetric responses to positive and negative shocks, therefore the answer to the first research question of this paper turns out to be "Yes".

Impulse responses from the subsample

Figures 7–8 show the responses of ACP and AFCP to negative and positive ACP shocks for the subsamples before and after 1998. Similar to Figures 4–5, clear asymmetric responses are observed for both subsample periods. Therefore, we can say that ACP and AFCP do not respond in the same fashion to negative and positive ACP shocks regardless of the sample period. In other words, asymmetric impulse responses persisted during the entire data period.

Comparison of the responses of ACP and AFCP over the two subsample periods reveals a very interesting feature. Across Figures 7–8, the level of the responses had become lower after the Asian financial crisis of 1998. In other words, smoother response patterns are observed in the subsample after the financial crisis. This suggests that both ACP and AFCP are less sensitive to a shock in a later subsample, thus consumption had become stabilised.

Figures 9–10 show the responses of ACP and AFCP to negative and positive AFCP shocks for the subsamples before and after 1998. In these figures, clear

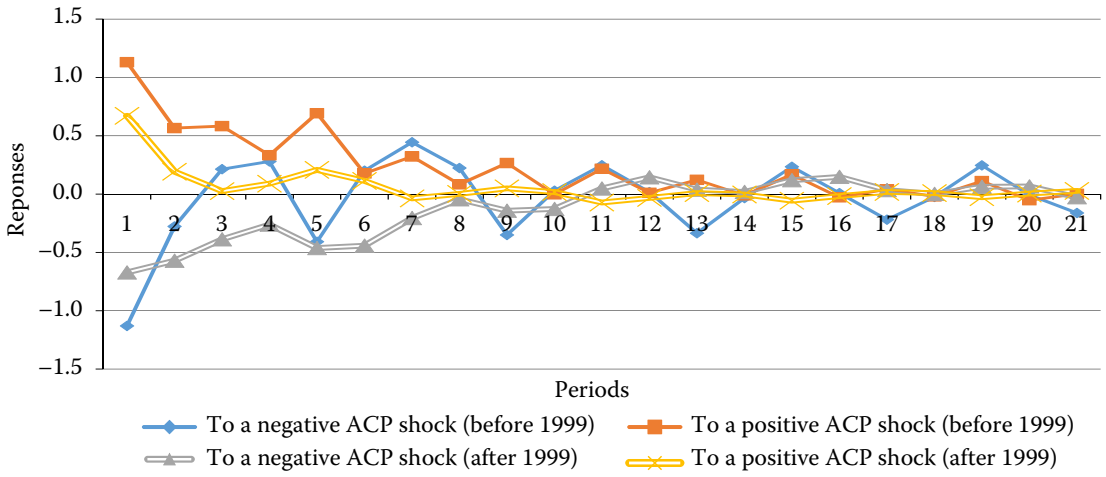

Figure 7. Responses of average consumption propensity (ACP) to a positive and negative ACP shocks (subsample)

Source: author's own derivation

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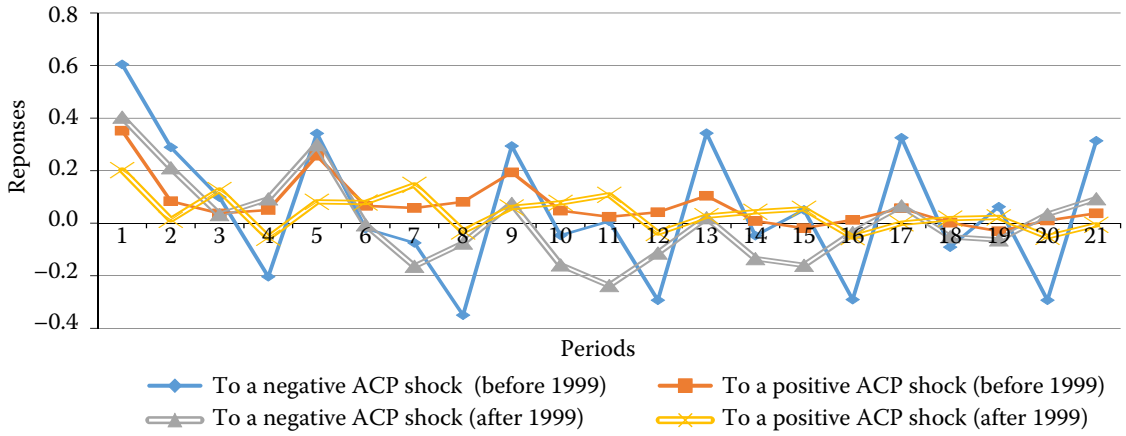

Figure 8. Responses of average food consumption propensity (AFCP) to a positive and negative average consumption propensity (ACP) shocks (subsample)

Source: author's own derivation

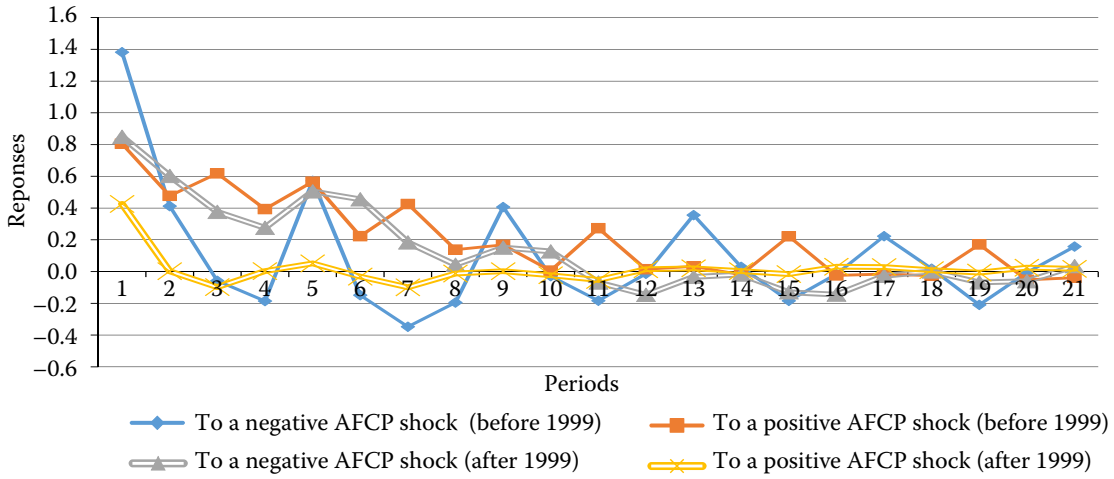

Figure 9. Responses of average consumption propensity (ACP) to a positive and negative average food consumption propensity (AFCP) shocks (subsample)

Source: author's own derivation

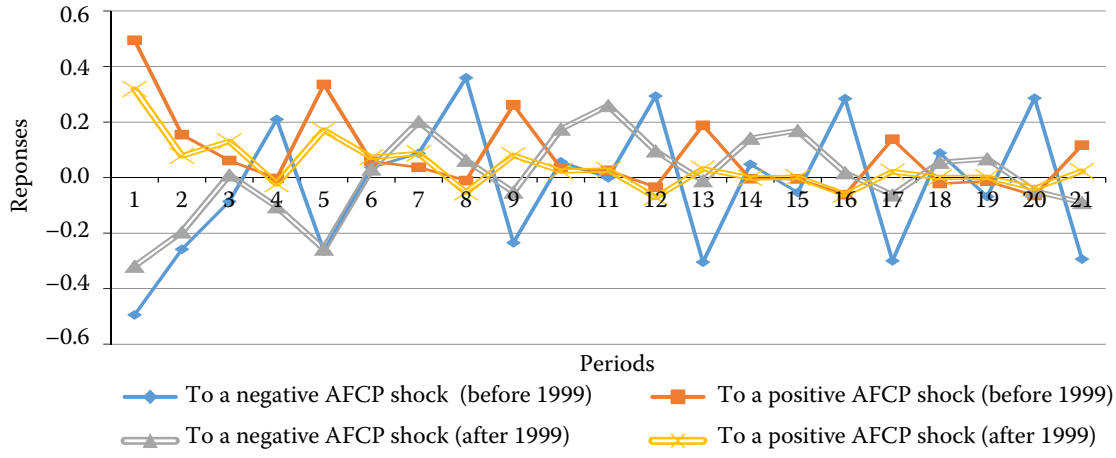

Figure 10. Responses of average food consumption propensity (AFCP) to a positive and negative AFCP shocks (subsample)

Source: author's own derivation

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asymmetric responses are observed again. This confirms the fact that asymmetric impulse responses persisted over time.

Similarly to Figures 5–6, responses appear to have become lower after the financial crisis in Figures 9–10, which suggests that not only food consumption but also overall consumption of households became stabilised in the second subsample period. This result is consistent with what we can observe in Figure 1. In other words, the fluctuations of ACP and AFCP appear to have become smaller after 1998 in Figure 1.[1] This finding provides the manifest answer to the third hypothesis raised in the introduction of the present paper.

CONCLUSION

Average consumption propensity (ACP) and average food consumption propensity (AFCP) are important indices for implementing macroeconomic and food policies. AFCP and ACP for the last decades in Korea show that there is a common trend as well as different movement patterns. This suggests that the relationship between AFCP and ACP is closely related, but the aspect in which they influence each other is very unique. Based on this point, the present paper starts with the intention of analysing three questions: Are the responses of ACP and AFCP asymmetric to positive and negative shocks of each series? Which one is more influenced by the shock of the other series? Are asymmetry structures different across the periods before and after the Asian financial crisis?

According to the estimation results of the SVAR model, ACP and AFCP are analysed to have asymmetric responses to negative and positive shocks, regardless of whether the shock is imposed on the own or on the other series. The absolute values of the responses indicate that ACP is more influenced by AFCP, which implies that the shock on AFCP is more permanent than the one on ACP. The responses of ACP and AFCP appear to have become lower during the period after 1998. This implies that not only food consumption, but also overall consumption of household became stabilised after the financial crisis.

The result that an impact on AFCP is more persistent than the one on ACP suggests that food policy and macroeconomic policy should be linked. In other words, food policies such as the pursuit of food price stabilization may affect ACP as well as AFCP, therefore they may have a positive impact on macroeconomic growth. In this context, food policy should take into account not only the food industry, but also the ripple effects on the entire economy, from the design stage to the evaluation of the effectiveness of the policy.

From this point of view, the rapid increase in international grain prices that occurred in 2008 can be interpreted to have brought an impact on household food expenditure as well as on economic growth of a country at the same time. This suggests that there is a need for a government policy to ensure that the impact of price increases in the international market is not fully transmitted into the domestic market. The fact that maintaining adequate levels of food self-sufficiency often becomes one of the main policy goals in many food-importing countries can be understood in this context. On the other hand, it can be inferred that lowering the AFCP of low-income households by directly providing a certain amount of food could increase expenditures for other purposes and raise the ACP of these households, which would have a positive effect on economic growth. In other words, the food policy for assisting low-income families may be helpful in achieving some of the goals intended by macroeconomic policy.

This study contributes to the literature, it explores the implications for the linkage of macroeconomic policy and food policy by directly analysing the relationship between ACP and AFCP. If we analyse the marginal consumption propensity or marginal food consumption propensity, the impact on the change in (food) expenditure incurred by income increases can be investigated, therefore providing another implication for the policy implementations. It would be worthwhile to perform an analysis on this issue in future research.

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[1]In the period before 1998, coefficients of variation are calculated to be 0.055 and 0.137 for ACP and AFCP, respectively. However, for the period after 1998, these coefficients are calculated to be 0.027 and 0.064 for ACP and AFCP, respectively.

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