Evaluation the effect of food subsidy reduction on Iranian household calorie intake: VAR application

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In each year, Iranian government provides for food subsidy in its budget. Recently, the effect of food subsidy to the households has been controversial. In this Article we use vector autoregressive method for investigating the effect of food subsidy reduction on Iranian households' calorie intake. The results show that one unit standard error reduction in food subsidy without income compensation has a considerable negative effect on calorie intake in short-run and that it takes around five years for households to adjust themselves to the new condition. But, if the negative shock of food subsidy reduction occurs with the same amount of positive income, then the effect of income increasing not only removes the negative effects of subsidy reduction, but also will have positive effect on calorie intake in short-run and long-run. Therefore, it seems that focusing on food subsidy reduction is not the best solution.

Introduction

From 70s till now, Iranian government has provided food subsidies in its budget. The amount of food subsidies have been increased from 5.4 billion RIALS in 1973 to 31901.7 billion RIALS in 2005. The growth rate of food subsidy, meanwhile these years has been 32 percent (HEIDARY et al., 2006).

It is clear that the goal of paying food subsidy is providing the needs of calories for each person and the community food security as a whole. As KHODADAD K.F et al. (2005) ,show about 10-20 percent of Iranian households intake less calorie than they need. Then it can be a good reason for continuing food subsidy.

Some of the researchers have focused on investigating the relationship between calorie intake and income. For example, BOUIS and HADDAD (1992) for Philippines and RAVALLION (1990) for Indonesia provide estimates that are either close to, and/or insignificantly different from zero, while Behrman and DEOLALILAR (1987) for India and Strauss (1994) for Sierra Leone produce estimate of around 0.82. Strauss (1986) examines the relationship between farm productivity and calorie intake in Sierra Leone and estimates a significant output-calorie elasticity of 0.34, while DEOLALILAR (1988) for India finds no evidence that nutrition determines wages.

Dawson and Tiffin (1998, 2002) examine the long-run calorie-income relationship applying co integration analysis and shows that calorie intake is Granger-caused by income and the calorie-income elasticity is .34, and food prices are insignificant.

In this paper we include food subsidies in the model. First, we investigate the unit root test for per capita calorie intake, per capita income, food prices and food subsidy using Augmented Dicky Fuller test. Second, we estimate the long run relationship between above variables and test for weakly exogenous variables. Third, we examine impulse responses of calorie intake to one standard error subsidy reduction with and without the same amount of income compensation.

Empirical method

In vector autoregressive model, it does not require the specification of a causal ordering prior to estimation. The VAR model, in our case can be expressed as:

$$\begin{bmatrix} C_t \\ y_t \\ P_t \\ S_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} a_{k,11} & a_{k,12} & a_{k,13} & a_{k,14} \\ a_{k,21} & a_{k,22} & a_{k,23} & a_{k,24} \\ a_{k,31} & a_{k,32} & a_{k,33} & a_{k,34} \\ a_{k,41} & a_{k,42} & a_{k,43} & a_{k,44} \end{bmatrix} \begin{bmatrix} C_{t-i} \\ y_{t-i} \\ P_{t-i} \\ S_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix} \quad (1)$$

Where c_t is logarithm of calorie supply variable, y_t is logarithm of income variable, s_t is logarithm of food subsidy variable, p_t is logarithm of food price variable, and k is the lag length and μ_i and a_{ij} are parameters.

By using impulse response function, it is possible to trace the effects over time of a shock to a given variable of one standard error on all variables in the model.

If all the variables in VAR have a unit root and their linear combination is stationary, then the series are co integrated.

In order to test hypothesis of integration and co integration in the VAR model, it is transformed into its error correction model (VECM) form:

$$\Delta X_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t\alpha k} + \varepsilon_t \qquad (2)$$

Where $X_t = [c_t, y_t, s_t, p_t]$ $\Delta x_t = x_t - x_{t-1}$ $\mu_{i=a}$ is a (4×1) vector,

$\Gamma_i(\Gamma_i = -[I - A_1 - .... - A_i])$ For $i = 1,....,(k-1)$ is a (4×4) matrix and ε_t is a (4×1) vector.

Π Is of reduced rank (r) and when $0 < r < 4$, Π can be decomposed into $\Pi = \alpha\beta'$ where α and β are $(4\times r)$ matrix.

The Granger representation theorem (Engle and Granger, 1987) shows that $\beta' x_t$ is stationary implying that x_t is co integrated with r distinct co integrating vectors given by the columns of β. Johansen’s (1988) procedure estimates (2) and trace statistics are used to determine the rank of Π which can then be decomposed to give the co integrating vector.

For example if r=1 than, (2) can be rewritten as:

$$\begin{bmatrix}\Delta c_t\\ \Delta y_c\\ \Delta s_t\\ \Delta p_t\end{bmatrix} = \mu + \sum_{i=1}^{k-1}\Gamma_i \begin{bmatrix}\Delta c_{t-i}\\ \Delta y_{c-i}\\ \Delta s_{t-i}\\ \Delta p_{t-i}\end{bmatrix} + \begin{bmatrix}\alpha_1\\ \alpha_2\\ \alpha_3\\ \alpha_4\end{bmatrix} [\beta_1\beta_2\beta_3\beta_4] \begin{bmatrix}c_{t-1}\\ y_{t-1}\\ s_{t-1}\\ p_{t-1}\end{bmatrix} + \begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\\ \varepsilon_{3t}\\ \varepsilon_{4t}\end{bmatrix} \qquad (3)$$

If β_4 is found to be insignificant, then by excluding p_t from the model we can estimate a restricted VAR. If for example $\alpha_3 = 0$, then s_t is a weakly exogenous variable (Enders, 2004, pp.333-334).In this case s_t does not respond to the discrepancy from long-run equilibrium and other variables do all of the adjustment. Impulse response analysis (LUTKEPOHL, 1993, pp, 43-56) is used to investigate the interrelationship among the variables. In this article we show the response of per capita calorie intake to subsidy shock with and without income compensation.

Data

The annual data relate to Iran for 1959-2004. Calorie intake is average per capita energy (calorie) intake per day, calculated on the basis of per capita dietary energy derived from national food balance sheets (source FAO:2006). Real per capita GDP is adjusted with CPI in 1990 and the real food price index is the corresponding nominal index deflated by the CPI in 1990 (Source: Central Bank of the Islamic Republic of Iran year book). The real food price index (1990 prices) is the corresponding nominal indexed by the CPI (source: Central Bank of the Islamic Republic of Iran year book). Food subsidy (1990 prices) is deflated by CPI (source: Consumers and Producers Protection Organization)

Results

We used ADF test with including trend for unit root investigation. Table (1) shows that all variable have unit roots in the level, but their first difference reject existence of unit root in 5% significant level.

Insert [Table 1]

Table (2) shows that the best lag length in respect to LR[1], AIC[2] and FPE[3] criteria is 3 lag. For determining the number of long-run relationships between the variables, we used trace statistics. Table (3) shows that with including intercept and trend in the long-run relationship the null of r= 0 rejects in favor of $r \leq 1$. Then there is only one long-run relationship between c_t, y_t, s_t, p_t. Right side of table (3) shows this normalized co integrating vector. The numbers in brackets are t-statistics.

Insert [Table 2,3]

All the signs of the coefficients are correct and in accordance with economics theories. But, the Coefficient of price and subsidy isn't significant at 5% level. By eliminating food subsidy from the model, the lag length becomes 2, but the number of long-run relationship is still one. The coefficient of the price is still at 5% level insignificant and with wrong sign. We then eliminate price, the lag length is still 2 and there is only one long-run relationship

[1] likelihood Ratio
[2] Akake information criterion
[3] Final prediction error

between c_t, y_t, s_t. All coefficients have right sign and are at 5% level significant. Table (4) shows the normalized co integrating vector.

Insert [Table 4]

Table (5) shows that, absolute value of long-run adjustment coefficients are less that one except for food subsidy. We test that s_t is a weakly exogenous variable by restricting $\alpha_s = 0$. The respective test statistics χ =0.78 (*p* value is 0.35), that shows food subsidy is weakly exogenous. This means that s_t does not respond to the discrepancy from long-run equilibrium and c_t, y_t do all of the adjustment. Table (6) shows the result of final model.

Insert [Table 5, 6]

The coefficients of 0.16 and 0.009 can be interpreted as the long-run income elasticity and food subsidy elasticity, respectively.

However, since feedback exists between c_t, y_t, s_t, this *ceteris paribus* interpretation is potentially misleading because it ignores relations between the three variables in the VAR model. Then, "impulse responses may give a better picture of the relations between the variables" (LUTKEPOHL, 1993, p, 380)

Since all the variables are I (1), the effects of the shocks are permanent. Further, since all variables are expressed in logarithms, the impulse response of variables to a positive shock of one standard error can be interpreted in terms of annual percentage changes following PESARAN and Shin (1998). Figure (1) shows the impulse response of calorie intake. The response of calorie intake to one standard error reduction in food subsidy is negative and its maximum effect occurs after five years (-0.19%) and after this period people will adjust their calorie intake. after 8 years it returns back to its long-run equilibrium. Figure (2) shows the response of calories intake to one standard error reduction in food subsidy shock that is compensated with the same amount of income increase. The response of calorie intake is positive and it reaches to its maximum (6.80%) after about 7 years and then returns to its long-run equilibrium. According to these results if shock of food subsidy reduction occurs with the same amount of positive income shock, then the effect of income increasing not only removes the negative effects of subsidy reduction, but also will have positive effect on calorie intake in short-run and long-run.

Insert [Figure 1, 2]

Summary and conclusion

This article uses Vector Autoregressive method to investigate relationship between per capita calorie intake, food subsidy and income in Iran using annual data for 1961-2004. By using co integration analysis we find a long-run relationship only between calorie intake, income and food subsidy variables. The weakly exogenous test shows that food subsidy does not respond to the discrepancy from long- run equilibrium and income and calorie intake do all of the adjustment.

The final model shows that long run income elasticity of calorie demand is 0.16. Also results show that long run food subsidy elasticity of calorie demand is inelastic at 0.009. The impulse responses analysis shows that a one standard error food subsidy reduction shock has negative effect on calorie intake and its maximum negative effect occurs after 5 years. But, one standard error food subsidy reduction shock with income compensation has positive effect on calorie intake and its maximum occurs after 7 years.

These results show that income growth can alleviate and eventually eliminate inadequate calorie intake. Therefore it seems that focus on food subsidy reduction is not the best solution without considering income growth.

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Table1: ADF Test for Unit Roots (H0: has 1 unit root)

Series	Prob.	Series	Prob.
LCAL	0.2504	D(LCAL)	0
LFCPI	0.2828	D(LFCPI)	0.0225
LRGDP	0.5534	D(LRGDP)	0.0132
LRS	0.7866	D(LRS)	0

Note: 95 per cent confidence level.

Table 2: determination Best Lag Length

Lag	LR	FPE	AIC
0	NA	0.104185	9.089881
1	349.2156	0.00000824	-0.360653
2	24.71524	0.00000845	-0.363981
3	32.34069*	5.95e-06*	-0.787341*
4	16.59567	0.00000734	-0.721177
5	15.69071	0.00000902	-0.77237

Table 3: Trace Statistics and Normalized Co integrating Vector (Full Model)

H0			Variables					
$r = 0$	$r \leq 1$	$r \leq 2$	c_t	y_t	p_t	s_t	Trend	Constant
79.58	42.07	21.13	1.00	-0.21	0.007	-0.0001	-0.0078	-4.55
(63.87)	(42.91)	(25.9)		[-8.82]	[0.49]	[-0.56]	[-3.028]	

Notes:

1. Critical values (95 per cent level) in parentheses.
2. The numbers in square brackets are t-statistics.

Table 4: Trace Statistics and Normalized Co integrating Vector (Reduced Model)

H0			Variables				
$r = 0$	$r \leq 1$	$r \leq 2$	c_t	y_t	s_t	Trend	Constant
57.03	25.3	9.4	1.00	-0.17	-0.0007	-0.006	-5.09
(42.9)	(25.9)	(12.5)		[-6.07]	[-2.8]	[-9.9]	

Notes: as for Table 3.

Table5: long-run adjustment coefficients

Variables		
D(c_t)	D(y_t)	D(s_t)
-0.72	0.81	-98.6
[-4.8]	[1.98]	[-0.97]

Notes: The numbers in square brackets are t-statistics.

Table6: Result of final model

long-run adjustment coefficients			Variables				
D(c_t)	D(y_t)	D(s_t)	c_t	y_t	s_t	Trend	Constant
0.016	-0.02	0.00	1.00	-0.158	-0.0009	-0.006	-5.32
[4.9]	[-2.2]	NA					

Notes: The numbers in square brackets are t-statistics.

Figure 1: Response of c_t to Food Subsidy Reduction

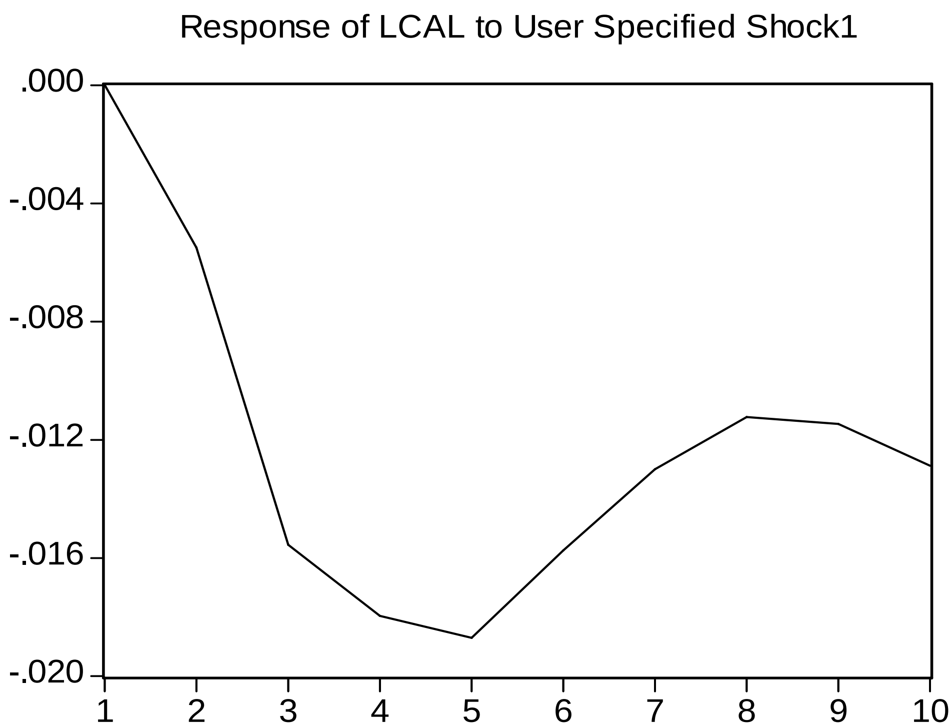

Figure 2: Response of c_t to Food Subsidy Reduction with Income Compensation