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Estimating Compensating Variation (CV) in Rural Sector with PIGLOG Preference Function

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ABSTRACT

The purpose of this paper is to measure the negative welfare effects resulting from rise of inflation rate on the consumers' welfare through extracting and calculating compensating variation (CV) based on the AIDS expenditure function. The findings given the CV criterion reflects that in order to compensate the welfare effects (for instance a 18 percent inflation rate over the 1975-2010period) the government should have paid on average 42531298 Rials annually to every rural household with size 6.5 per person. Measuring the CV correlation coefficient with the annual inflation rate of different commodity groups indicate that the commodity groups of housing, Food and Health Care have the highest negative welfare effect with 67, 45 and 31 percent on the rural consumers respectively.
KEYWORDS: Inflation Cost, Compensating Variation (CV), AIDS System Function.
JEL Classification: D1 ،C39.

1. 1 INTRODUCTION

Economists believe that the decisions making associated with providing public facilities should be accompanied with their effects investigations on the individuals' interests. Examining the welfare effects of different policies on the individuals' interests is not just limited to the public facilities, but also when a government tends to adjust trade tariffs, tax rates and so on therefore it is necessary to be highlighted. Despite the general consensus on welfare reduction comes from rise of goods prices on amount of lost consumers' welfare, but there are still disagreements about its quantification methods. J.Dupuit (1969) presented the Consumers' Surplus (CS) criterion given the area located between the Marshal's demand function and the price level. After that, Hicks introduced the welfare compensating Variation measure, such that if the demand function be extracted under his conditions it can show better the area. He supported a fixed marginal utility of money while the Marshal's Demand function is deprived of this property. Due to this reason, a new function entitled the compensating demand function or Hicks demand function was introduced that has the condition of fixed marginal utility of income. The Hicks demand function was able to measure welfare variation with introducing the compensating variation (CV).

Therefore in this paper we try to extract and calculate CV index for AIDS expenditure function in order to assess the welfare costs come from inflation rate increase. The study is divided into six sections including: introduce of CV; investigating the relationship of these standards with other welfare criteria like CS, PV and LV; introduce of AIDS function; extracting the CV index based on the former section; calculating the CV given the AIDS function estimates and finally offering the results.

It should be said that some studies such as Arnold (1979), Caves et al (1987), Chang and Hsing (1991), Chalfant (1987), Dennis (1981), Irene (1979), Junghun (2003), Glewwe and Twum (1998), Mishan (1979), Newberrg (1991), Slensnick (1991), Quigley and Rubinfeld (1989), Willing (1976) on the relevant literature have been conducted.

2. Extracting Equivalent and compensating Variations of AIDS Function

The AIDS function is not directly extracted from a specific utility function but it is obtained from the cost function which indicates a minimum necessary expenditure to access a specific utility level with respect to a given prices (displayed as identifier c (u,p)). The AIDS function in order to derive the demand equations uses a consumer expenditure function as a POGLOG form (Deaton &Muellbur, 1980) which is:

$$\log c(u, p) = (1-u)\log\{a(p)\} + u\log\{b(p)\}$$

Where $0< u <1$, such that if it is zero and one indicate subsistence level and the highest level of living respectively; terms a(p) and b(p) are subsistence level and the welfare cost which are defined as follows:

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$$\log a(p) = \alpha_0 + \sum a_i \log p_i + \frac{1}{2}\sum\sum \gamma_{ij} \log p_i \log p_j$$

$$\log b(p) = \log a(p) + \beta_0 \prod_{i=1}^{n} p_i^{\beta_i}$$

Thus, the AIDS cost function is equal to:

$$\log c(p,u) = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2}\sum_i\sum_j \gamma_{ij}^{*} \log p_i \log p_j + u\beta_0 \prod_{i=1}^{n} p_i^{\beta_i}$$

According to the Shephard's lemma, the first derivative of cost function shows compensating demand function, that is:

$$Q_i = \frac{\partial c(u, pi)}{\partial pi}$$

The AIDS pattern is obtained given the above equations, such that this price index is called Translog price index:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(\frac{x}{p})$$

$$logp = \alpha_\circ + \sum \alpha_k logp_k + \frac{1}{2}\sum_i\sum_k \gamma_{ki} logp_k logp_j$$

As mentioned before, the paper employs CV in order to measure the welfare effects resulting from inflation rate increase on consumers; thereby this criterion under the AIDS function will be extracted.

1-2-Extracting Compensating Variation (CV)

The CV criterion under the concept is defined as:

$$cv = e(u^\circ, p^1) - e(u^\circ, p^\circ)$$

To measure the criterion, we should obtain cost of acquiring initial utility, u°, at two initial and secondary price levels, p^1 and p°, given the AIDS expenditure function:

$$Lne(u^\circ, p_0) = \propto_\circ + \sum_{i=1}^{n} \propto_i Lnp_i^\circ + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} Lnp_i^\circ Lnp_j^\circ + u^\circ \beta_\circ \prod_{i=1}^{n} p_i^{\circ\beta_i} (1)\ Lne(u^\circ, p_1)$$

$$= \propto_\circ + \sum_{i=1}^{n} \propto_i Lnp_i^1 + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} Lnp_i^1 Lnp_j^1 + u^\circ \beta_\circ \prod_{i=1}^{n} p_i^{1\beta_i} \qquad (2)$$

With respect to equations 1 and 2:

$$u^\circ = \frac{1}{\beta_\circ \prod_{i=1}^{n} p^{\circ\beta_i}} [Lne(u^\circ, p_0) - \propto_\circ - \sum_{i=1}^{n} \propto_i Lnp_i^\circ - \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} Lnp_i^\circ \quad Lnp_j^\circ] \qquad (3)$$

$$u^\circ = \frac{1}{\beta_\circ \prod_{i=1}^{n} p^{1\beta_i}} [Lne(u^\circ, p_1) - \propto_\circ - \sum_{i=1}^{n} \propto_i Lnp_i^1 - \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} Lnp_i^1 \quad Lnp_j^1] \qquad (4)$$

The bellow equationis obtained under the two equations 3&4:

$$K_0 Lne(u^\circ, p_0) - K_0 A_0 = K_1 Lne(u^\circ, p_1) - K_1 A_1 \qquad (5)$$

Such that after simplifying equation 5 with respect to the following components, in the equation 6 can be written that:

$$K_0 = \frac{1}{\beta_\circ \prod_{i=1}^{n} p^{\circ\beta_i}} \text{ و } K_1 = \frac{1}{\beta_\circ \prod_{i=1}^{n} p^{1\beta_i}}$$

$$A_0 = \propto_\circ + \sum_{i=1}^{n} \propto_i Lnp_i^\circ + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} Lnp_i^\circ Lnp_j^\circ$$

$$A_1 = \propto_\circ + \sum_{i=1}^{n} \propto_i Lnp_i^1 + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} Lnp_i^1 Lnp_j^1$$

$$K_1 Lne(u^\circ, p_1) - K_0 Lne(u^\circ, p_0) = K_1 A_1 - K_0 A_0 \qquad (6)$$

Deducting term $K_1 Lne(u^{\circ}, p_0)$ from both sides of above equation can gives us simplified form as:

$$K_1[Lne(u^{\circ}, p_1) - Lne(u^{\circ}, p_0)] = K_0[Lne(u^{\circ}, p_0) - A_0] + K_1[A_1 - Lne(u^{\circ}, p_0)] \quad (7)$$

$$\frac{e(u^{\circ}, p_1)}{e(u^{\circ}, p_0)} = \exp\left[\frac{K_0}{K_1}[Lne(u^{\circ}, p_0) - A_0] + [A_1 - Lne(u^{\circ}, p_0)]\right]$$

Again we subtract component $\frac{e(u^{\circ}, p_0)}{e(u^{\circ}, p_0)}$ from the above equation, thus:

$$\frac{e(u^{\circ}, p_1) - e(u^{\circ}, p_0)}{e(u^{\circ}, p_0)} = \exp\left[\frac{K_0}{K_1}[Lne(u^{\circ}, p_0) - A_0] + [A_1 - Lne(u^{\circ}, p_0)]\right] - 1$$

$$\frac{e(u^{\circ}, p_1) - e(u^{\circ}, p_0)}{e(u^{\circ}, p_0)} = \exp\left[A_1 + \frac{K_0}{K_1}[Lne(u^{\circ}, p_0) - A_0]\right].\exp(-Lne(u^{\circ}, p_0)) - 1$$

$$e(u^{\circ}, p_1) - e(u^{\circ}, p_0) = \exp\left[A_1 + \frac{K_0}{K_1}[Lne(u^{\circ}, p_0) - A_0]\right] - e(u^{\circ}, p_0)$$

$$CV = \exp\left[A_1 + \frac{K_0}{K_1}[Lne(u^{\circ}, p_0) - A_0]\right] - e(u^{\circ}, p_0)$$

3-DATA AND MATERIALS

This study in order to estimate the AIDS function uses annual data pertaining to consumption expenditures of Iranian rural households and the relevant price indices over the period 1974-2010. Initial collected data comprises eight groups of commodities and services: Group of Food, Beverages and Tobacco, Group of Housing, and Fuel, Group of Clothing and Footwear, Furniture Group, Group of appliances and furniture, Group of Health care, Group of Transport and communications, Group of Recreational and Cultural Services and finally Group of Miscellaneous goods and services. The paper considers the last two groups as other commodities. Thus, the expenditure groups used in this study include: Group of Food, Beverages and Tobacco, Group of Housing, and Fuel, Group of Clothing and Footwear, Furniture Group, Group of appliances and furniture, Group of Health care, Group of Transport and communications and other commodities. The Food group in the years 1995 to 2010had the highest share of household budget such that on average 33 percent of consumption expenditures have been spent. The share of housing commodity and other commodities also over the period have had on average 29 percent and 38 percent of the budget respectively.

Table1. Geometric Average of Group Shares over the period 1974-2010.

Share of Housing Group	Share of Clothing Group	Share of Furniture Group	Share of Health care Group	Share of Transport and communications Group	Share of Food Group
27	11.3	10.8	14.6	21.3	**14.6**

Source: Current research, 2013.

6. Estimate of LAIDS Equations System

The paper uses the AIDS linear pattern in order to estimate the parameters of CV indictor and applies price indices, P^*, Instead of utilization of real price index, P, such that the pattern is converted as follows:

$$w_i = \alpha^*_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(\frac{x}{p^*}\right)$$

Term P^* Unlike the AIDS pattern in above equation is determined endogenously. Additionally, we used Aston price index, $\log P^* = \sum_i w_{it} \log p_i$, to attain a linear AIDS pattern. With respect to the Deaton & Muellbeauer (1980) point of view as well as given the empirical results can be claimed that where there is a high multicollinarity among the different commodity prices, therefore the LAIDS pattern could have better approximation for nonlinear AIDS model. The term P can be approximated as a proportion of relevant indices under condition:

$$p \cong \phi p^*$$

The main equation of AIDS function under the approximation can be written as bellow:

$$w_i = (\alpha_i - \beta_i \log \phi) + \sum_j \gamma_{ij} \log p_j + \beta_i \log\left(\frac{x}{p^*}\right)$$

$$\alpha^{*}_{i} = \alpha_i - \beta_i \log\phi$$

The equation LAIDS by using data concerning the period and employing Iterative Seemingly Unrelated Regression method was estimated so that after confirming all the classic's hypotheses,we put the results at table 2 and then the welfare cost of inflation in Iran under the CV of AIDS pattern was investigated.

Table2. Estimate of Unrestricted LAIDS equations System through ISURE over 1974-2010.

Variable	coefficient name	Coefficient	Std. Error	t-Statistic	Prob.
clothing group	intercept	-0.112479	0.06815	-1.650467	0.1007
	clothing price coefficient	0.068652	0.012748	5.385155	0
	food price coefficient	-0.070111	0.01146	-6.117743	0
	furniture price coefficient	0.029569	0.01471	2.010156	0.046
	health price coefficient	-0.002736	0.007796	-0.350956	0.7261
	housing price coefficient	-0.011331	0.006709	-1.68895	0.0931
	transport price coefficient	0.00442	0.009351	0.472746	0.637
	other goods price coefficient	-0.022781	0.010173	-2.239447	0.0265
	clothing income coefficient	0.023488	0.006169	3.807137	0.0002
food group	intercept	1.589244	0.304688	5.215974	0
	clothing price coefficient	-0.018166	0.060157	-0.301976	0.763
	food price coefficient	-0.01549	0.055093	-0.281162	0.7789
	furniture price coefficient	-0.084546	0.077129	-1.096159	0.2746
	health price coefficient	-0.062626	0.039538	-1.583958	0.1151
	housing price coefficient	-0.006156	0.03255	-0.18914	0.8502
	transport price coefficient	0.034629	0.043289	0.799955	0.4249
	other goods price coefficient	0.124041	0.051329	2.416587	0.0168
	food income coefficient	-0.089063	0.027318	-3.26021	0.0014
furniture group	intercept	-0.153564	0.064131	-2.394538	0.0178
	clothing price coefficient	-0.016945	0.01201	-1.410952	0.1601
	food price coefficient	-0.046548	0.01033	-4.506266	0
	furniture price coefficient	0.071412	0.014871	4.801968	0
	health price coefficient	0.045515	0.007384	6.164222	0
	housing price coefficient	-0.01114	0.006241	-1.785119	0.0761
	transport price coefficient	0.006199	0.008823	0.702601	0.4833
	other goods price coefficient	-0.049166	0.009764	-5.035282	0
	furniture income coefficient	0.02052	0.00583	3.519815	0.0006
health group	intercept	-0.048521	0.049646	-0.97734	0.3298
	clothing price coefficient	0.006369	0.009455	0.673609	0.5015
	food price coefficient	0.003475	0.008462	0.410601	0.6819
	furniture price coefficient	-0.017417	0.012083	-1.441435	0.1513
	health price coefficient	-0.000998	0.00619	-0.161164	0.8722
	housing price coefficient	0.013385	0.005162	2.592826	0.0104
	transport price coefficient	-0.014089	0.006853	-2.05587	0.0414
	other goods price coefficient	0.017139	0.007731	2.21691	0.028
	health income coefficient	0.006044	0.004474	1.350733	0.1786
housing group	intercept	0.042935	0.088846	0.483257	0.6295
	clothing price coefficient	-0.009657	0.016577	-0.582581	0.561
	food price coefficient	0.04072	0.015043	2.706972	0.0075
	furniture price coefficient	-0.015075	0.018791	-0.802249	0.4236
	health price coefficient	-0.035517	0.010086	-3.521267	0.0006
	housing price coefficient	0.018794	0.008719	2.155628	0.0326
	transport price coefficient	0.028499	0.012213	2.333494	0.0208
	other goods price coefficient	-0.01889	0.013157	-1.435738	0.153
	housing income coefficient	0.005474	0.008043	0.680554	0.4971
transportation group	intercept	-0.27737	0.096703	-2.868271	0.0047
	clothing price coefficient	-0.041505	0.018786	-2.209339	0.0285
	food price coefficient	0.028141	0.017885	1.573449	0.1175
	furniture price coefficient	0.028244	0.024504	1.152656	0.2507
	health price coefficient	0.002228	0.012762	0.174597	0.8616
	housing price coefficient	0.037694	0.010408	3.621481	0.0004
	transport price coefficient	-0.018864	0.013941	-1.353113	0.1779
	other goods price coefficient	-0.022292	0.016011	-1.392272	0.1657
	transport income coefficient	0.023844	0.008636	2.761077	0.0064

Source: Current research, 2013.

7. Estimating Welfare cost of Inflation

The Iranian government each year spends billions of dollars for basic goods to maintain or increase consumer's welfare level. This is while rise of inflation reduces their welfare levels. If the government wants to compensate these negative effects requires a measure for assessing the severity of consumers 'effectiveness. Hence, The purpose of this paper is to measure the negative welfare effect comes from rise in inflation rate on the consumers' welfare through extracting and calculating compensating variation (CV) based on the AIDS non-deferential function. It should be noted that the study in order to calculate welfare indices, CV, applies the commodity group price indices (cited at table 4) instead of P^1 and P^0 quantities, besides using the earned results of LAIDS pattern (cited at table 2) instead of β_is , so as the values of β_i for the different groups are observed at table 3.

Table3. The Values of β_i for Different Commodity groups under the LAIDS Model

Order	Commodity Group	Expenditure Coefficient (β_i)	Expenditure elasticity
1	Food	0.124041	0.79
2	Transportation	0.023844	1.33
3	Health Care	0.006044	1.01
4	Furniture	0.02052	1.42
5	Clothing	0.023488	1.25
6	Housing	0.005474	0.97

Source: Current research, 2013.

Classifying luxury and necessary goods Based on the Deaton & Muellbeauer's paper (1980) focuses the expenditure coefficients in the AIDS pattern so that their positive and negative coefficient symptoms indicate their types. As seen at the table 3, the groups of food and housing known as the necessary commodities while the groups of clothing, furniture, health care and transportation recognized as the luxury commodities in the country's rural arias based on the estimated results of the expenditure in the LAIDS model. Theoretically, because consumers not have a large reaction to the price of necessary commodities, therefore it is expected that rise of prices has more negative effects on their welfare.

Table 4. Geometric average of inflation in the commodity Groups over period 1354-2010.

Period	Transportation Group Inflation	Clothing Group Inflation	Housing Group Inflation	Health Care Group Inflation	Furniture Group Inflation	Food Group Inflation	Other commodities inflation
Total	17.83	13.26	15.99	13.54	14.25	16.85	15.57

Source: Current research, 2013.

Table 5. Geometric average of inflation index over 1975-2010.

Period	Inflation Index	Minimum Inflation Rate	Maximum Inflation Rate
Total	17.90	10.43	**30.28**

Source: Central Bank of Iran Databases & Current research, 2013.

Given the Aforementioned notes, now we can examine the consumers' welfare deviations resulting from the inflation in Iran. As well, The gained findings of CV criterion has been cited at tables 6 and 7.

Table 6. Measuring the welfare cost of inflation using CV index of AIDS function

Period	Sum of Compensating Variation (CV) in each group	Average of Compensating Variation (CV) in each group	Geometric Average of Ratio of CV to Total Expenditure (CV/M_0)	Geometric Average of Expenditure Ratio in each period (M_{1/M_0})
1975-2010	$\sum_{1354}^{1387} CV$ = 1941716402	2362850	$GEOMEAN_{1387}^{1354}$ = 5.26	$GEOMEAN_{1387}^{1354}$ = 1.78

Source: Current research, 2013.

With respect to the obtained values of term CV can be concluded that the government had to pay on average annually 2362850 Rials in order to neutralize the negative welfare effects of inflation over the period 1975-1979.

The results of CV during the period 1975-2010 imply that the households were willing to pay 17 percent of their annual spending in order to not face a inflation. The findings also indicated that for a 18 percent inflation rate, for instance, every rural household should receive 42531298 Rials annually to be compensated the welfare negative effects resulting from the inflation. In other words, to compensate each percent inflation rate, it was necessary to be paid 2735416 Rials over the period 1965-2005.

8. CONCLUSION

The Iranian government each year spends billions of dollars for basic goods to maintain or increase consumer's welfare level. This is while rise of inflation reduces their welfare levels. If the government wants to compensate these negative effects requires a measure for assessing the severity of consumers' effectiveness. Various criteria like LV, CS, PV, EV and CV are used in the literature of welfare economics to measure welfare changes resulting from price increases on consumers so that compensating variation (CV) because of representing consumers reactions to the changes of prices as well as considering a policy consequence after implementation are preferred to other methods. This study also to measure the welfare effects of inflation increase on the consumers extracted CV index based on the AIDS non-differential function and then under the estimates calculated the indices for six major commodity groups of Iranian rural households during the period 1974-2010. The findings indicated that for 18 percent inflation rate, every rural household must have received 61837489 *Rials* annually in order to be compensated the welfare negative effects resulting from the inflation. In other words, to compensate each one percent inflation rate, it is necessary to be paid 3435416 Rials over the period 1965-2005.

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