Calorie Consumption and Indonesia's Household Expenditure: Is There a Paradox?

Rustam¹, Mohamad Ikhsan², Djoni Hartono³, Sudarno Sumarto⁴

¹,²,³University of Indonesia, Jln. Prof. Dr. Sumitro Djojohadikusumo, Indonesia
⁴The National Team for the Acceleration of Poverty Reduction (TNP2K) and The SMERU Institute, Indonesia

Email: ¹rustam.datupijor@gmail.com, ²ican711@yahoo.com, ³djoni.hartono@gmail.com, ⁴ssumarto@tnp2k.go.id

*) Corresponding author

Abstract

During 2011-2014, anecdotal evidence suggested a paradox in Indonesia concerning calorie intake that had fallen, despite increased per capita expenditure and household size. This study will rigorously analyze calorie intake by applying several analytical methods, mainly repeated cross-section methods using an instrumental variable. The study used national scale data from the National Socio-Economic Survey (Susenas) in March 2011-2014. This study finds a meaningful relationship between calorie intake and per capita expenditure and household size in Indonesia in the 2011-2014 period. Besides, calorie needs and the “Subsidized Rice for the Poor” or the Raskin program are positively correlated with calorie intake. The research also suggests that the government needs to maintain household food assistance programs, ensure the stability of staple food prices, and apply economies of scale in calculating the poverty line.

Keywords:
calorie intake, household expenditure, household size, calorie needs, repeated cross-section method.

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Introduction

Calorie intake (CI) is a more direct measure of basic needs satisfaction and is widely used to calculate absolute poverty lines. The poverty line in Indonesia is calculated by using the Cost of Basic Needs (CBN) and Food Energy Intake (FEI) methods (Ravallion & Bidani, 1994). The minimum calorie needs vary by country. In Indonesia, 2,100 kilocalories per capita per day (Kcal/capita/day) are applied based on the Recommended Daily Dietary Allowance (RDA) consensus through the 1978 National Workshop on Food and Nutrition (Ravallion & Bidani, 1994). In India, poverty is measured by a direct method using minimum calorie adequacy of 2,400 Kcal/capita/day in rural areas and a minimum of 2,100 Kcal/capita/day in urban areas (Dev, 2005). In comparison, the Philippines applies minimum calorie adequacy of 2,000 Kcal/capita/day (Balisacan & Fuwa, 2004).

Several studies have found a strong relationship between welfare levels and food consumption (Attanasio et al., 2013; Ravallion, 2015). These empirical findings align with Engel’s Law, which proved a positive relationship between per capita income and food consumption, even though it tends to be inelastic. Several recent studies have, however, documented the “riddle” or paradox in food consumption. In the case of India (Deaton & Drèze, 2009), China (Du et al., 2002), and Britain during the Industrial Revolution (Clark et al., 1995), the population experienced rapid growth and rapid revenue growth. However, structural transformation in the form of calorie consumption was stagnant.

Deaton & Drèze (2009) showed that despite real expenditure growing, CI declined because households spend less on food and less on staple foods, at a certain level of expenditure, with cheaper sources of calories. This is in line with the results of empirical investigations in India that found that country has experienced a paradox over the past four decades, namely, monthly per capita real expenditure increasing over time, but the average number of calories consumed per capita falling (Basu & Basole, 2013).

Figure 1. Engel Calorie Curve Based on Intake Per Capita HE in Indonesia

Source: Statistics Indonesia, taken from various sources.
In a different context, Deaton & Paxson (1998) reported that households with more household members have a smaller CI per capita than a household with a similar per capita expenditure. This implies that households with more household members have poor nutrition. The above phenomenon contradicts the classic model (Barten, 1964) that states that households with more household members will have better nutrition as they consume more food per capita and benefit from economies of scale. Besides that, social capital is truly endogenous to household welfare (Adepoju & Oni, 2012).

In Indonesia's case, during 2011-2014, cross-section data shows that CI per capita per day tends to increase in line with increased income (proxied by average household expenditure/HE). The Engel calorie curve (Figure 1) shows a preliminary indication of the inconsistency of CI and household income in Indonesia, however, with CI levels remaining relatively flat regardless of the per capita expenditure after a certain point.

\[
\text{Figure 2. Engel Calorie Curve Based on Intake Per capita Household Expenditure Per capita and Household Size in Indonesia (2011-2014)}
\]

Source: Statistics Indonesia, taken from various sources

In Indonesia in 2011-2014, CI tended to decline, from 1,952 Kcal/capita/day in 2011 to 1,859 Kcal/capita/day in 2014. Depending upon the HE, it showed that an increase in household size (HS) tended to decrease CI per capita and vice versa (Figure 2). Empirical studies in several countries such as India (Figure 3), China, and the United Kingdom show that an increase in income results in a decrease in CI, and an increase in household size reduces household CI. However, a literature review has found no research on this puzzle using Indonesia datasets.
This paper aims to explain that the decrease in CI is closely related to the measurement of the poverty rate, especially in Indonesia, where the food poverty line is used as an indicator with minimum calorie needs set at 2,100 Kcal/capita/day. During 2012–2014, Indonesia’s poverty targets were not met, so to address this issue and fulfill the minimum CI needs in low-income groups, and the government continued a program of subsidized rice for the poor (Raskin).

On the whole, this study examines four main issues of interest: first, the relationship and effect of household expenditure per capita on the level of CI per capita; second, the relationship and effect of household size on CI per capita; third, the relationship and effect of calorie need based on physical activity level on CI per capita; and fourth, the effectiveness of the Raskin program on CI per capita.

Method

Empirical studies relating to variables in both areas of the puzzles are still very limited in developing countries. The use of cross-section data varies in each of the previous studies. Li (2011) used data exceeding 100,000 households in India from several time periods (1983, 1987-1988, 1993-1994, 1999-2000, and 2004-2005), while Basu and Basole (2013) used panel data consisting of 74 regions in the “state regions” which are rural areas in India from six periods, namely 1983-1984, 1987-1988, 1993-1994, 1999-2000, 2004-2005, and 2009-2010. Salois et al. (2010) explored the relationship between CI and other nutrients as a function of income using data from 171 countries (including Indonesia) in two time periods (1990-1992 and 2003-2005); Subramanian & Deaton (1996) estimated the elasticity of CI and HE by using households in rural areas of Maharashtra in India in 1983. Skoufias (2003) examined the relationship between
changes in income and calorie availability in Indonesia using household data from Susenas between 1996 and 1999 with a sample of around 60,000 households per year. Skoufias et al. (2009) used sample data of 7,553 households in 240 poor rural areas from eight Mexican states in the survey period between October 2003 and April 2004, while Skoufias et al. (2012) estimated the elasticity of income and calories from staple foods of grain before and after the 1997-1998 crisis in Indonesia using cross-section data; while the 1996 and 1999 Susenas survey used a sample of 60,678 and 62,217 households respectively.

Previous studies in several countries, including Indonesia, mostly used cross-section data or time-series data because it was challenging to obtain panel data with the same observation unit over the period. This study will use a fixed effect repeated cross-sections method using instrument variable estimation (Deaton, 1985; Moffitt, 1993; Verbeek, 2008; Skoufias et al., 2012) microdata level (household) as a unit of analysis. Theoretical model refers to Eli & Li (2015) that was further developed by Basu & Basole (2013).

The primary data source used to combine intake data and core data is the National Socio-Economic Survey (Susenas). The intake data is used to calculate CI per capita and expenditure per capita. The core data is used to describe individual/household characteristics. Both of these data sets are combined into a yearly household cross-section data structure. The observation period is from March 2011 to March 2014, where the observation unit is a household. This data period is due to the initial paradox of decreasing calorie consumption while household expenditure tends to increase. Data selection was based on the need for data to prove indications of the hypothesized CI paradox.

The main empirical model with the four main variables is specified through interaction with the time dimension (years) to measure the marginal effect on the 2011 base reference, referring to Skoufias et al. (2012). Interaction with the years is also treated equally towards the control variables and fixed effects. This study uses a fixed effect repeated cross-sections model that can be expressed as follows:

\[ log(Cal\_Int)_{jt} = \beta_0 + \sum_{k=1}^{4} x_{jk} \cdot \beta_{k} + \sum_{k=1}^{4} (X\theta)_{jk} \cdot \beta_{kt} + \sum_{m=1}^{7} z_{jtm} \cdot \beta_{m} + \sum_{m=1}^{7} (Z\theta)_{jtm} \cdot \beta_{mt} + \alpha_j + \theta_t + (a\theta)_{jt} + v_{jtl} \]  

To make the above empirical model clear with the four main variables in equation (1) above, the empirical model can be written as:

\[ log(Cal\_Int)_{jt} = \beta_0 + \beta_1 (log(Riil\_PCE))_{jt} + \beta_2 (log(Riil\_PCE) \times (D_{2012}))_{jt} + \beta_3 (log(Riil\_PCE) \times (D_{2013}))_{jt} + \beta_4 (log(Riil\_PCE) \times (D_{2014}))_{jt} + \beta_5 (log(HH\_size))_{jt} + \beta_6 (log(HH\_size) \times (D_{2012}))_{jt} + \beta_7 (log(HH\_size) \times (D_{2013}))_{jt} + \beta_8 (log(HH\_size) \times (D_{2014}))_{jt} + \beta_9 (log(Cal\_Req))_{jt} + \beta_{10} (log(Cal\_Req) \times (D_{2012}))_{jt} + \beta_{11} (log(Cal\_Req) \times (D_{2013}))_{jt} + \beta_{12} (log(Cal\_Req) \times (D_{2014}))_{jt} + \beta_{13} (log(D\_Raskin))_{jt} + \beta_{14} (log(D\_Raskin) \times (D_{2012}))_{jt} + \beta_{15} (log(D\_Raskin) \times (D_{2013}))_{jt} + \beta_{16} (log(D\_Raskin) \times (D_{2014}))_{jt} + \sum_{m=1}^{7} z_{jtm} \cdot \beta_{m} + \sum_{m=1}^{7} (Z\theta)_{jtm} \cdot \beta_{mt} + \alpha_j + \theta_t + (a\theta)_{jt} + v_{jtl} \]  

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Where:

\[ j = 1, 2, \ldots, 65 \text{ (urban/rural provinces as cross-sections)} \]
\[ t = 1, 2, \ldots, T \text{ (time period index in the year as repeated)} \]
\[ i = 1, 2, \ldots, n \text{ (the number of households)} \]
\[ m = 1, 2, \ldots, 7 \text{ (the number of control variables)} \]

- \( Cal_{Int} \) = average household CI per capita per day
- \( Riil_{PCE} \) = average monthly real expenditure per capita (proxy per capita income monthly real)
- \( HHsize \) = household size
- \( Cal_{Req} \) = estimated average calorie needs of household
- \( D_{Tahun} \) = dummy certain (year) time
- \( D_{Raskin} \) = dummy variable for household recipients of subsidized rice for the poor or non-recipient
- \( Z_{jti} \) = matrix of all control variables.
- \( (Z\theta)_{jti} \) = interaction of control variables and time
- \( \delta_j \) = fixed effect, urban / rural province.
- \( \theta_t \) = fixed effect, time
- \( (\alpha\theta)_{jt} \) = fixed effect, interaction of urban / rural provinces and time
- \( v_{jti} \) = error term.

The instrument variable technique is a standard reference for overcoming endogenous problems or inconsistencies in OLS estimation. The challenge is to find the instrument variable, which correlates with the explanatory variable but does not correlate with the error term component. Regression with instrument variables will produce consistent estimates (Deaton, 1997; Wooldridge, 2016). Some studies use Instrumental Variable (IV) in correcting the endogenous effects of social capital on poverty (Adepoju & Oni, 2012; Aker, 2007; Glaeser & DiPasquale, 1998; Grootaert, 1999; Grootaert & Narayan, 2004; Kirori et al., 2011). The study showed an endogenous problem that made it difficult to estimate the magnitude and direction of influence (Adepoju and Oni, 2012; Aker, 2007; Hassan and Birungi, 2011; Kirori et al., 2011; Tenzin et al., 2013). In cases where there is an endogenous problem, estimation using the Ordinary Least Square (OLS) method will be biased and inconsistent even though the number of samples is increased (Juanda, 2009). Dummy variables as instrument variables are often used (Angrist & Krueger, 2001), the instrument variable in this study used a dummy variable for a female partner who does not work. The consideration is that calorie consumption expenditure in households is primarily determined by women’s decision making as a spouse of the head of the household and the pattern of purchasing and processing food needs in the household.
Results and Discussion

Overview of CI and HE

The preliminary description of the trends in aggregate data for CI and average HE in Indonesia during 2011-2014 indicates a food consumption puzzle. This puzzle is evident from a decrease in CI per capita per day despite an increase in real monthly expenditure per capita (correlation coefficient -0.71). Other facts powerfully demonstrate a variation in the puzzle between urban and rural areas where the phenomenon is present in urban areas (correlation coefficient -0.74) but rare in rural areas (correlation coefficient 0.99). The variation between urban and rural areas is probably due to different consumption patterns and the primary calorie sources for each area. An increase in intertemporal food and non-food consumption and higher between-years growth in urban areas than rural areas are other possible factors. Similar shifts in Engel’s calorie curve occur in demand for calories and food observed by comparing urban or rural areas (wealthier areas versus lower areas). CI per capita decreased in urban and rural areas, but the decline in rural areas was higher.

Changes in the source of household calories are suspected of being the results of a move from grains and root vegetables (GRV) to other sources of calories, especially oils and fats and food and beverages (FB). Both urban and rural areas experienced calorie shifting. However, this phenomenon delineates the differences in consumption patterns between urban and rural populations. The shift in household CI sources is essential since it is related to improving nutritional status (through nutritional adequacy rates, where calories are a component in the calculation) and public welfare.

Observations within-year indicate that an increase in income will reduce CI for the GRV group. However, between-year observations reveal that when fixed income is constant, CI tends to decrease. This is implied by the shift in Engel’s calorie curve that moves to the bottom. This means that the higher the income, the more the CI decreases for the GRV group. This phenomenon demonstrates a similar pattern to the relationship between HE and total consumption of per capita calories.

When conducting a within-year observation of the other three food groups (eggs, fish, milk, and meat (EFMM); vegetables, nuts, and fruits (VNF); and FB), this study found that an increase in income essentially results in increasing CI per capita. Meanwhile, a between-years observation on the other three food groups specifies that the higher the income, the lower the CI from each other’s food groups. This condition can also be shown by the shift of Engel’s calorie curve that is likely to move downwards between years. The indication of a decrease in the amount of CI in Indonesia also seemed to exist for HE’s deciles.

Overview of CI and Household Size

Economic theory predicts that households’ economic scale often improves household economic welfare by increasing per capita consumption of personal goods. Larger households must manage higher per capita consumption of personal goods such as food. Household size is one of the determinants of household CI patterns.
Household size is one of the determinants of the household CI pattern. The average household size during 2011-2014 was stagnant at around 4.6 people while the CI per capita tended to shrink, except in 2014 when there was an increase. The decrease in CI per capita in line with the increase in household size between 2011-2014 occurs within the year and between years and in rural and urban areas.

**Result of Fixed Effect Repeated Cross-Sections Method**

The empirical model using a *fixed effect repeated cross-sections method* in this study aims to examine the relationship between daily CI per capita and some key variables of interest such as (i) real per capita HE; (ii) daily calorie needs per capita; (iii) household size; and (iv) the subsidized rice received. The best empirical model uses the instrument variables (IV) method to eliminate the endogeneity problem resulting in a robust and consistent estimator. The instrument variables used are strongly correlated with real household expenditure per capita and are eminently proved by the test results (Table 1).

**Relationship between CI and HE**

The *fixed effect repeated cross-sections* (IV) method for the Indonesia data in 2011 reveals an increase in CI per capita and an increase in per capita expenditure, which is statistically significant using a *within-year* comparison. This result is consistent with Basu & Basole (2013) findings, but the value of elasticity is more excellent at 0.556 compared to 0.309 with a significance level of 1 percent (Table 1). The estimation of the *marginal effect* coefficient of CI and per capita household expenditure on the *between-years* observation is negative and significantly different in 2012 and 2014. Empirically, there tends to be a paradox concerning the increasing expenditure per capita, resulting in CI per capita decline.

Aguiar & Hurst (2005) shows that there is a decline in food expenditure, neither the quantity nor the quality of food intake with retirement status. However, unemployed household experience a decline in consumption commensurate to the impact of job displacement on permanent income.

**Relationship Between CI and Household Size**

The results of the *fixed-effect repeated cross-sections* (IV) method for Indonesia in the observation of the *baseline* year shows that an increase in household size by 1 percent will result in a decrease in CI per capita by 0.108 percent. The between-year observation results show that the increase in household size by 1 percent in 2014 led to a decrease in CI per capita in 2011 of 0.053 percent (Table 1). These findings are statistically significant, and it shows that an increasing household size will lead to a decline in CI per capita, even though it was only significantly different in 2014 from 2011 and noted as unfavorable. Pelto et al. (1991) shows that large household size will rise up the risk factor for malnutrition in developing countries, especially for infants and young children.
### Table 1. Results of Log Estimation (CI Expenditure Per capita per day) Using Fixed Effect Repeated Cross-Sections Method (OLS and IV)

| Variable | OLS | IV |
|----------|-----|----|
| Log(real per capita HE) | 0.250*** 0.003 | 0.556*** 0.080 |
| Marginal effect | | |
| Log(real per capita HE)*D2012 | 0.010*** 0.005 | -0.171* 0.095 |
| Log(real per capita HE)*D2013 | 0.016*** 0.005 | -0.067 0.101 |
| Log(real per capita HE)*D2014 | 0.025*** 0.005 | -0.208** 0.088 |
| Log(calorie needs) | 0.374*** 0.014 | 0.285*** 0.028 |
| Marginal effect | | |
| Log(calorie needs)*D2012 | 0.076*** 0.020 | -0.023 0.035 |
| Log(calorie needs)*D2013 | 0.004 0.019 | 0.014 0.037 |
| Log(calorie needs)*D2014 | 0.023 0.019 | 0.034 0.033 |
| Log(household size/HS) | 0.171*** 0.004 | -0.108*** 0.017 |
| Raskin Program | | |
| Log(HS)*D2012 | 0.003 0.005 | -0.022 0.023 |
| Log(HS)*D2013 | | |
| Log(HS)*D2014 | 0.011** 0.005 | -0.007 0.024 |
| Raskin Program | 0.033*** 0.003 | 0.109*** 0.020 |
| Marginal effect | | |
| Raskin Program*D2012 | 0.002 0.004 | -0.043* 0.025 |
| Raskin Program*D2013 | 0.001 0.004 | -0.010 0.026 |
| Raskin Program*D2014 | | |
| Observations | 284,963 | 284,963 |
| R-squared | 0.369 | 0.230 |
| Control Variable | Yes | Yes |
| Raskin Program | Yes | Yes |
| Dummy Province, Regency/Village | Yes | Yes |
| Dummy Year | Yes | Yes |
| (Dummy Province, Regency/Village)*(Dummy Year) | Yes | Yes |
| Endogeneity:Wu-Hausman: F-stat. [p-value] | 27.96 [0.000] |
| Endogeneity:Durbin score: chi-sq. test [p-value] | 119.9 [0.000] |
| Excluded instrument test, F-stat. | 139.6 |

### Relationship Between CI and Calorie Needs

The fixed effect repeated cross-sections (IV) method for Indonesia in 2011 (baseline) shows a positive relationship between calorie needs per capita and CI per capita at a 1 percent significant level. The increase in per capita calorie needs is following an increase in CI per capita (Table 1). The marginal effect coefficient estimates are CI per capita, and calorie needs per capita on the between-years observation are negative and did not
show significant changes throughout the period observed. There is, therefore, insufficient evidence to show that an increase in calorie needs per capita will reduce CI per capita.

**Relationship between CI and Subsidized Rice**

Using the fixed-effect repeated cross-sections (IV) method, this study finds that the Raskin program positively correlates with the CI per capita and is still essential. Compared to the Kochar (2005) shows that CI elasticity and the Raskin program were almost equal at 0.11 to 0.08. The between-years observation also showed that the CI per capita of the subsidized-rice recipient households in 2012 and 2014 are significantly different from the baseline and are negative (Table 1). The empirical evidence shows that the Raskin program will increase CI per capita and tend to result in a decrease in CI per capita between years.

**Conclusion**

This research for Indonesia concludes that, empirically, there tends to be a paradox that an increasing expenditure per capita results in calorie intake per capita declining. This research is statistically significant and shows that an increase in household size will lead to a fall in calorie intake. There is insufficient evidence to show that an increase in calorie needs per capita will reduce calorie intake per capita. Thirdly, this research shows that the Raskin program has led to increased calorie intake per capita.

Based on the results of this research and the conclusion above, this study recommends several policy adjustments are government must define particular distributors/stalls/shops/supermarkets that serve and help the non-cash food assistance cardholder to receive their benefit, education on the importance of fulfilling proper and balanced calorie consumption mainly to overcome underweight/obesity and wasting and stunting conditions, the government needs to improve and ensure the stability of the price of staple food at the consumer level-especially for the fulfillment of the fundamental rights of the community, and BPS needs to consider the use of economies of scale in calculating the poverty line to fix the apparent overestimation of the poverty line that calculated using the current BPS method.

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**Disclaimer**

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