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Abstract: Most CGE models and many econometric models pay little attention to the demographic-economic interactions in the economy, with the notable exception, of course, of labor market behavior. However, with many national and regional economies experiencing significant demographic changes – ageing of the population, differential (in terms of income and occupational characteristics) out- and in-migration and deepened income disparities, there is a need to consider ways in which some of these demographically-induced changes can be handled. Using Chicago data, this paper explores some implications of demographic changes – especially ageing of population and income distribution - on consumption behavior in the Chicago region using an extended Chicago Region Econometric Input-Output Model (CREIM), where a modified Almost Ideal Demand System (AIDS) is integrated.

Key words: Demographic Changes, Almost Ideal Demand System, Chicago Region Econometric Input-Output Model

1 Introduction

Most CGE models and many econometric models pay little attention to the demographic-economic interactions in the economy, with the notable exception, of course, of labor market behavior. However, with many national and regional economies experiencing significant demographic changes – ageing of the population, differential (in terms of income and occupational characteristics) out- and in-migration and deepened income disparities – there is a need to consider ways in which some of these demographically-induced changes can be handled. In a sense, the duality between production structure and the structure of income distribution advanced in the context of social accounting systems can be enhanced by a broader vision of the demographic influences on consumption, income distribution and thus production.

Some important research has made progress on this topic. Hewings (1982) and Hewings *et al.* (1989) emphasized the role of the household sector and the importance of consumption patterns

in the analysis of using extended input-output and social accounting models. Li *et al*. (1999) and Rose and Li (1999) constructed an income distribution matrix to explore various facets of income distribution at the national and regional levels. Rose and Beaumont (1988, 1989), and Rose and Li (1999) calculated estimates of interrelational income multipliers using the method proposed by Miyazawa (1968, 1976). Recently, Wakabayashi and Hewings (2007) found some implications of life cycle changes on Japanese consumption behavior using a modified AIDS estimation system in the interregional context.

<<insert figure 1 here>>

In contrast to past literature, this paper considers not only the ageing of population but also income distribution. To explore some implications of demographic changes on consumption behavior in the Chicago region, an extended Chicago Region Econometric Input-Output Model (CREIM) is developed, into which a modified Almost Ideal Demand System (AIDS) is integrated. A recent prediction of US population shows that the proportion of the ageing population will accelerate after 2010 in the US (see figure 1).

<<insert figure 2 here>>

Figure 2 reveals that incomes and expenditures by quintiles of income showed different increasing trends during the period from 1984 to 2003. Even though the income ratio of the lowest 20 percent to the highest 20 decreased slightly in twenty years, the income ratio in 2003 still amounted to 15.5, showing more deepened purchasing power inequality. The expenditure ratio of the lowest 20 percent to the highest 20 percent in 2003 stood at 4.4 up from 3.8 in 1984, implying that the richer have increased consumption. This means that income distribution is another important factor that influences consumption patterns.

In this research, first of all, a Chicago region consumption matrix has been constructed using available disaggregate level data; the challenge here will be construction of an appropriate, econometrically sound, AIDS-type system under conditions of limited information. Secondly, this paper attempts to characterize the consumption behavior in the Chicago region using a modified AIDS system. Thirdly, the impacts of installation of such a system in a computable general equilibrium (CGE) model, CREIM, will be assessed. Finally, future consumption behavior using an AIDS-type CREIM model will be estimated. One of the major issues to be

addressed is the degree to which it is analytically important to estimate consumption by age group or income quintile; in this sense, the present paper takes the next step from the Wakabayahsi and Hewings (2007) analysis by incorporating disaggregated consumption functions into an impact and forecasting model. In this way, it is possible to explore the importance of household consumption disaggregation in contrast to results generated with a single representative household.

The remainder of the paper is composed of five sections. In Section 2, an AIDS model to analyze households with age characteristics and income distributions is introduced and extended. In Section 3, an AIDS-type Chicago Region Econometric Input-Output Model to predict the demographic changes in the Chicago region up to 2030 is described; the data used to implement the model is discussed in Section 4. The empirical estimations are provided in Section 5. Section 6 explores the implications for empirical estimations while a concluding discussion appears in section 7.

2 The Modified Almost Ideal Demand System[1]

To analyze the demographic changes in the Chicago region, this research employs AIDS (Almost Ideal Demand System), which was proposed by Deaton and Muellbauer (1980). This system is derived from the PIGLOG (price-independent log)-class expenditure function defined as follows.

$$\ln C(U,P) = (1-U)\ln A(P) + U \ln B(P) \tag{1}$$

where $\ln A(P) = \alpha_0 + \sum_k \alpha_k \ln P_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \ln P_k \ln P_j$ and

$$\ln B(P) = \ln A(P) + \beta_0 \prod_k P_k^{\beta_k}$$

To derive price elasticities which reflect both own price effects and cross price effects, the *K*-good expenditure function is expressed in terms of "two-good economies" producing *i* and *–i.*[2]

[1] This section draws on Wakabayashi and Hewings (2007)

$$\ln C(U,P) = (1-U)\ln A(P) + U \ln b(P) \tag{2}$$

where $\ln A(P) = \alpha_0 + \alpha_i \ln P_i + \alpha_{-i} \ln P_{-i} + \ln A \frac{1}{2}(\gamma^*_{ii} \ln P_i \ln P_i + \gamma^*_{i\text{-}i} \ln P_i \ln P_{\text{-}i} + \gamma^*_{\text{-}ii} \ln P_{\text{-}i} \ln P_i + + \gamma^*_{-i-i} \ln P_{-i} \ln P_{-i}$

and $\ln B(P) = \ln A(P) + \ln B(P) = \ln A(P) + \beta_0 (P_i^{\beta_i} P_{-i}^{\beta_{-i}})$

A modified AIDS cost function can be written as:

$$\ln C(U,P) = \alpha_0 + \alpha_i \ln P_i + \alpha_{-i} \ln P_{-i} + \frac{1}{2}(\gamma^*_{ii} \ln P_i \ln P_i + \gamma^*_{i-i} \ln P_i \ln P_{-i} + \gamma^*_{-ii} \ln P_{-i} \ln P_i + \gamma^*_{-i-i} \ln P_{-i} \ln P_{-i}) + \beta_0 (P_i^{\beta_i} P_{-i}^{\beta_{-i}}) \tag{3}$$

where $\gamma_{ii} = \gamma^*_{ii}, \gamma_{i-i} = \gamma^*_{i-i} = \gamma^*_{-ii}$

Applying Shepherd's lemma to this expenditure function, the function can be described as:

$$w_i = \frac{\partial \ln C(U,P)}{\partial \ln P_i} = \frac{P_i Q_i}{C(U,P)} = \alpha_i + \gamma_{ii} \ln P_i + \gamma_{i-i} \ln P_{-i+} \beta_i U \beta_0 (P_i^{\beta_i} P_{-i}^{\beta_{-i}}) \tag{4}$$

For a utility-maximizing consumer, total expenditure X is equal to $C(U, P)$ and this equality can be inverted to give U as a function of P and X, the indirect utility. (4) can be rewritten as the AIDS demand functions in budget share form:

$$w_i = \alpha_i + \gamma_{ii} \ln P_i + \gamma_{i-i} \ln P_{-i} + \beta_i \ln(X/P) \tag{5}$$

where w_i is the budget share of the good i for the household, P_i is the price of good i, and (X/P) is the total expenditure on all goods and services in real terms. A price index P is defined by

$$\ln P = \alpha_0 + \alpha_i \ln P_i + \alpha_{-i} \ln P_{-i} + \frac{1}{2}(\gamma_{ii} \ln P_i \ln P_i + \gamma_{i-i} \ln P_i \ln P_{-i} + \gamma_{-ii} \ln P_{-i} \ln P_i + + \gamma_{-i-i} \ln P_{-i} \ln P_{-i}) \tag{6}$$

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[2] This approach is also helpful to preserve degree of freedom in a small sample, since it can save *k-2* degrees of freedom in the estimation. And the expenditure function changes from $C = \sum_k P_k Q_k$ for k goods to $C = P_i Q_i + P_{\text{-}i} Q_{\text{-}i}$ for good i and $-i$.

where $\gamma_{i-i} = \frac{1}{2}(\gamma^*_{i-i} + \gamma^*_{-ii})$

Since the price index *P* is defined as (6), the AIDS model is non-linear. Deaton and Muellbauer (1980) suggested the real price index *P* can be replaced by the Stone price index $\hat{P}$ to transform the AIDS into a linear one.

$$w_i = \alpha_i + \gamma_{ii} \ln P_i + \gamma_{i-i} \ln P_{-i} + \beta_i \ln(X / \hat{P}) \tag{7}$$

$$\ln \hat{P} = w_i \ln P_i + w_{-i} \ln P_{-i} \tag{8}$$

The AIDS with the Stone price index is called 'Linear Approximate Almost Ideal Demand' (LA/AIDS). Many researchers employ LA/AIDS, since the model is easily applied to the estimation. To be consistent with consumption theory, the model should require the following conditions

$$\sum_i \alpha_i = 1,\ \sum_i \gamma_{ij} = 0,\ \sum_i \beta_i = 0 \text{ (adding up)} \tag{9}$$

$$\sum_j \gamma_{ij} = 0 \text{ (homogeneity)} \tag{10}$$

$$\gamma_{ij} = \gamma_{ji} \text{ (symmetry)} \tag{11}$$

Since homogeneity implies $\gamma_{ii} = -\gamma_{i-i}$, (7) can be re-written as

$$w_i = \alpha_i + \gamma_{ii} \ln\left(P_i / P_{-i}\right) + \beta_i \ln(X / \hat{P}) \tag{12}$$

Since the modified AIDS is flexible, it is not guaranteed to satisfy the homogeneity and symmetry conditions. So these conditions are introduced as parameter restrictions in the estimation process. This means that these properties are satisfied by parameter restrictions in the model.

The modified AIDS assumes that the size of the family affects budget share and *N*, the number of household members, was introduced as a shift parameter of α_i. Then the model can be expressed as:

$$w^k_{it} = \alpha_i + e_i N^k_t + \gamma_{ii} \ln(P_{it} / P_{-it}) + \beta_i \ln(X^k_t / \hat{P}^k_t) + e^k_i \tag{13}$$

where e_i^k is the error term and *i* and *k* refer to ten consumption types and six ages of reference person.

$$w_{it}^r = \alpha_i + e_i N_t^r + \gamma_{ii} \ln(P_{it} / P_{-it}) + \beta_i \ln(X_t^r / \hat{P}_t^r) + e_i^r \quad (14)$$

where e_i^r is the error term and *i* and *r* refer to ten consumption types and five quintiles of income.

The empirical results of (13) show life cycle changes in consumption behavior and the estimations of (14) show the impacts of income distribution on consumption behavior. From the estimation results (13) and (14), the price elasticity ε_{it}^j and expenditure elasticity η_{it}^j are:

$$\varepsilon_{it}^j = \frac{\gamma_{ii}}{w_{it}^j} + w_{it}^j - 1 \quad \text{for } j = k \text{ (age of reference person), } r \text{ (quintiles of income)} \quad (15)$$

$$\eta_{it}^j = \frac{\beta_i}{w_{it}^j} + 1 \quad \text{for } j = k \text{ (age of reference person), } r \text{ (quintiles of income)} \quad (16)$$

3 The AIDS-type Chicago Region Econometric Input-Output Model

To predict the demographic changes in the Chicago region up to 2030, this research extends the Chicago Region Econometric Input-Output Model (CREIM). An ideal approach to extend the CREIM for this research would be to construct a consumption distribution matrix (industry by age group or industry by income quintiles), income distribution matrix (industry by age group or industry by income quintiles), and interrelational multipliers (age group by age group or income quintiles by income quintiles). However, their complete construction would be impossible, since the necessary data are not available. To overcome restrictions of data availability, an alternative development of an AIDS-type CREIM will be described that will make it possible to predict the demographic changes in the Chicago region by constructing appropriate estimates for transfer transactions.

The regional econometric input-output model (REIM), initially designed by Conway (1990, 1991), and developed by Israilevich and Hewings (1997), provides an alternative perspective for impact analyses or forecasts. The CREIM, which generates forecasts of the Chicago economy

on an annual basis, with the forecast horizon extending up to 30 years, is a computable regional general equilibrium model, based on the Marshallian equilibrium of outputs. The model combines traditional input-output analysis with time-series analysis. The input-output component enables a detailed analysis of purchases and sales between industries, while the time-series component allows for the analysis of inter-temporal change in the transaction flows of goods and services. Together, these two components yield a detailed analysis of structural change over time at the sectoral level.

The CREIM model is a system of linear and nonlinear equations formulated to predict 264 endogenous variables. The CREIM identifies 53 industries and three government sectors. For each industry, there are projections of output, employment, and earnings. Out of the 253 equations, only 53 relate to the linear input-output components. Many of the non input-output equations are nonlinear and estimated in a recursive fashion. As a result, the relationships of one sector to another include the formal input-output link as well as a set of complex links through a chain of actions and reactions that could potentially involve the whole economy. Further details may be found in Israilevich *et al* (1997); a stylized representation of the structure is provided in figure 3.

<<insert figure 3 here>>

To predict the impacts of demographic changes in the Chicago region, a modified AIDS system was integrated into the CREIM. An AIDS-type CREIM can be constructed by including a modified AIDS system into equations of final demand by households. The AIDS system equations that are to be included are derived from estimates using a 20 year time series (1984-2003), in final demand equations.

$$w_{it}^{k} = \alpha_i + e_i N_t^k + \gamma_{ii} \ln(P_{it} / P_{-it}) + \beta_i \ln(X_t^k / \hat{P}_t^k) + e_i^k \quad (17)$$

where e_i^k is the error term and *i* and *k* refer to ten consumption types and six age groups (see Appendix for a description of these types and groups).

$$w_{it}^{r} = \alpha_i + e_i N_t^r + \gamma_{ii} \ln(P_{it} / P_{-it}) + \beta_i \ln(X_t^r / \hat{P}_t^r) + e_i^r \quad (18)$$

where e_i^r is the error term and *i* and *r* refer to ten consumption types and five income quintiles.

However, to predict w_i, the budget shares of consumption type i of the household k (age group) or r (income quintiles), the model should predict price indexes (P_{it}, P_{-it}, $\hat{P}_t^k, \hat{P}_t^r$), the size of family by age group (N_t^k) or by income quintiles (N_t^r), and expenditures by age group (X_t^k) or by income quintiles (X_t^r) up to 2030.

We can predict the price indexes (P_{it}, P_{-it}, $\hat{P}_t^k, \hat{P}_t^r$) using exogenous price variables (US CPI) with an auto-regressive error process. The following equations will be added into the CREIM model.

$$\begin{aligned} CCPI_{ik} &= p\left[CCPI_{ik}(lag), USPCPI\right] \\ CCPI_{ir} &= p\left[CCPI_{ir}(lag), USPCPI\right] \end{aligned} \tag{19}$$

where $CCPI_{ik}$ is the consumer price index of the Chicago region for consumption type i for i = 0 to 10 (0: total, 1-10: consumption types) of k age group, $CCPI_{ik}(lag)$ is the lag variable of $CCPI_{ik}$, $CCPI_{ir}$ is the relative consumer price index of the Chicago region for consumption type i of r income quintiles, $CCPI_{ir}(lag)$ is the lag variable of $CCPI_{ir}$ and $USPCPI$ is the prediction of the US consumer price index from the CREIM. Using these Chicago CPI predictions, a future time series of relative CPI price index in the Chicago region ($CCPI_i / CCPI_{-i}$) and the real total expenditure on all goods and services (X/P) can be estimated.

To estimate the size of family by age group (N_t^k) or by income quintiles (N_t^r), and expenditures by age group (X_t^k) or by income quintiles (X_t^r), the household number equations are constructed.

$$\begin{aligned} &AN^k = g^k\left[AN^k(lag), USPOP^k\right] \quad \text{for } k = 1 \text{ to } 6 \text{ (age of reference person)} \\ &\left[IN^r(lag), CPOP\right] \quad \text{for } r = 1 \text{ to } 5 \text{ (quintiles of income)} \end{aligned} \tag{20}$$

where AN^k is the household number of k age group, $AN^k(lag)$ is the lag variable of AN^k, IN^r is the household number of r income quintiles, $IN^r(lag)$ is the lag variable of IN^r, $USPOP^k$ is the prediction of the US population by age (under 25 years, 25-44 years, 45-65 years, over 64 years) and $CPOP$ is the prediction of Chicago total population from CREIM.

The family size equations are constructed by using predictions of $USPOP$ and $CPOP$.

$$A^k = n^k\left[A^k\left(lag\right), USPOP^k\right] \quad \text{for } k = 1 \text{ to } 6 \text{ (age of reference person)}$$
$$I^r = n^r\left[I^r\left(lag\right), CPOP\right] \quad \text{for } r = 1 \text{ to } 5 \text{ (quintiles of income)} \tag{21}$$

where A^k is the family size of k age group, $A^k(lag)$ is the lag variable of A^k, I^r is the family size of r income quintiles, $I^r(lag)$ is the lag variable of I^r.

Thereafter, the income equations can be estimated:

$$CY^k = h^k\left[CY^k(lag), CYTOT\right] \quad \text{for } k = 1 \text{ to } 5 \text{ (age group, except over 64 years)}$$
$$CY^r = h^r\left[CY^r(lag), CYTOT\right] \quad \text{for } r = 1 \text{ to } 5 \text{ (income quintiles)} \tag{22}$$

where CY^k is the income of household of k age group, $CY^k(lag)$ is the lag variable of CY^k, CY^r is the income of household of r quintiles of income, $CY^r(lag)$ is the lag variable of CY^r, and $CYTOT$ is the prediction of Chicago total wage income from CREIM.

The income used for the analysis of demographic change includes wages and salaries and transfer incomes such as pensions and property income. The latter two components are particularly important for the household income of the oldest age group (over 64 years). Since data on transfer incomes cannot be obtained from CREIM, which only has data on wage income by industry, this research will be based on the structure of a Chicago social accounting matrix to identify a time series of households' transfer incomes. Basically, the input-output (IO) table shows us the consumption/expenditure patterns of the different types of transactors. However, it does not provide much information about the income side of the equation. In the case of households, the IO table only provides information about wage and salary (i.e. factor) income, which is may not comprise the total sources of income that finance total household expenditure.

From the structure of Chicago social accounting matrix, it is possible to identify the composition of household income, which include wages and salaries, other value-added income, and transfer incomes. To estimate a time series of households' transfer income from CREIM, the ratio of transfer income to wage income is calculated and applied to the ratio of time series of total wage

income from CREIM. Then, the predictions of household income of oldest age group (over 64 years) can be estimated.[3]

$$TY = CYTOT^{*} \text{ ratio of households' transfer income to wage income}^{4} \quad (23)$$

where TY is the transfer income for households, and $CYTOT$ is the prediction of Chicago total wage income from CREIM.

The income equation of the reference person with over 64 years is expressed as:

$$CY^{6} = h^{6}\left[CY^{6}(lag), TY\right] \quad (24)$$

Finally, the consumption equations can be constructed:

$$\begin{aligned} CC^{k} &= m^{k}\left[CC^{k}(lag), CC\right] \quad \text{for } k = 1 \text{ to } 6 \text{ (age of reference person)} \\ CC^{r} &= m^{r}\left[CC^{r}(lag), CC\right] \quad \text{for } r = 1 \text{ to } 5 \text{ (quintiles of income)} \end{aligned} \quad (25)$$

where CC^{k} is the household consumption of k age group, $CC^{k}(lag)$ is the lag variable of CC^{k}, CC^{r} is the household consumption of r income quintiles, $CC^{r}(lag)$ is the lag variable of CC^{r}, and CC is the prediction of Chicago total consumption from CREIM. The extended system is summarized in table 1.

<<insert table 1 here>>

4 Data

The data source for consumption expenditure of households is the Consumer Expenditure Survey of US Bureau of Labor Statistics (BLS). The survey provides US yearly disaggregate data during 1984 – 2003 and Chicago yearly aggregate data during 1987-2003. Consumption goods and services of U.S. disaggregate data are aggregated into 10 categories shown in the Appendix. Each consumption expenditure is divided into six age groups (under 25 years, 25 – 34 years, 35 – 44 years, 45 – 54 years, 55 – 64 years, over 64 years) according to age of the reference person

[3] While non wage and salary income obviously accrues to other household groups, attention was focused on the >64 year age groups.

[4] Ratio of Households' transfer income = Households' transfer income / Households' wage income = (15,351 + 36,391 + 31,711 + 948) / 146,923 = 0.57445

and five income quintiles (the lowest 20 percent, second 20 percent, third 20 percent, fourth 20 percent, the highest 20 percent).

To construct consumption time series in the Chicago region for the period 1984 – 2003, aggregate expenditures are first estimated for 1984-1986 using an ARIMA model. Then, using the consumption expenditure structure of the US as a whole, Chicago consumer expenditures by age group and by income quintiles are estimated. All variables are converted into real-valued terms using the Chicago Consumer Price Index (CPI) developed by BLS.

<<insert table 2 here>>

Table 2 summarizes the budget share of each consumption good and service by age group. Households of the under-25 age group spend more on education, transportation, clothing, food and beverages, and less on health care, insurance, pensions and housing. Those of 25 - 34 and 35 - 44 age groups reveal similar consumption patterns; they spend more on housing, transportation and entertainment, and less on health care and education. Households of 45 - 54 spend more on education, insurance and pensions, and they spend less on housing and health care. Those of 55 - 64 spend more on health care, insurance and pensions, and less on education and clothing. The oldest age groups (over 64) spend more on health care and food, and spend less on education, clothing, and transportation. Households of under 25 and over 64 reveal higher standard deviations than other age groups, reflecting the fact that consumption behaviors of the youngest and the oldest age groups vary among different years in the Chicago region.

<<insert table 3 here>>

Table 3 summarizes the budget share of each consumption good and service by income quintiles. Households of the lowest 20 percent and second 20 percent show similar consumption patterns, spending more on food, beverages, housing, and health care, and less on insurance, pension, transportation and entertainment. Those of the third 20 percent spend more on transportation, health care and personal care, and less on education and pension. Households of the fourth 20 percent spend more on transportation, entertainment, insurance and pensions, while they spend less on housing, health care and education. Those of the highest 20 percent spend more on insurance, pensions, education and entertainment, and less on food, beverages, housing, transportation and health care. Not surprisingly, households with higher incomes spend more on

luxury items as opposed to necessities, and low income households spend significant percentages of their income on food, clothing and housing, with little left over for other purchases. Households of the lowest 20 percent show higher standard deviation than other age groups. Examining the standard deviations, it should be noted that low income households have higher volatilities in consumption behaviors because of income constraints.

5 Empirical Estimations

Tables 4 and 5 reveal the estimation results of price and expenditure elasticities of the one representative household (total) and six representative households by age group. With the one representative household (total), consumers are more price-elastic in the purchase of food, beverages, tobaccos and pensions, and less price-elastic in their spending on clothing, health care and education. They consider housing, transportation, entertainment and personal care as Giffen goods, implying that the household is willing to spend more on them when their prices increase. The one representative household considers food, beverages, tobaccos and health care as necessities, and housing, closing, transportation and entertainment as luxuries. The household tends to decrease expenditures on education as its income increases.

<<insert tables 4, 5 here>>

Disaggregate households by age group show different consumption patterns, compared with the one representative household. Table 4 presents price elasticities by age group; most households, except those in the over 45 - 54 age group, are elastic in purchasing food, beverages and tobacco. The oldest age group (over 64) is the most elastic (-6.64) on food and the 25 - 34 age group is the most elastic (-2.84) on beverages and tobacco. In spending on housing, some age groups (25 - 34, 45 - 54, over 64) are inelastic, and others (under 25, 35 - 44, 55 - 64) consider it a Giffen good. All households are inelastic in purchasing clothing, and the 55 - 64 age group is the most inelastic (-0.08). In spending on transportation, some age groups (35 - 44, 55 - 64, over 64) are inelastic, and others (under 25, 25 - 34, 45 - 54) consider it a Giffen good. In purchasing health care service, many age groups (25 - 44, 55 - 64, over 64) are inelastic, and the under 25 age group is elastic, and the 45 -54 age group consider it a Giffen good. In spending on entertainment, some age groups (25 - 44, over 64) are inelastic, and others (under 25, 45 - 64)

consider it a Giffen good. In purchasing personal care service, the 25 - 34 and 45 – 54 age groups are much elastic, and the under 25 and 35 - 44 age groups are inelastic, and the oldest age groups (55 - 64, over 64) consider it a Giffen good. In spending on education, many age groups (25 - 44, 55 - 64, over 64) are inelastic, and the under 25 and 45 - 54 age groups consider it a Giffen good. Most households, except the oldest group, are elastic in purchasing insurance and pensions, and the 45 - 54 age group is the most elastic (-4).

Table 5 shows expenditure elasticities by age group. All households consider food a necessity and the over-64 age group is the most inelastic (0.26). In purchasing beverages and tobacco, younger age groups (under 25, 25 - 34) consider them luxuries, and the middle age groups (35 - 64) consider them necessities, while the oldest age group (over 64) considers them inferior goods. In spending on housing, some age groups (under 25, 25 - 34, 55 - 64) consider it a necessity, and others (35 - 54, over 64) consider it a luxury. Clothing is considered a luxury to most age groups, except the youngest (under 25), and the 55 - 64 age group is the most elastic (1.57). In purchasing transportation goods and services, some age groups (25 - 44, over 64) consider it a necessity, and others (under 25, 45 - 64) consider it a luxury. In spending on health care and personal care, some age groups (under 25, 45 - 64) consider them necessities, and others (25 - 44, over 64) consider them luxuries. These same households reveal opposite consumption patterns in transportation and health care (or personal care). Entertainment is considered a luxury to most households, except the youngest, and the 55 - 64 age group where it is the most elastic (1.80). In purchasing education, the under 25 and 55 - 64 age groups consider it a luxury, and 25 - 34 and over 64 age groups consider it a necessity, and other groups (35 - 54) consider it an inferior good. Insurance and pensions are considered a luxury to most households, except the 25 - 34 age group, and the youngest (under 25) age group is the most elastic (1.46).

<<insert tables 6 and 7 here>>

Tables 6 and 7 present estimation results of price and expenditure elasticities of the five representative households by income quintiles. Table 6 shows price elasticities by income quintiles. All households are elastic in purchasing food, beverages and tobacco, and the second 20 percent is the most elastic (-3.3) in food and the highest 20 percent is the most elastic in beverages and tobacco (-2.16). All income quintiles are inelastic in spending on housing and

clothing, and the third 20 percent is the most inelastic in housing and the highest 20 percent is the most inelastic in clothing. All households consider transportation a Giffen good, so they tend to cut their expenditure when its price decreases. All income quintiles are inelastic in purchasing health care and entertainment services, and the fourth 20 percent is the most inelastic in both services. Most income quintiles, except the highest 20 percent, are elastic in spending on personal care, and the fourth income quintile is the most elastic. All households are inelastic in purchasing education goods and services, and the highest 20 percent is the most inelastic in education. Most income quintiles, except the lowest 20 percent, consider others (insurance and pensions) a Giffen good.

Table 7 shows expenditure elasticities by income quintiles. All households consider food a necessity, and the fourth 20 percent is the most inelastic. In purchasing beverages and tobacco, the lowest 20 percent, the second 20 percent and the fourth 20 percent have negative elasticities, which implies that they will decrease the expenditure when their prices will go down. All income quintiles consider housing and transportation luxuries. The highest 20 percent is the most elastic in housing (1.52) and clothing (2.33), and the third 20 percent is the most elastic (1.56) in transportation. Health care is considered a necessity to all households, and the third 20 percent has the lowest elasticity (0.10). All income quintiles consider entertainment a luxury, and the second 20 percent has the highest elasticity (1.89). In spending on personal care, low income quintiles (the lowest to third 20 percent) consider it a luxury, and high income quintiles (fourth to the highest 20 percent) consider it a necessity. In purchasing education goods and services, the lowest 20 percent considers them a luxury, the second 20 percent considers them a necessity, while the higher income households (third to the highest 20 percent) have negative elasticities. In spending on others (insurance and pensions), low income quintiles (the lowest to second 20 percent) consider them luxuries, and high income quintiles consider them necessities.

<<insert tables 8, 9 here>>

The AIDS-type CREIM model is solved after including 373 equations into the CREIM model. Tables 8 and 9 show the predictions of households' expenditure shares from the AIDS-type CREIM. Six representative households by age group show different consumption patterns, compared with the one representative household. Table 8 presents the predictions of households'

expenditure shares by age group. Most households, except the under 25 age group, will decrease their spending on food. All households are expected to cut spending on beverages, tobacco and clothing. On housing expenditures, the middle age groups (25-64) will increase, and the youngest (under 25) and the oldest age (over 64) groups are expected to decrease their allocations. Most households, except the over-64 age group, will increase expenditures on transportation. Most households, except the under 35 - 44 age group, are expected to increase spending on entertainment. On personal care expenditures, the 25 – 34 and 45 – 54 age groups will decrease, and other age groups are expected to decrease. Most households, except the over 64 age group, are expected to increase expenditures on education. On other expenditures (insurance and pensions), the middle age groups (25-64) will decrease, and the youngest (under 25) and the oldest age (over 64) groups are expected to increase.

<<insert figure 4 and table 10 here>>

The AIDS-type CREIM model predicts a deepened income disparity in the Chicago region (see figure 4 and table 10). In particular, the highest 20 percent household is expected to dominate the income growth in the region. Table 10 also shows that Gini coefficient for the income quintiles in the Chicago region; they are expected to increase gradually in the future. A combination of changes may be advanced to explain this phenomenon. As a result of competitive pressures, a great deal of the manufacturing jobs that sustained the middle income households disappeared over the period 1970-2000; further erosion is anticipated in the next two decades. In addition, these same competitive pressures have resulted in significant increases in labor productivity with the outcome that jobs generated per $1 million of production have decreased by up to 50% over the last two decades of the last century. A third factor in reducing the middle income categories has been a combination of the fragmentation and hollowing-out processes. The former has been an accumulation of effects that has seen production processes split into more separate functions, often located in different states; the latter has been characterized by Chicago firms becoming less dependent on local sources for inputs and local markets for sales. Taken together, the effects of these two forces has been a reduction in the intra-regional multiplier effects, resulting in less jobs being created locally when industry expands (see Hewings *et al*. 1998). A final change that has taken place is the role of out-migration; over the period 1998-2004, out-migration resulted in a net loss of income to the

Chicago region of close to $2 billion annually. Further, the average income of in-migrants was lower than the income of out-migrants; over time, these losses will contribute to further enlarging the gap between higher and lower income households in the region.

The five representative households by income quintile show different consumption patterns in comparison with the one representative household or six representative households by age group. Table 9 provides the predictions of households' expenditure shares by income quintiles. All households will increase spending on housing, transportation and health care, while they are expected to cut expenditure on food, beverages, tobacco and clothing. For entertainment expenditures, most income quintiles, except the second 20 percent, will decrease their spending. On the other hand, most households, except the second 20 percent, are expected to increase spending on education expenditures. Most households, except the lowest 20 percent, will spend more on others (insurance and pensions).

<<insert figures 5, 6 here>>

Consumption predictions provide some insights into future consumption trends. Figure 5 shows future consumption trends until 2030, providing the opportunity to compare consumption associated with the one representative household and disaggregate households of six age groups and five income quintiles. Comparing the two summations of disaggregate consumptions by age group and by income quintiles, the one representative household has lower consumption predictions than the two sums of disaggregate consumptions by age group and by income quintiles. In 2003, the sum of disaggregate consumptions by age group is almost the same to the one representative household. On the other hand, the sum of disaggregate consumptions by income quintiles is higher than that of the one representative household by 4.6% for the same year. According to the predictions, in 2030, the sum of disaggregate consumptions by age group is expected to be higher than that of the one representative household by 6.5% and the sum of disaggregate consumptions by income quintiles is expected to be higher than that of the one representative household by 9.3%. The disaggregate consumption trends by age group in figure 6 reveal that the middle and the old age groups (45–54, 55-64, over 64) are predicted to show higher growth of consumption than the one representative household. The table 11 reveals that the 45 – 54 age group is expected to contribute the most for the consumption growth by age group. On the other hand, the younger age groups (under 25, 25-34, 35-44) are expected to have

lower growth of consumption than the one representative household. From the disaggregate consumption trends by income quintiles, we can find that only the fourth 20 percent income quintile shows lower consumption growth than the one representative household. The highest 20% income quintile is expected to contribute the most for the consumption growth by income quintiles.[5] Figure 6 provides generational changes in budget shares of household consumption by age group. The figures imply that different generations will change their consumption behaviors in the future. The youngest age group (under 25) reveals greater generational changes in the budget shares of clothing, entertainment and education. The middle age groups (25-54) present greater generational changes in the budget shares of housing, personal care and entertainment. The oldest age group shows greater generational changes in the budget of food, clothing, entertainment and others. Compared with Japanese data evaluated by Wakabayashi and Hewings (2007), the youngest age group (under 25) in the Chicago region records the highest budget share on education; however, it is the 45 - 49 age group in Japan that spends the highest budget share on education. For health care, the youngest age group (under 25) in the Chicago region spends the lowest budget share, but the same age group of Japan spends more than the average budget share on this same bundle of goods and services. Interestingly, age groups of both regions show similar consumption behaviors for transportation and leisure.

To compare the relative importance of consumption by age group in the future, the numbers of households by age group are estimated through 2030; table 11 provides consumption and numbers of households by age group. The youngest and the oldest age groups (under 25, over 64) show relatively low consumption as compared to their individual number of households. On the other hand, two age groups (35-44, 45-54) present relatively high consumption compared with their individual number of households. Interestingly, the relative importance of the consumptions of the 25 – 34 and the 35 – 44 age groups are expected to decrease after 2003 and 2010, respectively.

<<insert tables 11, 12 here>>

Do these changes matter and are they statistically significant? To check whether the differences in consumption behaviors between the one representative household and the disaggregate

[5] Detailed tables are available from the authors by request

representative households (six age groups and five income quintiles) and those between disaggregate representative households are statistically significant, *F* tests are applied. Table 12 shows statistical significance levels for differences between the one representative household and six age groups, and those between age groups. Compared with the one representative household, most age groups show statistically significant differences in housing consumption, but all age groups present no statistically significant differences in the consumption of personal care and pensions, and most age groups show no statistically significant differences in the consumption of beverages, transportation and entertainment. Between age groups, most age groups show significant differences in the consumption of housing, health care and education. However, most age groups present no significant differences in the consumption of clothing, entertainment and personal care.

<<insert table 13 here>>

Table 13 shows statistical significance levels of differences between the one representative household and five income quintiles, and those between income quintiles. The statistical significance levels for differences of income quintiles are lower than those of age groups. Compared with the one representative household, all income quintiles show statistically significant differences in clothing. However, all income quintiles represent no statistically significant differences in the consumption of transportation, personal care and others (pension), and most income quintiles show no statistically significant differences in the consumption behaviors of housing, health care and entertainment. Between income quintiles, there are significant differences in the consumption of clothing. However, income quintiles represent no significant differences in the consumption of food, beverages, transportation and personal care, and most income quintiles show no significant differences in the consumption of housing, health care and entertainment.

6 Implications

To identify the impact of demographic changes in the Chicago region, a comprehensive vision of the demographic influences on consumption, income distribution and production will now be presented. Table 14 shows the impact on the Chicago economy of the six representative households - six age groups - in 2003. Suppose the Chicago economy experiences an increase of one job or one in-migrant. The income of the Chicago region increases by $36,383, and the household consumes $27,214 out of its income ($36,383). It purchases $32 agricultural goods, $8,449 manufacturing goods and $18,733 services. Its consumption behavior induces a $54,296 production increase in the Chicago region. This means that the household's consumption amplifies the Chicago region's production by almost two times. The Chicago's production increases $16,831 in services sectors, $11.477 in non-durable manufacturing sectors, $8,963 in financial sectors, $6,015 in durable manufacturing sectors, $5,462 in trade sectors, $3.636 in TCU (transportation, communications and utilities) and $1,912 in other sectors.

<<insert table 14 here>>

Six representative households by age group reveal different economic impacts. The youngest (under 25 years) age groups consume more than their income, but 45-64 age groups consume less than 70% of their incomes. Different consumption patterns by age group amplify the Chicago region's production by different magnitudes. The youngest (under 25 years) age group's consumption increases the production by 1.98 times, but those of oldest age group raise the production by more than 2 times. The multiplier effects of different age groups generate different production increases by industries. Suppose one retiree immigrates into the Chicago region. The in-migration increases Chicago's income by $21,660 and regional consumption by $19,013. The in-migrant's consumption patterns bring about $38,097 of production increase in the Chicago region - $12,105 in service sector, $7,561 in non-durable manufacturing sectors, $6,475 in financial sectors, $4,065 in durable manufacturing sectors, $3,926 in trade sectors, $2,602 in TCU sectors, $1,363 in other sectors. More interestingly, suppose that an older worker retires, the firm hires a young worker instead, and the retiree emigrates to the Florida. In the one representative household model, there is no change in employment, income, consumption and production. However, the six representative households' model can capture the change. The

Chicago economy has an income decrease of $27,036, a decrease of its consumption by $13,993, and a decrease of production by $28,180. If the retired worker stays in the Chicago region, there is no change in employment, income, consumption and production in the one representative household model. On the other hand, in the six representative households' model, Chicago economy's income will decrease $5,376, while its consumption and production will increase $5,020 and $9,917, respectively.

<<insert table 15 here>>

Table 15 presents the Chicago economy by five representative households-five income quintiles-in 2003. Consider again the impact of an increase of one job or the impact of an additional in-migrant. The lowest 20% income household consumes 2.13 times than its income, but the highest 20% income household consumes only 0.60 of its income. Different consumption patterns by income quintiles amplify the Chicago region's production by differing amounts. The lowest 20% income quintiles' consumption increases the production by 1.99 times, but those of the highest 20% income quintiles raise the production by more than 2 times. The multiplier effects of different age groups generate production increases in different industries. Therefore, we can conclude that different consumption patterns caused by demographic changes - ageing population and income disparities - will change the industrial production structure of the Chicago region in the future. In turn, these changes in production structure will have important implications on the profile of activities that remain competitive in the Chicago region, creating further feedback effects on the nature of local jobs and wage and salary income.

In this research, a further important question can be raised. Is consumption becoming more important in the Chicago region in the future? To answer this question, the feedback effects of consumption on the production in the Chicago region can be evaluated. To accomplish this, the trends of consumption multipliers in the Chicago region up to 2030 were estimated. From 2003, the consumption multipliers are predicted to increase gradually until 2030 rising from 1.98 to 2.03.

<<insert table 16 here>>

To examine the implications of the impacts of demographic changes caused by the ageing population and the deepened income disparities in the Chicago region, the consumption

multipliers were estimated by age group and by income quintiles. Table 16 shows the predictions of the Chicago regions' consumption multipliers until 2030. Six representative households by age group show similar increasing trends. In 2003, only the consumption multiplier of the oldest age group (over 64 years) was more than 2. But, in 2030, all six households are expected to have consumption multipliers of more than 2. Similarly, five representative households by income quintiles present upward trends of their consumption multipliers. In 2003, only the highest 20% income quintile showed the consumption multiplier of more than 2. But, in 2030, all five households' consumption multipliers are expected to exceed 2. While these change may appear to be small, recall that consumption accounts for about 70% of gross product; small changes in total expenditures and in the allocation of expenditures across goods and services can generate large impacts on the economy.

7 Conclusions

The main contribution of the research is to provide the implications of the analysis of consumption behavior in the Chicago region generated by two kinds of demographic shocks - life cycle changes and income distribution changes. This paper presents an important extension of CREIM to AIDS-type CREIM to predict the changes of demographic changes in the Chicago region. The results generated by this research provide some important implications. First of all, disaggregate households' demands by age group or by income quintiles provide more insights and capture some of the inherent variability in consumption patterns compared to analyses conducted with a single (aggregated) representative household. In many regional computable general equilibrium models, the demographic-related influences – ageing population and income distribution – have not addressed the implications that result from disaggregating household consumption behavior by age or income groups. As regional CGE models become more dynamic in character, it will become important to include greater specification of consumption behavior by cohort. In the US, many regional economies are becoming increasingly dependent on non-wage and salary incomes, reflecting in-migration of retirees. Their expenditure patterns need to be considered much more carefully, especially since older age group's income consists mostly of dividend, pensions and property incomes. The approach in this paper considers total income, including non-wage and salary incomes into AIDS-type CREIM model.

Secondly, the expanded model predicts that consumption multipliers by age groups and by income quintiles will increase gradually up to 2030. This implies that consumption is becoming more important in the Chicago region; hence, small changes in consumption behavior are likely to generate significant impacts on the region's economy. A further consideration that needs to be addressed is the way in which propensities to consume locally will change; increases in consumption may not always lead to increases in locally produced goods and services.

Thirdly, the widening disparity in income distribution that is suggested by the model results may have a striking impact on household consumption patterns. This implies that income distribution needs to be included into any national and regional models that are trying to analyze demographic changes. The accumulation of long-term structural changes in combination with greater population mobility are likely to create income distribution dynamics that have not been considered extensively to date.

Finally, more effort in model building needs to focus on the income-consumption links. This research can be extended in two directions; first, with additional data manipulation, it may be possible to extend the AIDS-type CREIM to include an interrelational matrix, income matrix and consumption matrix. Li *et al*. (1999) and Rose and Li (1999) have proposed some possible ways to build data bases. However, until now very little research has taken advantage of these sources of model enrichment. Alternatively, one could use a computable general equilibrium (CGE) model to identify the impacts of installation of such a system. Using the interrelational matrix or using the CGE approach, we can undertake extensive error and sensitive analysis to explore the most important parameters generating the estimation results on the demographic and economic changes in the Chicago region.

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Appendix 1. List of Variables

The AIDS-type CREIM model estimates disaggregate households' consumption patterns by age of reference person and by income quintiles. The classifications are as follows:

Consumption types	Contents
0	Total annual expenditure
1	Food
2	Beverages and tobaccos[1]
3	Housing
4	Clothing
5	Transportation
6	Health care
7	Entertainment
8	Personal care
9	Education[2]
10	Others[3]

Notes: 1. includes alcoholic beverages and tobacco products & smoking supplies
2. includes education and reading
3. includes miscellaneous, cash contributions, and personal insurance and pensions

Age of reference person	Contents
0	Total
1	Under 25 years
2	25-34 years
3	35-44 years
4	45-54 years
5	55-64 years
6	Over 64 years

Income quintiles	Contents
0	Total
1	Lowest 20 percent
2	Second 20 percent
3	Third 20 percent
4	Fourth 20 percent
5	Highest 20 percent

The variables used in the AIDS-type CREIM model are as follows:

WCA_{ij} : budget share of the good *j* for household of *i* age of reference person in current terms

AN_i : number of household members for household of *i* age of reference person

$CPIA_{ij}$: CPI index of the good *j* for household of *i* age of reference person

$CPIA_{ij\mathrm{A}}$: relative CPI index (CPI *j*/CPI-*j*) of the good *j* for household of *i* age of reference person

TA_{i0} : total expenditure for household of *i* age of reference person in real terms

$TAIB_i$: income before taxes for household of *i* age of reference person in real terms

WCI_{ij} : budget share of the good *j* for household of *i* income quintiles in current terms

IN_i : number of household members for household of *i* income quintiles

$CPII_{ij}$: CPI index of the good *j* for household of *i* income quintiles

$CPII_{ijA}$: relative CPI index (CPI *j*/CPI-*j*) of the good *j* for household of *i* income quintiles

TI_{i0} : total expenditure for household of *i* income quintiles

$TIIB_{i0}$: income before taxes for household of *i* income quintiles

USPCPI : U.S. Consumer Price Index (from CREIM)

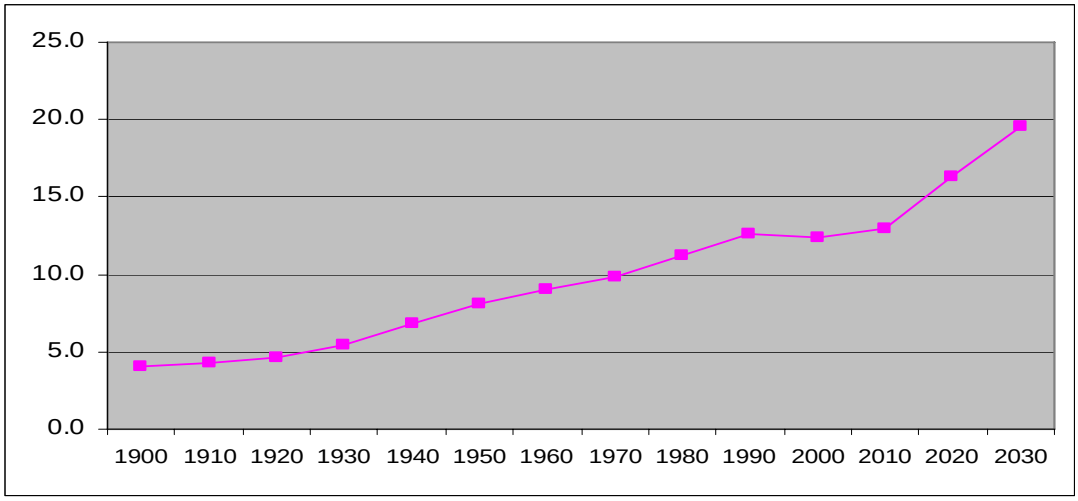
$USPOP_i$: U.S. Population of *i* age (from CREIM)
(0: total, 1: under 25 years, 2: 25 - 44 years, 3: 45 - 64 years, 4: over 65 years)

$CPOP_i$: Chicago Population of *i* age (from CREIM)
(0: total, 1: under 25 years, 2: 25 - 44 years, 3: 45 - 64 years, 4: over 65 years)

CYTOT: Chicago total income (from CREIM)

CC: Chicago total consumption (from CREIM)

Figure 1 Percentage of the population age 65 and over in the US, 1900 to 2030



Source: US Census Bureau, 1900 to 2000; 2010 to 2030, International Programs Center, International Data Base, 2004.

Figure 2 Annual expenditures by income quintiles in the US, 1984 and 2003

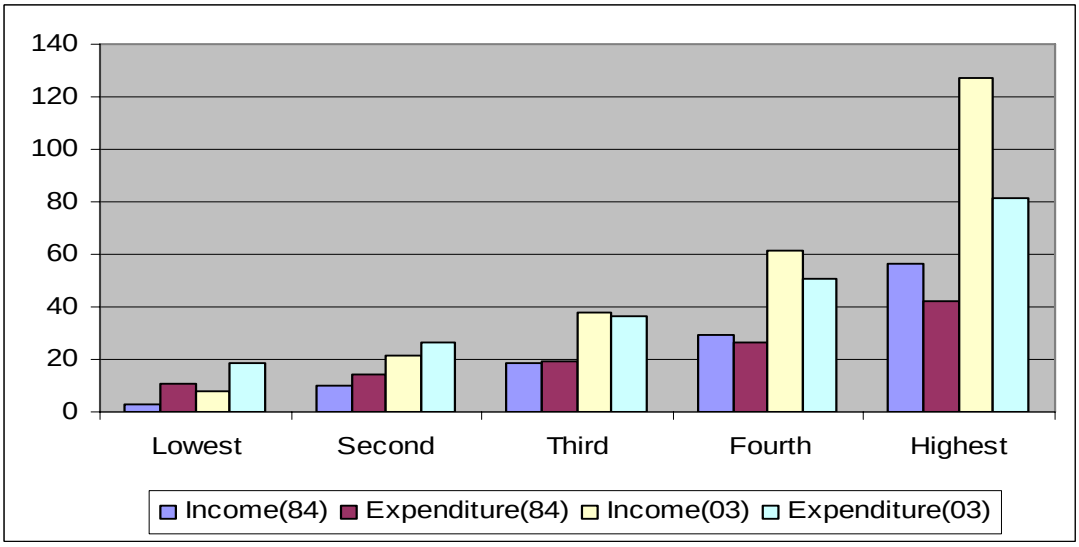


Figure 3 Main framework of the Chicago Regional Econometric Input-Output Model

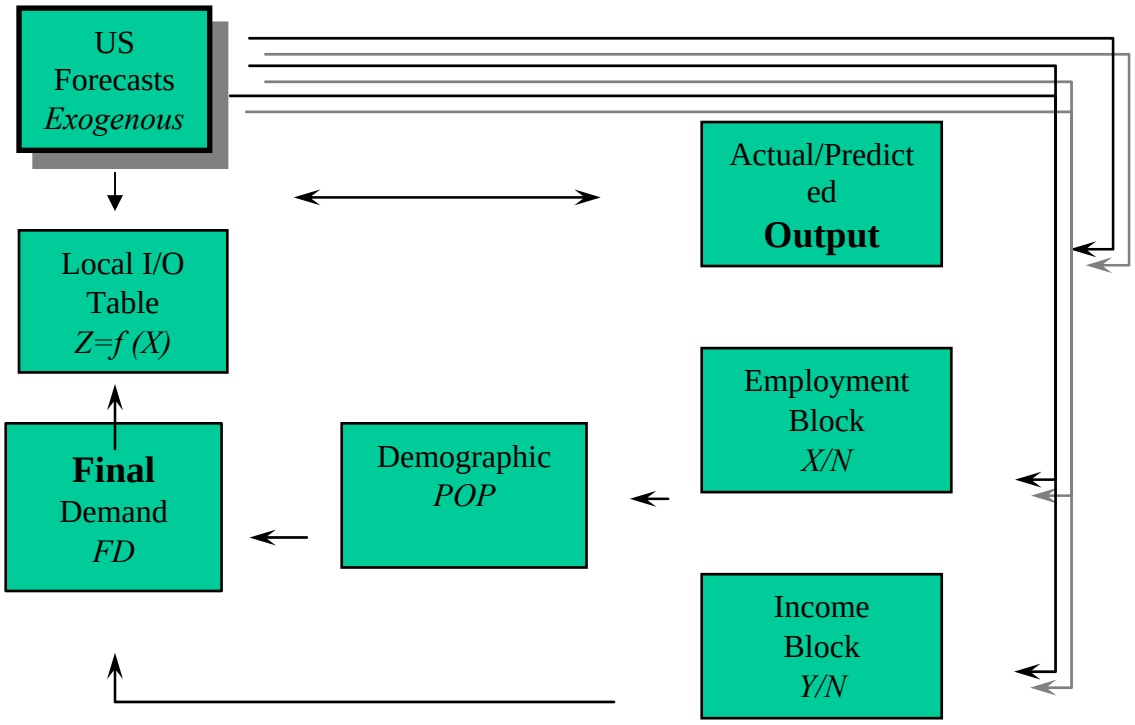


Figure 4 Income predictions by income quintiles until 2030

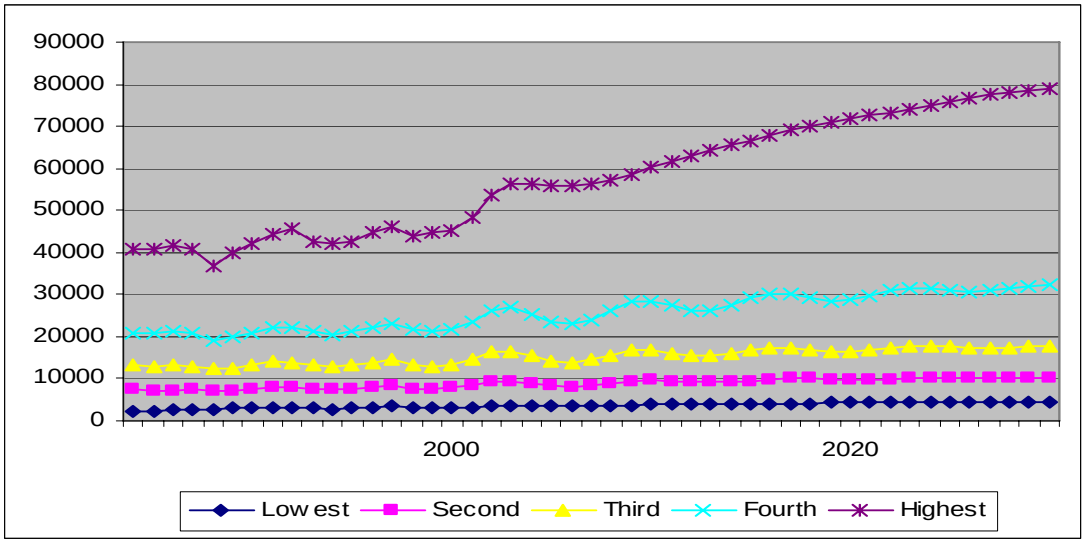


Figure 5 Consumption predictions until 2030

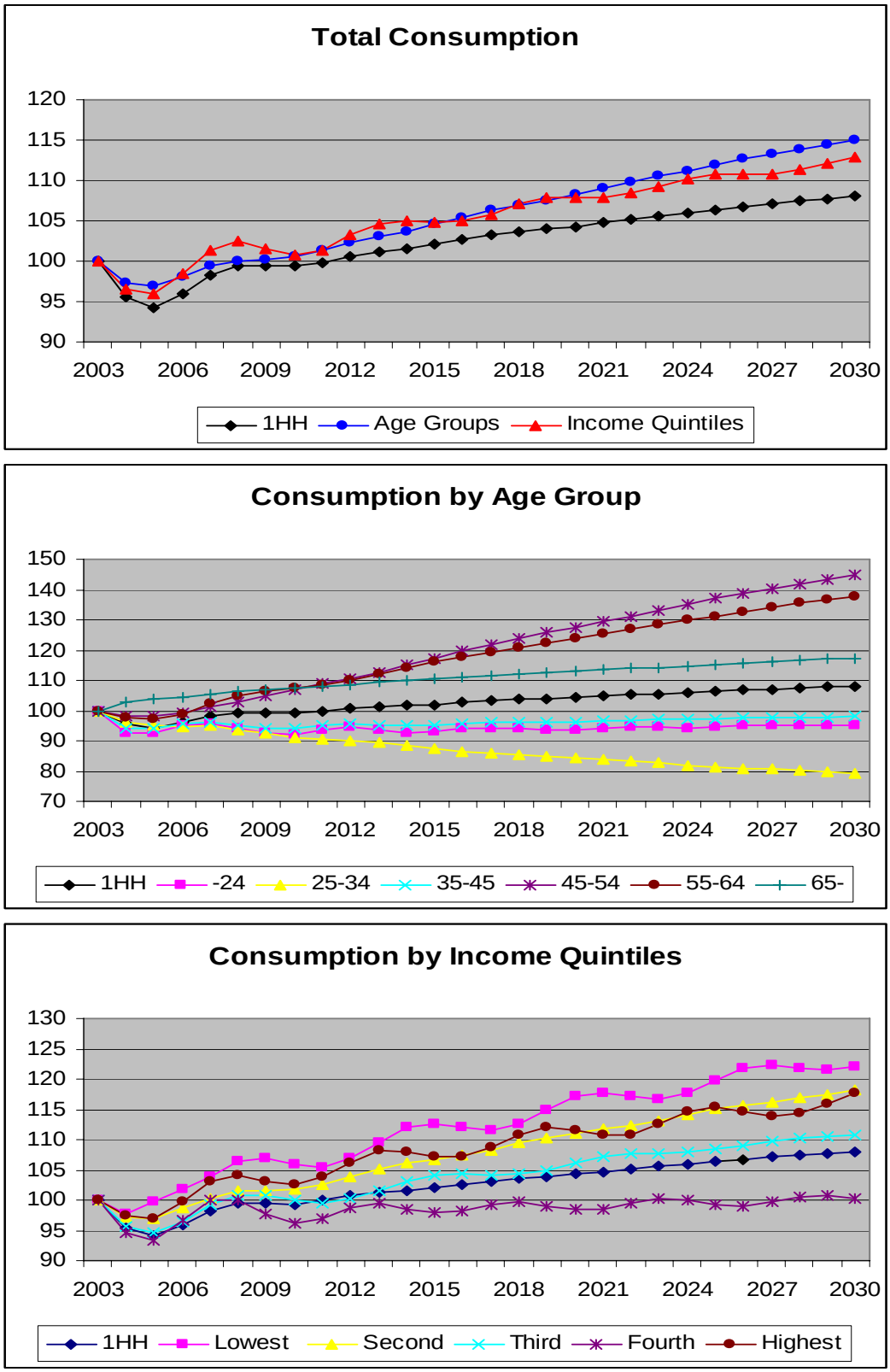
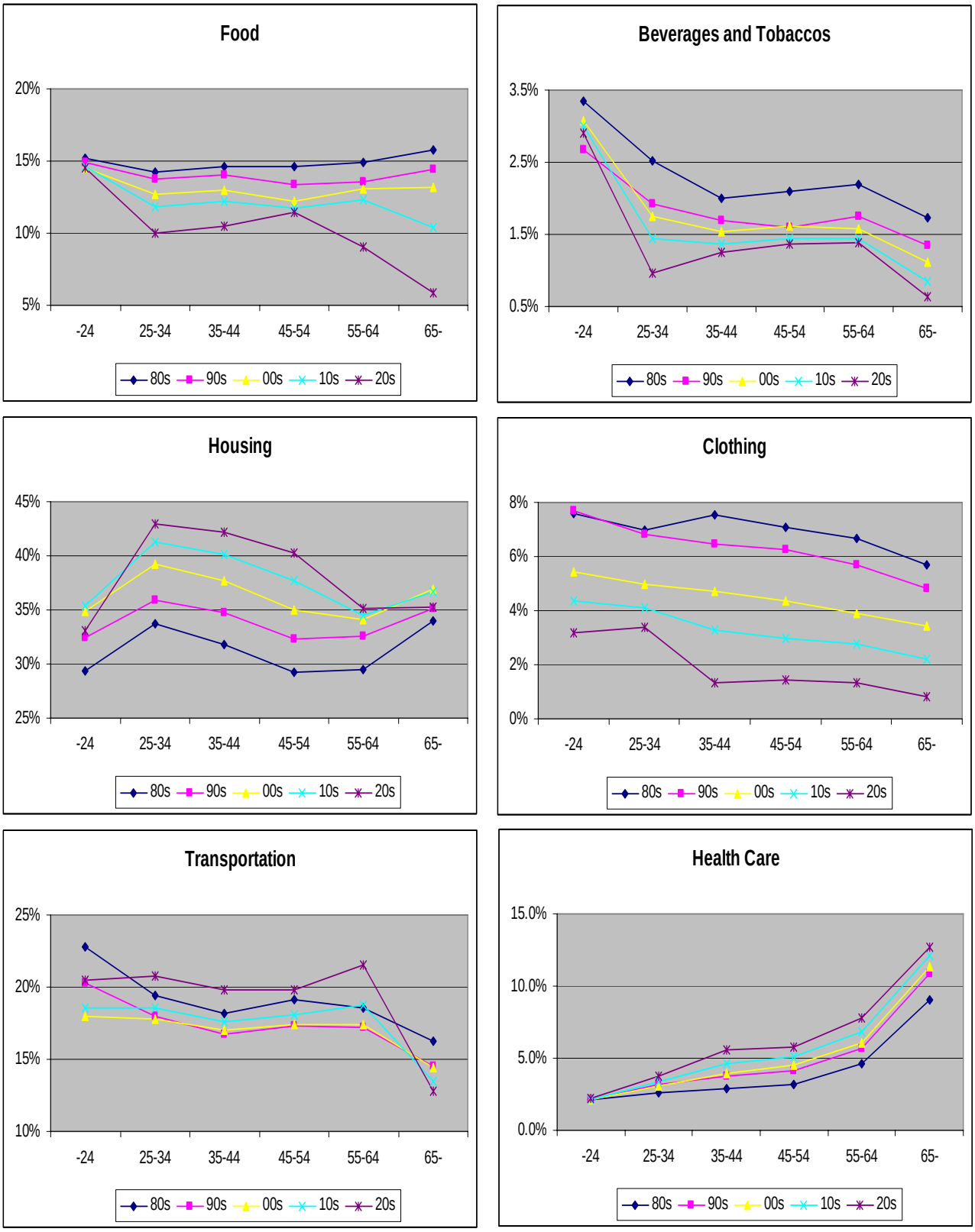
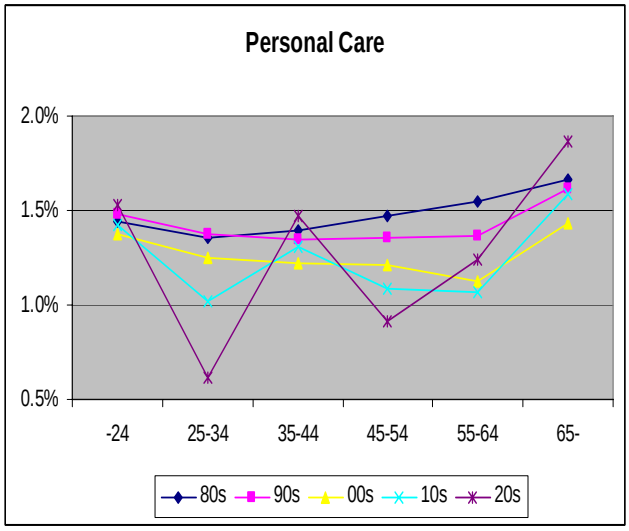
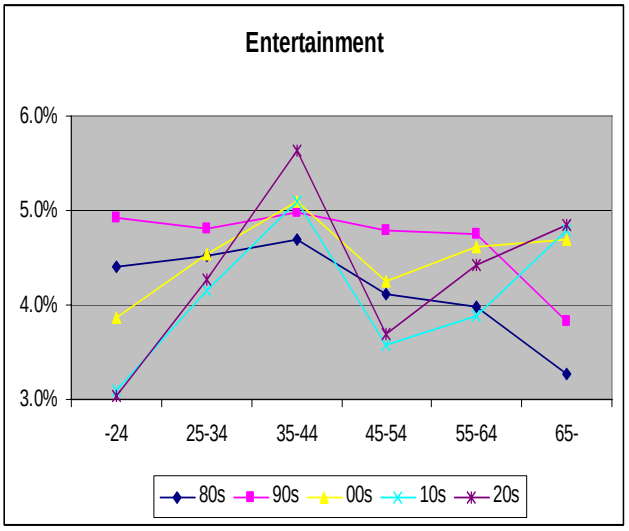
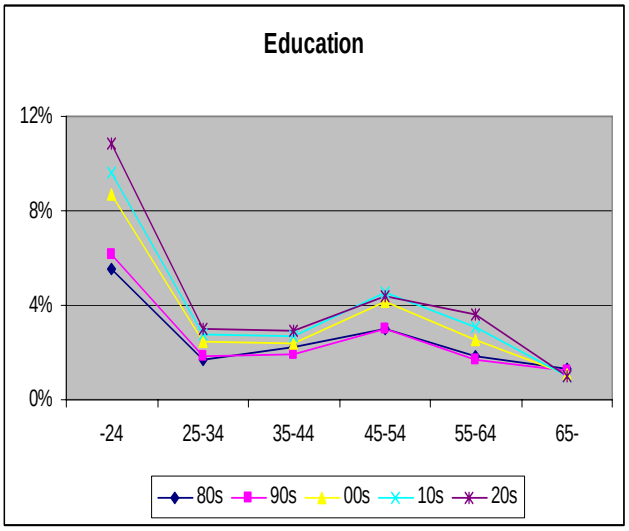


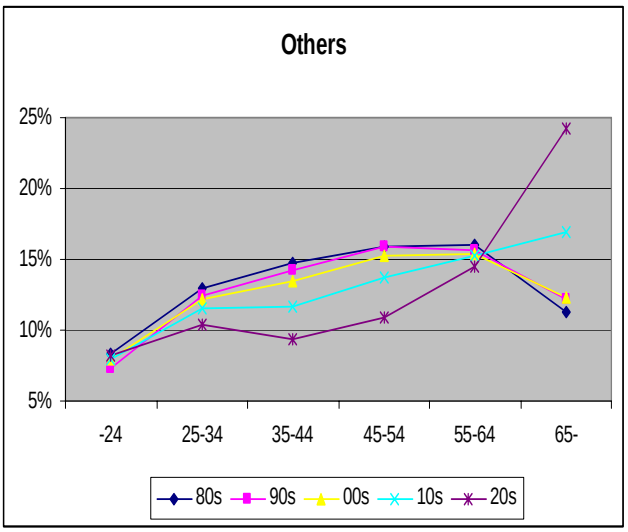
Figure 6 Changes in Budget Shares of Household Consumption by Age Group




Personal Care
2.0%
1.5%
1.0%
0.5%
-24
25-34
35-44
45-54
55-64
65-
80s
90s
00s
10s
20s


Entertainment
6.0%
5.0%
4.0%
3.0%
-24
25-34
35-44
45-54
55-64
65-
80s
90s
00s
10s
20s


Education
12%
8%
4%
0%
-24
25-34
35-44
45-54
55-64
65-
80s
90s
00s
10s
20s


Others
25%
20%
15%
10%
5%
-24
25-34
35-44
45-54
55-64
65-
80s
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00s
10s
20s

Table 1 Characteristics of AIDS-type CREIM

Projection Horizon
1 -30 years
Model Size
637 endogenous variables (add 373 variables)
55 exogenous variables
619 behavioral equations (add 373 equations)
22 identities (add 4 identities)
Industrial Detail
53 industries with projections of output, employment, income
Other Selected Endogenous Variable Block
Final Demand (include detailed data on household consumptions)
Income & Employment Related Variables (include detailed data on household income)
Population Cohort (include family size and household number)

Table 2 Summary statistics of households' expenditure shares by age group

(Number of Observations: 20)

Consumption Types		Total	Under 25	25 - 34	35 – 44	45 – 54	55 - 64	Over 64
Food	Mean	13.94	14.90	13.72	13.97	13.62	13.79	14.63
	Min	12.09	13.17	11.90	11.97	12.00	11.83	12.05
	Max	15.69	17.19	15.78	16.08	15.36	15.87	17.05
	S.D.	1.00	0.88	0.92	1.00	1.03	1.18	1.39
Beverages and Tobaccos	Mean	1.87	2.94	2.11	1.78	1.79	1.89	1.47
	Min	1.35	2.00	1.57	1.32	1.20	1.51	0.98
	Max	2.37	3.80	2.68	2.28	2.35	2.36	1.89
	S.D.	0.33	0.51	0.41	0.28	0.34	0.31	0.27
Housing	Mean	33.53	31.58	35.49	34.14	31.56	31.79	34.98
	Min	30.65	27.11	32.26	31.21	28.18	27.74	33.39
	Max	36.28	34.73	38.98	37.61	35.04	35.10	37.19
	S.D.	1.89	2.20	1.87	2.23	2.20	2.24	1.32
Clothing	Mean	6.27	7.41	6.69	6.65	6.36	5.84	4.98
	Min	4.29	5.20	4.85	4.73	4.16	3.80	3.32
	Max	7.23	9.22	7.85	8.03	7.59	7.47	6.31
	S.D.	0.91	1.08	0.80	1.04	1.01	1.03	0.93
Transportation	Mean	17.65	20.89	18.57	17.37	17.98	17.78	15.16
	Min	15.21	17.65	15.38	15.08	15.43	15.22	13.37
	Max	20.29	25.16	21.19	19.63	21.41	20.15	17.94
	S.D.	1.34	2.31	1.52	1.34	1.43	1.41	1.21
Health care	Mean	4.57	2.10	2.94	3.42	3.83	5.31	10.22
	Min	3.41	1.67	2.38	2.46	3.08	3.85	7.81
	Max	5.41	2.73	3.51	4.12	4.87	6.16	12.06
	S.D.	0.59	0.28	0.35	0.50	0.54	0.65	1.15
Entertainment	Mean	4.58	4.69	4.72	4.94	4.56	4.58	3.70
	Min	3.96	3.92	3.99	4.42	3.69	3.65	3.03
	Max	5.15	5.53	5.60	5.57	5.30	5.66	4.93
	S.D.	0.37	0.48	0.39	0.36	0.45	0.66	0.51
Personal care	Mean	1.40	1.44	1.34	1.34	1.37	1.42	1.61
	Min	1.12	1.15	1.07	1.10	1.04	1.17	1.28
	Max	1.72	1.78	1.72	1.64	1.64	1.72	2.06
	S.D.	0.15	0.17	0.16	0.15	0.16	0.17	0.17
Education	Mean	2.28	6.26	1.81	2.07	3.09	1.83	1.23
	Min	1.82	4.09	1.29	1.53	2.40	1.16	1.02
	Max	2.90	9.04	2.51	2.51	4.01	2.66	1.55
	S.D.	0.33	1.54	0.33	0.30	0.50	0.33	0.14
Others	Mean	13.90	7.80	12.60	14.33	15.84	15.78	12.01
	Min	12.96	6.88	11.44	13.02	14.82	14.43	10.07
	Max	15.03	9.00	13.86	15.83	16.89	17.54	17.01
	S.D.	0.57	0.64	0.61	0.75	0.59	0.79	1.63

Table 3 Summary statistics of households' expenditure shares by income quintiles
(Number of Observations: 20)

Consumption Types		Total	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Food	Mean	13.94	16.75	16.17	14.82	13.91	12.04
	Min	12.09	13.78	14.15	12.79	12.29	10.64
	Max	15.69	19.25	18.82	16.41	15.88	13.35
	S.D.	1.00	1.31	1.28	1.03	0.97	0.88
Beverages and Tobaccos	Mean	1.87	2.45	2.28	2.20	1.90	1.53
	Min	1.35	1.75	1.63	1.66	1.39	1.00
	Max	2.37	3.10	3.05	2.87	2.48	1.83
	S.D.	0.33	0.40	0.47	0.42	0.33	0.24
Housing	Mean	33.53	37.80	34.89	32.85	31.40	31.49
	Min	30.65	35.04	31.82	30.17	28.92	28.91
	Max	36.28	40.36	38.17	35.80	33.81	34.25
	S.D.	1.89	1.71	1.73	1.77	1.68	1.66
Clothing	Mean	6.27	6.14	6.12	6.28	6.24	6.48
	Min	4.29	4.65	4.27	4.32	4.30	4.27
	Max	7.23	7.22	7.43	7.86	7.38	7.63
	S.D.	0.91	0.74	0.89	0.88	0.98	0.99
Transportation	Mean	17.65	14.76	17.19	18.34	18.71	16.83
	Min	15.21	12.17	14.63	15.65	16.58	14.36
	Max	20.29	18.69	20.40	21.41	20.88	19.93
	S.D.	1.34	1.59	1.31	1.46	1.42	1.52
Health care	Mean	4.57	6.35	6.59	5.14	4.15	3.28
	Min	3.41	4.20	4.91	3.97	3.04	2.50
	Max	5.41	7.42	8.39	6.26	4.92	4.06
	S.D.	0.59	0.79	0.83	0.64	0.62	0.46
Entertainment	Mean	4.58	3.87	3.81	4.27	4.68	5.06
	Min	3.96	3.02	2.98	3.69	4.00	4.22
	Max	5.15	4.60	4.78	4.83	5.36	5.87
	S.D.	0.37	0.45	0.46	0.35	0.45	0.44
Personal care	Mean	1.40	1.56	1.59	1.50	1.43	1.30
	Min	1.12	1.30	1.25	1.23	1.13	1.06
	Max	1.72	1.82	2.05	2.01	1.66	1.55
	S.D.	0.15	0.16	0.20	0.17	0.16	0.13
Education	Mean	2.28	3.48	1.77	1.65	1.80	2.52
	Min	1.82	2.38	1.27	1.23	1.36	2.02
	Max	2.90	4.50	2.25	2.17	2.32	3.83
	S.D.	0.33	0.59	0.25	0.25	0.26	0.45
Others	Mean	13.90	6.85	9.59	12.95	15.79	19.49
	Min	12.96	5.69	8.17	11.87	14.95	18.13
	Max	15.03	8.04	13.70	14.29	16.99	22.04
	S.D.	0.57	0.67	1.16	0.72	0.59	1.01

Table 4 Price elasticities (ε_i^j) by ages of reference person

Consumption Types	Total	Under 25	25 – 34	35 - 44	45 - 54	55 - 64	Over 64
Food	-2.99**	-1.92	-3.21*	-3.43**	-0.85	-5.13**	-6.64**
Beverages & tobaccos	-1.74**	-1.57	-2.84**	-1.57*	-0.68	-1.61**	-1.63
Housing	0.10*	0.64**	-0.17**	0.48**	-0.27*	0.10	-0.09*
Clothing	-0.13**	-0.44**	-0.57**	-0.21**	-0.25**	-0.08**	-0.20**
Transportation	0.31**	0.90**	0.67**	-0.08*	0.35**	-0.06**	-0.02**
Health care	-0.16**	-1.18	-0.14**	-0.25**	0.01**	-0.25**	-0.37**
Entertainment	0.08**	0.35	-0.25	-0.55	0.70**	1.57**	-0.43
Personal care	0.07	-0.35	-5.30	-0.70	-3.43	1.93	1.98
Education	-0.43**	0.36**	-0.33*	-0.74*	0.16**	-0.86	-0.96
Others	-1.03	-1.51	-2.23	-3.22**	-4.00	-2.85*	7.84

Note: Significance levels at 1% and 5% are indicated by ** and *, respectively

Table 5 Expenditure elasticities (η_i^j) by ages of reference person

Consumption Types	Total	Under 25	25 - 34	35 – 44	45 – 54	55 - 64	Over 64
Food	0.36**	0.78	0.95	0.84	0.60**	0.53**	0.26**
Beverages & tobaccos	0.13	1.27	1.07	0.56	0.18**	0.94	-0.01*
Housing	1.35	0.51**	0.57**	1.38**	1.32**	0.89	1.15
Clothing	2.11**	0.87	1.32	1.29	1.10	1.57*	1.15
Transportation	1.26	1.07	0.94	0.88	1.05	1.32*	0.96
Health care	0.58	0.60	1.30	1.11	0.65	0.74*	1.17
Entertainment	1.52*	0.77	1.06	1.46	1.24	1.80**	1.56
Personal care	1.14	0.62	1.78*	1.20	0.70	0.56	1.70
Education	-0.54**	2.25**	0.76	-1.06**	-0.36**	1.74	0.55
Others	0.94	1.46**	0.93	1.33	1.21	1.07	1.30

Note: Significance levels at 1% and 5% are indicated by ** and *, respectively

Table 6 Price elasticities (ε_i^j) by income quintiles

Consumption Types	Total	Lowest 20%	Second 20 %	Third 20 %	Fourth 20 %	Highest 20 %
Food	-2.99**	-2.99	-3.29*	-2.63**	-1.78	-2.68**
Beverages and tobaccos	-1.74**	-1.22	-1.29	-1.69**	-1.33	-2.16**
Housing	0.10*	-0.58	-0.14	-0.003**	-0.22	-0.03**
Clothing	-0.13**	-0.46**	-0.27**	-0.20**	-0.08**	-0.003**
Transportation	0.31**	0.15**	0.22**	0.51**	0.24**	0.57**
Health care	-0.16**	-0.17**	-0.09**	-0.27**	-0.01**	-0.04**
Entertainment	0.08**	-0.56	-0.36	-0.35	-0.09	-0.17
Personal care	0.07	-2.21	1.31	-1.02	-2.25	-0.38
Education	-0.43**	-0.81	-0.68	-0.68	-0.46**	-0.02**
Others	-1.03	-11.11**	0.87	1.11	0.45	1.15

Note: Significance levels at 1% and 5% are indicated by ** and *, respectively

Table 7 Expenditure elasticities (η_i^j) by income quintiles

Consumption Types	Total	Lowest 20%	Second 20 %	Third 20 %	Fourth 20 %	Highest 20 %
Food	0.36**	0.49**	0.48**	0.34**	0.24**	0.29**
Beverages and tobaccos	0.13	-0.24**	-0.97**	0.09	-0.53**	0.43
Housing	1.35	1.06	1.28*	1.32*	1.48**	1.52**
Clothing	2.11**	1.65**	1.63*	1.71**	1.95**	2.33**
Transportation	1.26	1.50*	1.21	1.56**	1.29	1.02
Health care	0.58	0.10**	0.35	0.95	0.66	0.46
Entertainment	1.52*	1.33	1.89**	1.54*	1.60	1.63
Personal care	1.14	1.20	1.30	1.24	0.71	0.60
Education	-0.54**	1.39	0.15	-0.31**	-0.21	-0.95*
Others	0.94	2.39**	1.31	0.61	0.65	0.75

Note: Significance levels at 1% and 5% are indicated by ** and *, respectively

Table 8 Predictions of households' expenditure shares by age group

Consumption Types		Total	Under 25	25 - 34	35 - 44	45 – 54	55 – 64	Over 64
Food	2003	12.8	14.5	12.7	13.0	12.4	12.3	13.0
	2010	12.9	14.7	12.8	13.1	12.1	13.4	12.7
	2020	10.7	14.8	11.3	11.7	11.5	11.3	8.7
	2030	8.5	14.8	9.3	9.9	11.3	7.8	4.6
Beverages and Tobaccos	2003	1.7	3.3	1.8	1.6	1.7	1.6	1.2
	2010	1.4	3.1	1.7	1.4	1.6	1.5	1.0
	2020	0.9	3.0	1.3	1.3	1.4	1.4	0.7
	2030	0.7	3.0	1.1	1.2	1.3	1.4	0.6
Housing	2003	36.3	34.1	39.0	37.6	34.4	34.4	36.7
	2010	37.0	36.0	40.2	38.6	35.9	34.3	37.1
	2020	37.4	34.4	41.9	40.7	38.7	34.6	36.1
	2030	36.7	32.3	43.4	43.3	41.2	35.3	35.3
Clothing	2003	4.3	5.2	4.8	4.7	4.2	3.8	3.3
	2010	3.5	5.1	4.5	4.2	3.8	3.5	3.0
	2020	2.3	4.2	3.9	2.9	2.7	2.6	1.9
	2030	0.3	2.7	3.1	0.5	0.9	0.8	0.4
Transportation	2003	16.9	18.1	17.7	16.7	17.3	17.6	14.7
	2010	16.5	17.9	17.6	16.8	17.4	17.7	14.0
	2020	17.0	18.9	19.2	18.2	18.6	19.7	13.1
	2030	17.7	20.4	21.4	20.2	20.1	22.3	12.6
Health care	2003	5.2	2.1	3.2	3.9	4.4	6.2	11.3
	2010	5.6	2.2	3.1	4.2	4.8	6.4	11.8
	2020	6.0	2.2	3.5	5.0	5.3	7.1	12.3
	2030	6.4	2.3	3.7	5.9	5.9	8.1	12.9
Entertainment	2003	4.9	4.1	4.7	5.2	4.7	5.4	4.9
	2010	4.3	3.3	4.2	4.9	3.7	3.9	4.8
	2020	4.3	3.0	4.1	5.2	3.5	4.0	4.8
	2030	4.5	3.1	4.3	5.8	3.9	4.8	4.9
Personal care	2003	1.3	1.4	1.2	1.2	1.2	1.2	1.5
	2010	1.2	1.4	1.2	1.2	1.2	1.0	1.4
	2020	1.3	1.5	0.9	1.4	1.0	1.1	1.7
	2030	1.4	1.6	0.5	1.5	0.9	1.3	1.9
Education	2003	2.9	9.0	2.5	2.2	4.0	2.7	1.1
	2010	3.2	8.5	2.6	2.6	4.5	2.8	1.0
	2020	3.2	10.2	2.8	2.8	4.5	3.3	1.0
	2030	3.0	11.5	3.0	3.0	4.2	3.8	1.0
Others	2003	13.7	8.2	12.3	13.7	15.7	14.9	12.3
	2010	13.6	7.8	12.1	12.8	14.9	15.5	13.3
	2020	13.2	8.0	11.1	10.8	12.8	15.0	19.8
	2030	13.0	8.4	10.1	8.7	10.2	14.5	25.8

Table 9 Predictions of households' expenditure shares by income quintiles

Consumption Types		Total	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Food	2003	12.8	16.4	14.9	13.8	12.7	10.8
	2010	12.9	16.2	14.5	13.4	13.1	11.9
	2020	10.7	13.9	11.6	11.4	12.1	10.4
	2030	8.5	12.6	8.9	9.5	11.2	8.6
Beverages and Tobaccos	2003	1.7	2.3	2.0	1.8	1.8	1.5
	2010	1.4	2.2	2.1	1.6	1.8	1.6
	2020	0.9	1.9	1.7	1.2	1.6	1.4
	2030	0.7	1.7	1.5	0.9	1.5	1.2
Housing	2003	36.3	40.1	38.2	35.8	33.8	33.9
	2010	37.0	39.1	38.6	36.4	33.9	34.2
	2020	37.4	41.6	39.3	36.4	34.0	34.5
	2030	36.7	43.5	39.9	36.2	34.0	34.6
Clothing	2003	4.3	5.2	4.3	4.3	4.3	4.3
	2010	3.5	5.4	3.7	4.0	3.6	3.8
	2020	2.3	5.5	2.7	3.0	2.2	2.6
	2030	0.3	4.9	1.1	1.5	0.0	0.4
Transportation	2003	16.9	13.5	16.3	17.8	18.9	15.9
	2010	16.5	13.9	16.0	17.7	18.5	15.4
	2020	17.0	16.0	16.8	18.9	19.0	15.8
	2030	17.7	17.0	17.8	20.2	19.7	16.6
Health care	2003	5.2	6.7	7.0	6.3	4.8	3.9
	2010	5.6	6.7	7.2	6.6	5.2	4.1
	2020	6.0	7.3	7.7	7.1	5.8	4.3
	2030	6.4	8.0	8.3	7.7	6.4	4.7
Entertainment	2003	4.9	3.7	4.8	4.8	4.8	5.4
	2010	4.3	3.2	4.7	4.5	4.3	5.0
	2020	4.3	3.5	5.1	4.5	4.2	5.0
	2030	4.5	3.7	5.5	4.7	4.3	5.3
Personal care	2003	1.3	1.5	1.3	1.3	1.2	1.2
	2010	1.2	1.6	1.2	1.3	1.3	1.2
	2020	1.3	1.6	1.2	1.4	1.2	1.1
	2030	1.4	1.6	1.2	1.4	1.1	1.1
Education	2003	2.9	4.4	1.8	1.6	2.0	3.8
	2010	3.2	4.7	1.6	1.7	2.2	4.4
	2020	3.2	5.2	1.5	1.6	2.3	4.5
	2030	3.0	5.5	1.5	1.7	2.4	4.3
Others	2003	13.7	6.3	9.5	12.5	15.5	19.2
	2010	13.6	7.0	10.4	13.0	16.2	18.4
	2020	13.2	3.6	12.3	14.5	17.7	20.4
	2030	13.0	1.4	14.3	16.2	19.4	23.3

Table 10 Gini coefficients of income quintiles, 1990-2030

1990	2000	2010	2020	2030
0.418	0.429	0.444	0.470	0.473

Table 11 Consumption and numbers of households by age group until 2030

YEAR		Under 25	25 – 34	35 – 44	45 – 54	55 – 64	Over 64
2003	Consumption	3,482	14,592	20,832	20,687	12,964	11,693
	(%)	4.1%	17.3%	24.7%	24.6%	15.4%	13.9%
	# of HHs	230	530	655	621	445	615
	(%)	7.4%	17.1%	21.2%	20.1%	14.4%	19.9%
2010	Consumption	3,202	13,303	19,603	22,136	13,929	12,555
	(%)	3.8%	15.7%	23.1%	26.1%	16.4%	14.8%
	# of HHs	227	531	679	587	466	643
	(%)	7.2%	16.9%	21.7%	18.7%	14.9%	20.5%
2020	Consumption	3,255	12,275	20,036	26,367	16,050	13,210
	(%)	3.6%	13.5%	22.0%	28.9%	17.6%	14.5%
	# of HHs	227	490	724	575	479	686
	(%)	7.1%	15.4%	22.8%	18.1%	15.1%	21.6%
2030	Consumption	3,320	11,597	20,418	29,986	17,870	13,718
	(%)	3.4%	12.0%	21.1%	30.9%	18.4%	14.2%
	# of HHs	226	460	764	573	480	722
	(%)	7.0%	14.3%	23.7%	17.8%	14.9%	22.4%

Table 12 F tests of six representative households by age group (F statistic)

Food	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	4.10*	1.75	1.55	7.29*	5.16*	3.78*
Under 25		1.59	2.13	4.42*	4.42*	3.74*
25 – 34			0.46	1.27	1.81	1.52
35 – 44				2.59	2.85*	2.22
45 – 54					4.22*	2.47
55 – 64						0.47
Beverages	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	1.20	2.12	2.37	3.29*	0.99	1.26
Under 25		1.19	1.16	1.89	2.01	1.73
25 – 34			4.68*	7.57*	2.95*	2.12
35 – 44				1.03	1.97	0.09
45 – 54					3.20*	1.16
55 – 64						1.13
Housing	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	7.63*	7.13*	3.06*	4.69*	1.01	0.81
Under 25		8.92*	7.94*	17.02*	8.14*	10.97*
25 – 34			7.42*	63.88*	13.11*	9.90*
35 – 44				1.79	4.06*	1.05
45 – 54					2.62	0.85
55 – 64						1.18
Clothing	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	1.19	3.25*	3.97*	2.14	4.14*	1.83
Under 25		0.32	0.52	0.15	1.40	0.53
25 – 34			1.72	1.26	1.27	0.42
35 – 44				0.11	0.56	0.46
45 – 54					0.58	0.14
55 – 64						0.55
Transportation	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	3.06*	0.45	0.31	0.33	1.51	1.60
Under 25		1.54	4.06*	3.49*	6.15*	8.27*
25 – 34			1.35	0.85	1.09	1.30
35 – 44				0.71	1.54	1.03
45 – 54					1.09	1.64
55 – 64						2.19
Health Care	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	4.76*	1.04	0.86	1.57	0.82	2.90*
Under 25		3.13*	2.61	3.53*	14.75*	7.23*
25 – 34			1.18	27.24*	8.65*	6.95*
35 – 44				0.41	1.06	6.45*
45 – 54					1.58	6.16*
55 – 64						17.69*
Entertainment	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	0.93	0.91	1.45	1.74	4.33*	0.48
Under 25		0.92	1.09	0.89	2.60	0.80
25 – 34			0.19	1.21	2.05	0.42
35 – 44				0.69	3.52*	0.25
45 – 54					4.30*	0.47
55 – 64						4.62*
Personal care	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	0.47	1.00	0.13	0.79	0.72	0.57
Under 25		1.12	0.39	0.56	1.02	1.31
25 – 34			0.75	2.31	2.03	1.40
35 – 44				0.31	0.73	0.51
45 – 54					0.73	1.49
55 – 64						1.51
Education	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	14.85*	2.09	6.35*	1.97	1.94	5.15*
Under 25		9.94*	18.80*	12.77*	20.09*	19.70*
25 – 34			8.29*	33.51*	1.29	3.01*
35 – 44				4.08*	5.66*	10.91*
45 – 54					5.51*	7.97*

55 – 64						3.11*
Others	Under 25	25 – 34	35 – 44	45 - 54	55 - 64	Over 64
Total (1 HH)	0.69	0.29	0.87	0.72	0.80	1.09
Under 25		1.07	0.43	1.84	5.64*	0.48
25 – 34			1.45	51.90*	6.14*	0.79
35 – 44				4.18*	2.21	0.93
45 – 54					0.88	1.43
55 – 64						2.72*

Note: Significance levels at 5% are indicated by * (5% critical value of $F_{4,32} = 2.67$).

Table 13 F tests of five representative households by income quintiles (F statistic)

Food	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	2.57	2.63	4.72*	4.83*	5.14*
Lowest 20%		1.57	1.45	1.24	1.64
Second 20%			0.89	1.22	1.51
Third 20%				1.48	2.76*
Fourth 20%					2.37
Beverages	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	2.49	3.39*	0.92	2.74*	4.05
Lowest 20%		1.03	0.83	0.43	0.84
Second 20%			0.78	1.04	1.70
Third 20%				0.41	0.74
Fourth 20%					0.57
Housing	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	1.62	2.10	1.42	2.24	2.80*
Lowest 20%		2.15	1.83	2.01	4.31*
Second 20%			2.58	2.98*	3.46*
Third 20%				1.81	2.34
Fourth 20%					3.00*
Clothing	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	7.36*	4.34*	6.08*	5.40*	7.47*
Lowest 20%		2.48	3.92*	5.26*	6.30*
Second 20%			0.77	2.25	3.51*
Third 20%				2.82	4.42*
Fourth 20%					4.10*
Transportation	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	1.33	0.56	1.71	0.53	0.28
Lowest 20%		0.63	0.89	0.71	1.52
Second 20%			0.74	0.35	0.75
Third 20%				1.25	2.23
Fourth 20%					1.41
Health Care	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	4.46*	0.95	0.24	0.82	1.48
Lowest 20%		3.70*	2.27	1.81	3.32*
Second 20%			0.89	0.70	1.07
Third 20%				0.85	0.71
Fourth 20%					0.98
Entertainment	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	1.13	2.63	1.46	1.68	1.78
Lowest 20%		2.62	1.15	0.62	1.17
Second 20%			1.24	1.45	1.60
Third 20%				0.51	0.69
Fourth 20%					0.77
Personal Care	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	0.38	0.13	0.35	0.24	0.15
Lowest 20%		0.79	0.19	0.37	0.80
Second 20%			0.23	0.46	0.22
Third 20%				0.59	0.68
Fourth 20%					0.31
Education	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	1.06	2.71*	3.90*	2.19	2.47
Lowest 20%		3.05*	1.93	1.23	1.08
Second 20%			2.49	2.16	3.81*

Third 20%				5.50*	6.30*
Fourth 20%					4.49*
Others	Lowest 20%	Second 20%	Third 20%	Fourth 20%	Highest 20%
Total (1 HH)	1.91	0.66	0.70	1.46	0.61
Lowest 20%		0.88	3.86*	8.37*	1.94
Second 20%			1.99	3.33*	1.03
Third 20%				7.21*	2.36
Fourth 20%					3.02*

Note: Significance levels at 5% are indicated by * (5% critical value of $F_{4,32} = 2.67$).

Table 14 Chicago economy by age group (2003, per household)

	Total	Under 25	25 – 34	35 – 44	45 – 54	55 – 64	Over 64
Income	36,383	14,716	35,857	43,473	48,410	41,752	21,660
IC ratio[1]	0.7480	1.0288	0.7678	0.7316	0.6881	0.6978	0.8778
Consumption	27,214	15,140	27,532	31,805	33,312	29,133	19,013
(Agriculture)	32	20	33	38	38	33	23
(Manufacturing)	8,449	5,401	8,997	10,028	10,273	8,820	5,327
(Service)	18,733	9,719	18,503	21,739	23,001	20,280	13,662
Multiplier	1.9952	1.9821	1.9905	1.9938	1.9957	1.9973	2.0037
Production	54,296	30,009	54,804	63,413	66,482	58,188	38,097
(Resources)	147	85	149	173	179	156	102
(Construction)	1,307	706	1,309	1,523	1,602	1,406	930
(Non-durables)	11,477	6,941	11,967	13,535	13,993	12,107	7,561
(Durables)	6,015	3,513	6,192	7,066	7,346	6,386	4,065
(TCU)[2]	3,636	1,947	3,630	4,233	4,458	3,916	2,602
(Trade)	5,462	2,905	5,440	6,354	6,700	5,890	3,926
(FIRE)[3]	8,963	4,727	8,902	10,418	10,998	9,679	6,475
(Services)	16,831	8,940	16,757	19,577	20,645	18,154	12,105
(Government)	458	242	456	533	562	495	331

Note: 1. The ratio of consumption to income
2. Transportation, communications and utilities
3. Financial institutions, insurance and real estate

Table 15 Chicago economy by income quintiles (2003, per household)

	Total	Lowest 20%	Second 20 %	Third 20 %	Fourth 20 %	Highest 20 %
Income	36,383	5,836	15,284	26,716	43,503	90,479
IC ratio[1]	0.7480	2.1253	1.1647	0.9032	0.7756	0.5995
Consumption	27,214	12,403	17,801	24,130	33,739	54,239
(Agriculture)	32	19	25	31	40	55
(Manufacturing)	8,449	4,098	5,743	7,750	10,799	15,648
(Service)	18,733	8,286	12,034	16,349	22,900	38,537
Multiplier	1.9952	1.9896	1.9917	1.9921	1.9924	2.0014
Production	54,296	24,676	35,455	48,070	67,223	108,551
(Resources)	147	72	100	133	183	281
(Construction)	1,307	588	849	1,151	1,611	2,640
(Non-durables)	11,477	5,427	7,679	10,382	14,486	21,926
(Durables)	6,015	2,800	3,986	5,395	7,534	11,704
(TCU)[2]	3,636	1,630	2,355	3,196	4,473	7,374
(Trade)	5,462	2,442	3,531	4,794	6,710	11,115
(FIRE)[3]	8,963	3,993	5,782	7,851	10,993	18,307
(Services)	16,831	7,520	10,877	14,767	20,671	34,268
(Government)	458	204	296	402	563	935

Note: 1. The ratio of consumption to income
2. Transportation, communications and utilities
3. Financial institutions, insurance and real estate

Table 16 Consumption multiplier estimations until 2030

Income quintiles	Total	Lowest 20%	Second 20 %	Third 20 %	Fourth 20 %	Highest 20 %
2003	1.9952	1.9896	1.9917	1.9921	1.9924	2.0014
2005	1.9980	1.9920	1.9941	1.9952	1.9956	2.0028
2010	2.0078	1.9986	2.0042	2.0044	2.0047	2.0113
2015	2.0249	2.0115	2.0222	2.0216	2.0223	2.0298
2020	2.0063	1.9909	2.0039	2.0024	2.0034	2.0105
2025	2.0224	2.0015	2.0209	2.0184	2.0201	2.0292
2030	2.0312	2.0092	2.0299	2.0265	2.0288	2.0380
Age group	Under 25	25 – 34	35 – 44	45 – 54	55 – 64	Over 64
2003	1.9821	1.9905	1.9938	1.9957	1.9973	2.0037
2005	1.9846	1.9934	1.9958	1.9990	1.9994	2.0053
2010	1.9920	2.0012	2.0047	2.0066	2.0066	2.0171
2015	2.0071	2.0161	2.0208	2.0218	2.0225	2.0389
2020	1.9870	1.9960	2.0007	2.0013	2.0020	2.0229
2025	1.9982	2.0087	2.0150	2.0130	2.0171	2.0459
2030	2.0060	2.0144	2.0241	2.0210	2.0255	2.0560