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INCOME INEQUALITY IN TAIWAN 1976-1995: AGING, FERTILITY AND FAMILY COMPOSITION*

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1. Introduction

Taiwan is noted as a country that has grown rapidly without increasing income inequality (Fei, Ranis and Kuo, 1979). Taiwan is also one of the first countries outside of the OECD to experience a sharp and sustained decline in its birth rates after 1951 and is therefore already experiencing an increase in the share of its population and labor force in middle and late ages, due to its demographic transition.[1] Primary educational attainments in Taiwan were widespread before Japanese rule was terminated, and expansion of secondary and technical tertiary education proceeded rapidly, with the difference between the education of men and women narrowing, and the labor force participation of women outside of the home increasing. This paper considers how the personal distribution of income has changed in Taiwan from 1964 to 1995. It then assesses how changes in the age composition of families, the educational endowments of its people, and the time they supply to the labor force, have contributed to the observed income inequality.

The paper is organized as followed. The next section illustrates the basic dilemma of

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measuring income inequality across households when the composition of households differs by income level and endogenously responds to the growing economic opportunities available to adults over their lifetime. Section 3 discusses additional issues that arise in the analysis of income inequality. Section 4 describes the survey data examined in this paper and reviews trends and developments in Taiwan that may be relevant. Section 5 reports changes in household income inequality from 1976 to 1995 in Taiwan and how adult incomes are related to different dimensions of household composition: size, proportion of children and elderly members. Section 6 constructs measures of "full income" inequality that are independent of the changing time allocation of women during this period. The concluding section summarizes the findings.

2. Income Inequality and per Capita Income Inequality: Historical Overview

It is difficult to draw welfare conclusions from changes in household income data if the composition of households is changing at different income levels. Previous studies of the household income distribution in Taiwan illustrate this point; Table 1 tabulates income by household size for 1966, 1972, 1976 and 1995. If the share of income in column (3) is divided by the share of households in column (1), this measure of average household income increases with household size (Plotted in Figure 1). But the rate of increase in household income is less than that of size (i.e. the plot of household relative income is insufficiently steep), and consequently household income per capita decreases in larger households, which is obtained by dividing column (3) by the share of persons in column (2), and is also plotted in Figure 1. The sharp decline in the share of one person households and households with 8 or more

Table 1

Distribution of Income among Households and Persons in Households, by Size of Households: 1966 to 1993

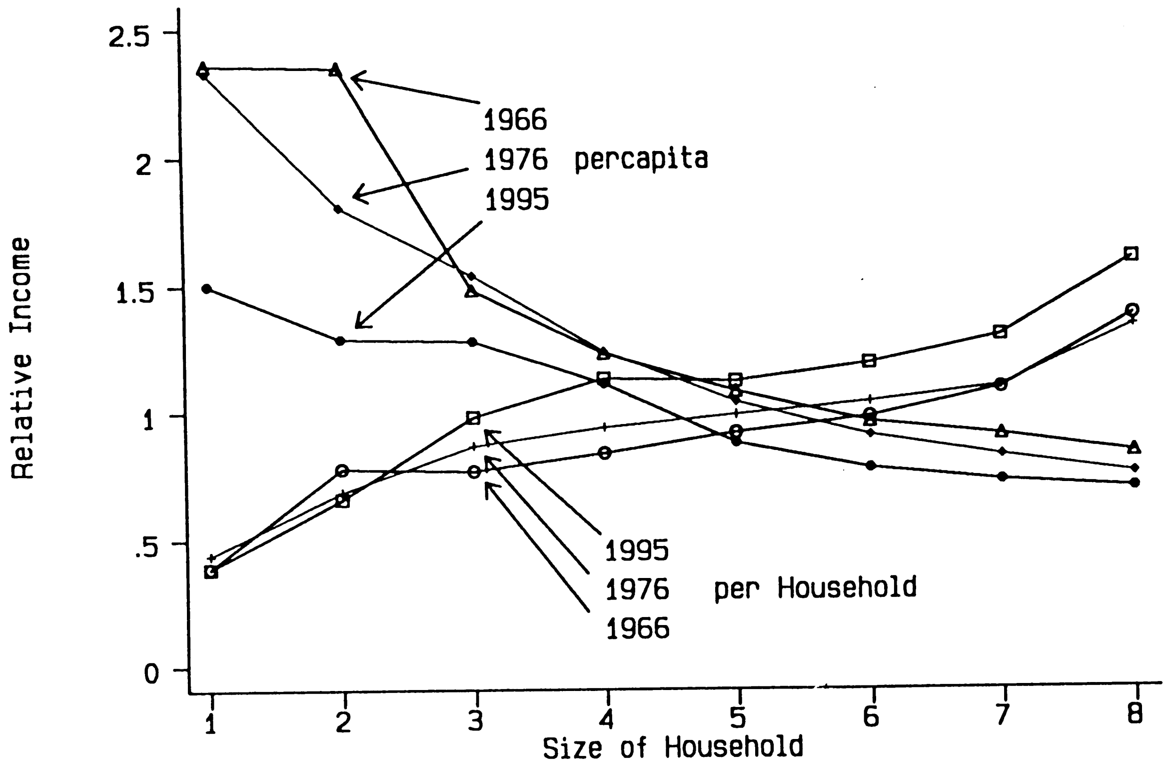
Household Size Class	1966			1972			1976			1995		
	Percent of House-holds (1)	Percent of Persons (2)	Percent of Income (3)	Percent of House-holds (1)	Percent of Persons (2)	Percent of Income (3)	Percent of House-holds (1)	Percent of Persons (2)	Percent of Income (3)	Percent of House-holds (1)	Percent of Persons (2)	Percent of Income (3)
1 person	6.6	1.1	2.6	3.3	0.6	1.4	3.2	0.6	1.4	7.8	2.0	3.0
2 persons	5.4	1.8	4.2	4.1	1.5	2.8	5.5	2.1	3.8	14.8	7.5	9.7
3 persons	7.7	4.0	5.9	9.3	5.0	7.7	9.5	5.4	8.3	16.1	12.3	15.7
4 persons	11.5	7.9	9.7	13.8	9.8	12.5	17.7	13.5	16.7	26.5	27.0	29.9
5 persons	15.3	13.0	14.0	21.2	18.9	20.9	22.9	21.8	22.6	19.5	24.9	21.9
6 persons	14.8	15.1	14.5	19.3	20.7	19.6	18.8	21.5	19.6	8.9	13.6	10.6
7 persons	14.9	17.8	16.2	12.6	15.8	13.7	10.8	14.4	11.9	4.0	7.1	5.2
8 or more Persons	23.9	39.3	32.9	16.4	27.7	21.4	11.8	20.7	15.8	2.5	5.7	4.0
Total Units[a]	2,281	13,360	96.46	2,772	15,470	167.7	9,442	49,483	1,189.6	14706	57699	1,793.5
Total Disparity Measure: Income per Household or per Person	20.8	17.2	-	12.8	19.0	-	11.9	19.7	-	20.5	19.1	-

Source: 1966 and 1972 from Kuznets (1990) Table 2.
1976 and 1995 calculated by author from Survey data files.

[a] Income total on col.(3) is in billions of current Yuan.

Figure 1

Relative Income By Household Size: Taiwan 1966, 1976, 1995



persons from 1966 to 1972 are notable changes in the composition of households shown in Table 1. The decline in large households continues throughout the period. whereas the proportion of one-person households revives to the initial level during the 1980s, as resources became sufficient to permit more young and old individuals to maintain separate households.

Kuznets (1980b) summarized income inequality in this case by the Total Disparity Measure (TDM), defined as the sum of differences in percentage shares of households, and shares of income, across the distribution by household size, disregarding in the summation the signs of the differences. Kuznets compares this TDM with the Gini/Lorenz concentration ratio, because it also sums the absolute value of differences in incomes, as measured across any particular grouping of the population, e.g., by household size or by sector. From 1966 to 1972 the TDM declines markedly in the bottom row of Table 1 from 20.8 to 12.8 in terms of the distribution of income per household (col. 1), whereas the TDM increases somewhat, from 17.2 to 19.0, for the distribution of household income per capita (col. 2). Kuznets concludes "that the evidence for significant reduction in income inequality over the decade preceding 1975 does not stand up under scrutiny. The crude adjustment for size of households removes the trend suggested by the conventional distributions; and leave us with apparent constancy over the period" (Kuznets, 1980b, p.264).

Tabulations of the subsequent micro survey data that are examined in this paper confirm roughly parallel estimates of inequality in 1976 to those Kuznets derived from published tabulations for 1972. However, by the 1990s, the TDM across household incomes (Col. 1) indicates the income inequality has returned to the level of 1966, or 20.5 by 1995. On the other hand, the inequality in the distribution of household per capita income (Col. 2) has remained relatively constant across this grouping of households from 1972 to 1995 with the TDM fluctuating narrowly around 19. This empirical pattern for Taiwan is the main finding of this paper, and is documented more fully in the subsequent analysis. Kuznets viewed the early evidence of decline in inequality in Taiwan as based on an inadequately standardized index of income inequality. Is there any reason to view the recent increase in household income inequality, by the same measure, as a more satisfactory indicator of change in social or economic inequality?[2] Kuznets (1980b) was skeptical that the decrease in inequality in income distributed by households from 1964 to 1975 was significant, and a similar caution should be exercised before interpreting the increase in inequality during the 1980s in household incomes as a real loss in social welfare due to inequalities in consumption opportunities.

Yet it is common practice in studies of income inequality to report the income distribution across households and not incorporate in the analysis the compositional differences in households, of which size is only the most obvious (e.g., Chiou, 1996, Chu, 1997). In summarizing inequality in terms of per capita household income, Kuznets' TDM implicitly weighted inequality by persons in col. 3 of Table 1, rather than by households as in Col. 1. This shift toward more democratic weights, although reasonable, does not preclude more refined standardizations for household composition. An intermediate position between dividing household income by size and ignoring its size might be to divide household income by the number of adults in the household, because adults might be income earners and decision makers regarding how families are constituted, in which case the number of adults in the household could be viewed as the social "weight" of the household. As argued later, research on household income distributions should ultimately account for the observed changes in family formation and household composition, because these changes are a response of individuals to labor market opportunities, the households' skills and nonhuman wealth, private transfers between altruistic or cooperating households in the extended kinship system, and public tax and transfer schemes.

3. Measures of Inequality

There are many ways to measure inequality; I focus here on only a few. First there is the distinction between household and individual inequality. The household includes individuals who, to some degree, pool income and share consumption. The traditional definition of a household was that its members shared a kitchen or the consumption of food in particular. Transfers across households in an extended family network can separate production from consumption, but a major function of the household is providing consumption for those residing within the household. Those members of the household who are less productive, either because of their stage in the life cycle, as with children and the elderly, or because they are temporarily unemployed or disabled, or more permanently incapacitated, or specializing in home production, as is a housewife, are presumably supported in their consumption requirements by the more productive members of the household. To assess the distribution of welfare in a society, the basic unit for the study of consumption is, therefore, the household or coresidential family. Exchanges between households are not studied here, because both sides of the exchange are not observed in this or most standard household sample surveys.

The second distinction in defining inequality is the time period over which income flows are averaged. For many purposes it would be useful to measure inequality in income over a lifetime, for if financial markets can redistribute these resources over time to when they are most urgently needed for consumption and investment purposes, the lifetime constraint is most relevant for welfare comparisons. Shocks to income in one period that are offset by shocks in the opposite direction in another period might then not be construed as necessarily affecting lifetime inequality, and if these shocks are not entirely unanticipated, people may still be able to insure themselves against generally expected perturbations of nature. But most survey data are collected for much shorter intervals, typically one year. Annual income will be the primary basis for assessing inequality in this paper, though it is expected to overstate longer term welfare inequality. Comparing inequality in consumption to that in annual income provides one check on the possible magnitude of this upward bias.[3]

The third issue that is central to this paper is how to adjust household income for the composition of the household. The first procedure is to neglect the composition or size of households and treat all family/households as a comparable welfare unit. The second most common procedure is to divide income by the number of persons in the household, ignoring how consumption requirements vary according to the characteristics of persons or how the composition of the household may reflect the preferences of its members. More refined approximations might introduce an adult equivalent share for children that might be between about .3 and .5, and some studies even adjust for the different calorie requirements of adult males and females, presumably related to their weight or customary work (Deaton and Muellbauer, 1980; Fogel, 1994). Evidence can also be marshalled that suggests there are economies of scale in consumption which increase with household size.[4] The third procedure considers household income per adult, to neutralize the effects on income distribution related to differential fertility by household income. In this third approach the number of adults in the household becomes the population weight, and children are not attributed consumption requirements in reckoning inequality.

In these three methods for dealing with household composition, it is implicitly assumed that there is an equal sharing within the household that gives all members access to the same welfare level from their consumption. A fourth issue in measuring inequality is how to measure and interpret welfare inequality <u>within</u> the household. Adult men and women may not have the same claim on resources within the household, and this may vary across households and overtime. The example above of lower calorie requirements for the average woman than man is based on weight-determined body metabolism rates, which may also be linked to lower physical productivity of women than men in some physically demanding (i.e., high calorie) tasks (Schultz, 1996). There could be another sharing rule less closely related to biological work capacity and more directly linked to the relative productivity or bargaining power of women and men, given their technological production opportunities and their training and skills. The educational attainments of men and women in Taiwan are becoming more similar, and this may have implications for the gender gap in wages for those who work in the labor force, as well as the gap in marginal productivity in home production. The convergence in educational attainment of women and men may thus foreshadow a modification in the rules for sharing of household output and consumption.

The fifth issue is how to summarize the dispersion in the distribution of income. Two indicators of inequality or dispersion are consulted. The first is the Gini concentration ratio (G), which is the sum of the absolute value of the differences in income (y) between all possible pairs of households, divided by twice the mean income (m) multiplied by the number of households (n) squared:

$$G \ = \ [1/(2mn^2)]\sum_{i=1}^{n}\sum_{j=1}^{n} |y_i - y_j| f\,(y_i) f\,(y_j)\ , \tag{1}$$

where the subscripts i and j run across all n households, and $f(y_i)$ is the frequency of households with income y_i. The Lorenz curve provides a visual analogue for the concentration ratio and provides the intuition for why $0 \leq G \leq 1.0$.

The second indicator is the log variance (ℓv), which is the average squared deviation of a household's logarithmic income $(\ell n(y_i))$ from the population's (geometric) mean logarithmic income.

$$\ell v \ = \ [1/n]\sum_{i=1}^{n} (\ell n(y_i) \ - \ \overline{\ell n(y)})^2 \ f\,(y_i)\ , \tag{2}$$

where $\overline{\ell n(y)}$ refers to the mean log income for all n households. This measure of dispersion assigns greater weight to equal transfers of income from the mean to the poor than from the rich to the mean, because the logarithmic transformation collapses the income scale to proportional variation. The deviations of the individual from the population log mean are also squared in the log variance, whereas the absolute values of the deviations are arithmetically summed in the case of the Gini. This implies that the log variance also assigns greater weight than does the Gini to outliers.

An attraction of the log variance as a measure of income inequality is that it can be directly decomposed into the shares of the log variance attributable to various household characteristics that may affect income (Fisher, 1930). An unfortunate feature of the log variance is that families that do not have positive income in the reference period cannot be included, because the logarithm of a nonpositive number is undefined. Assigning all persons at least some minimum positive income level is an arbitrary solution to this difficulty, but not a conceptually attractive one. Over a lifetime, a negative income constraint is implausible, but for shorter periods, savings and dissaving as well as interhousehold and public transfers allow for the smoothing shocks to income as they affect consumption, and of course, a family can legitimately report negative capital income or self-employed income in any particular year, although only two households do in the data analyzed here.

Two steps in my analysis motivates the choice of log income and log variance as the measures of welfare levels and inequality. In estimating earnings functions it is widely found that the income dependent variable is fit by the standard conditioning variables better if income is expressed in logarithmic form (Mincer, 1974; Heckman and Polachek, 1974), and the errors to this regression are more nearly normal and homoskedastic than in the arithmetic form of the earnings function. Analysis of variance methods are also motivated by the normality distribution to develop tests of statistical significance (Fisher, 1930). In Figures 2 and 3 the actual distributions of household logincome per adult are shown for 1976 and 1995 from the Taiwan Personal Income Surveys analyzed later. The histograms of the data are compared to the frequency distribution (plotted as a solid line) implied by the parameters of the fitted lognormal distribution. The approximation is reasonably close for both the individual full-time earnings and household per adult income (shown). If household incomes are actually distributed log normally, alternative measures of inequality — e.g., Gini, log variance, coefficient of variation, quantiles — are monotonic analytic functions of each other.

Figure 2

Fraction of Households by Household Income per Adult: Taiwan, 1976

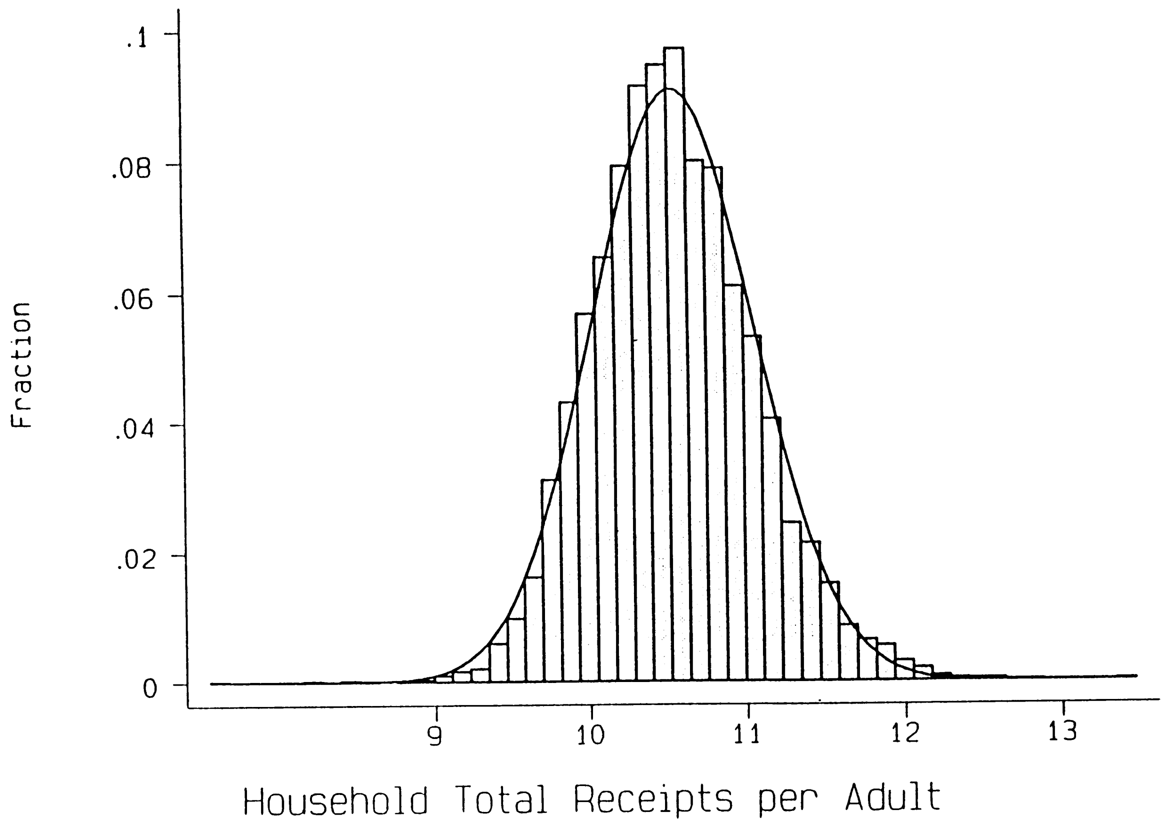
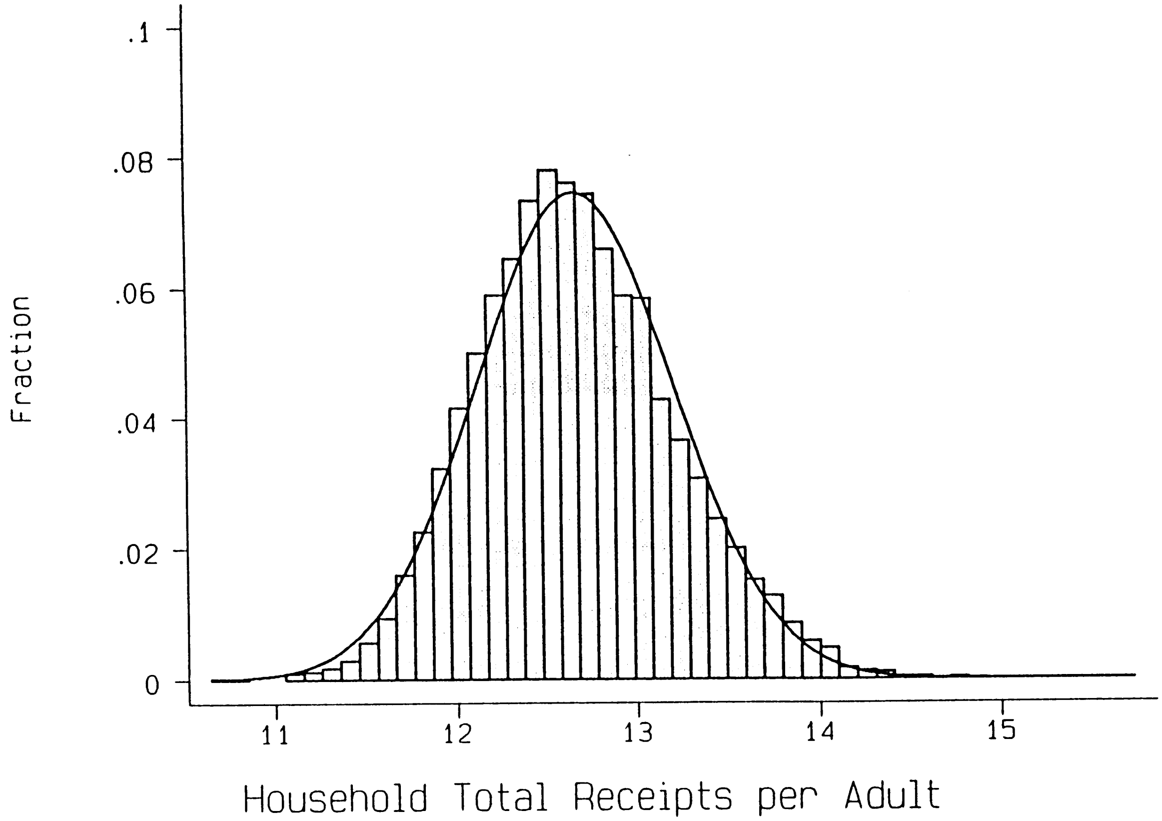


Figure 3

Fraction of Households by Household Income per Adult: Taiwan, 1995



In particular, the Gini then becomes a computed function of the log variance (e.g., Aitchison and Brown, 1957, Appendix A). However, if measured household income deviates sufficiently from log normal, these alternative measures of inequality could vary in opposite directions, or for example, the Lorenz curves could cross allowing for ambiguity in ordering distributions according to different summary measures of inequality.

4. Data and Trends in Taiwan

Data are drawn from the Survey of Personal Income for Taiwan (or Family Income and Expenditure Survey) conducted by the Directorate-General of Budget, Accounting and Statistics (DGBAS), Executive Yuan. This household random stratified survey was initiated in 1964 and expanded to include disaggregations of rural and urban areas of Taiwan from 1966. The questionnaire has changed relatively little after 1966, including for each individual in the household their income sources, economic status, industrial sector of employment, marital status (after 1987), education, sex, and age, plus detailed categories of household consumption expenditures and outlays on durable goods. Before 1976, only published cross tabulations of the survey are available, but from 1976 onward the individual household data files are available from DGBAS. The survey methodology appears to have been consistently applied from 1966 onward (Fei, Ranis and Kuo, 1979), although the size of the survey has grown from approximately 3,000 families in 1964, to 9,500 families in 1976, to 15,000 since 1980. Approximately 50,000 individuals are enumerated in 1976, increasing to 75,000 in 1985, and decreasing to approximately 58,000 by 1995, as average household size declined. Household members are identified by their relationship to the head of household. This leaves some ambiguity in matching husbands and wives, if one of them is not the head of household. Additional information on the identify of spouses in the household is added after 1987. Consequently, to preserve the same basis for comparing (matched) couples for all years of the survey, the working sample is later restricted to couples who are household heads.[5]

Two changes in family composition in this period are portrayed in the last two rows in the panel I of Table 2. The number of adults (i.e., persons over age 15) per family has decreased from 3.24 in 1976 to about 2.95 by 1995. This includes a marked decline in the proportion of adults residing with their elderly parents or parent-in-laws.[6] The greater frequency of extended family living arrangements associated with several countries of the Far East (Kuznets, 1990a) appears to be diminishing in Taiwan after 1976.

The other change in family composition is the decrease in number of children per adult from .62 to .32 from 1976 to 1995. The secular evolution of the demographic transition in Taiwan is most readily measured in the decline in birth rates that followed the abrupt reduction in mortality after the Second World War. The crude birth rate peaked at 50 per thousand persons in 1951, and declined to 38 by 1961, to 26 by 1971, and then slowed its descent to 23 in 1981, and stabilized at about 16 after 1991. Primarily as a consequence of this decline in crude birth rates the proportion of the population under 15 years of age fell from 45 percent in 1965 to 25 percent in 1993. Expected lifetime fertility for women, or the total fertility rate defined as the sum of current age-specific birth rates from age 15 to 45, fell from 5.1 children per woman in 1964 to less than replacement of 1.8 children after 1986. The corresponding percent of the population elderly, or age 65 and over, increased from 2.6 percent in 1965, to 4.3 percent in 1980, to 7.1 percent in 1993, and is projected to continue to

Table 2

Households, Incomes and Inequality, with Three Adjustments for Composition

	1976	1980	1985	1990	1993	1995
I. Composition of Families						
1. Number of Families	9437	14697	16430	16434	16434	14706
2. Number of Adults	30545	46307	51548	49003	49687	43409
3. Number of Persons	49483	71231	75496	68846	67227	57699
Adults per Family (2/1)	3.24	3.15	3.14	2.98	3.02	2.95
Children per Adult (3/2-1.0)	.62	.54	.46	.40	.35	.32
II. Income Level:						
4. Mean Income Families (in thousands of current NT)	126.	254.	362	593	836	996
5. Mean Income Families per Adult (in thousands of current NT)	38.8	80.7	115	199	277	337
6. Mean Income Families per Capita (in thousands of current NT)	24.0	52.5	78.1	142	204	254
7. Mean Log Income Families	11.601	12.308	12.645	13.118	13.457	13.635
8. Mean Log Income Per Adult	10.433	11.159	11.511	12.052	12.381	12.587
9. Mean Log Income Per Capita	9.943	10.724	11.126	11.711	12.086	12.310
III. Income Inequality						
10. Gini Coefficient Families	.2892	.2845	.2977	.3134	.3150	.3131
11. Gini Coefficient per Adult	.2872	.2795	.2974	.3026	.3023	.2965
12. Gini Coefficient per Capita	.2947	.2973	.3015	.3023	.2959	.2887
13. Variance of Log Income Families	.2771	.2915	.3177	.3752	.3969	.3838
14. Variance of Log Income per Adult	.2488	.2637	.2698	.2794	.2829	.2634
15. Variance of Log Income per Capita	.2586	.2676	.2758	.2793	.2678	.2491
16. Consumer Price Index (1991=100)	48.3	71.5	86.6	96.5	107.5	116.0

increase rapidly in the future (DGBAS, 1994; Taiwan, Ministry of Interior, 1991).

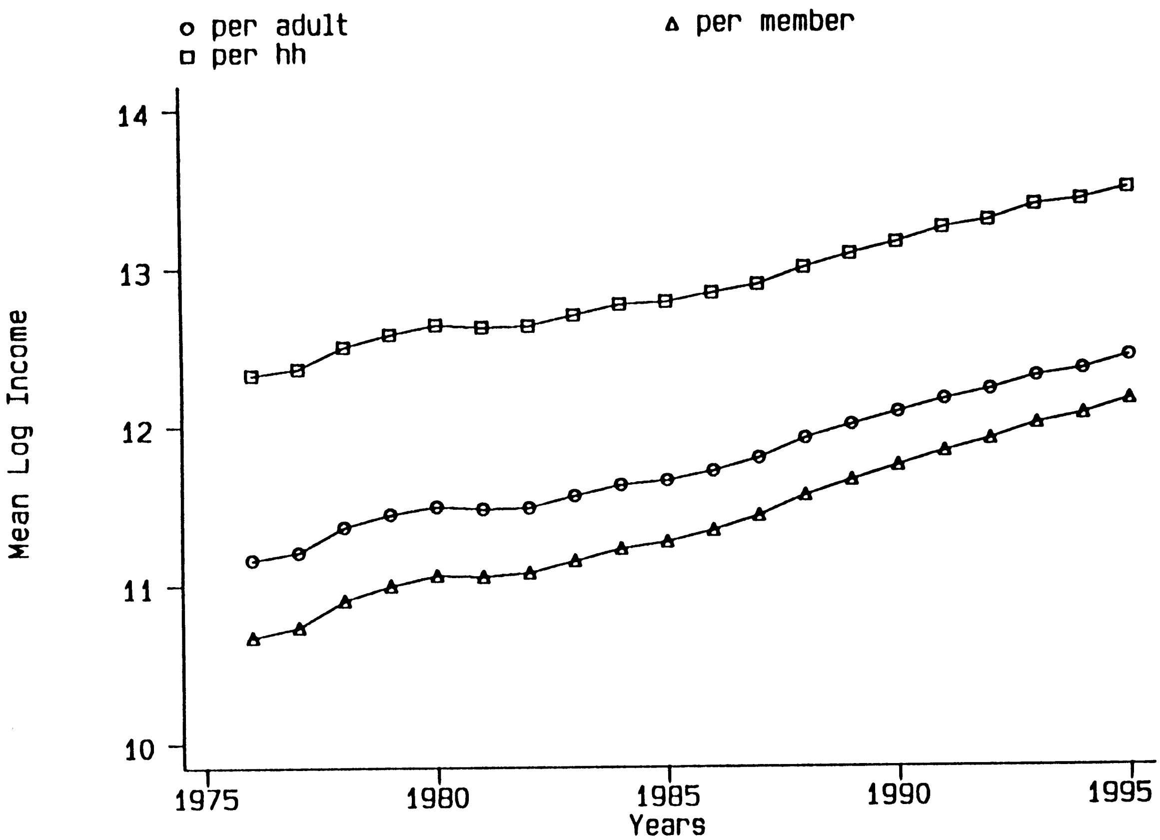
Household income per capita reported in panel II of Table 2 has increased eight fold in the 17 years from 1976 to 1993, whereas income per adult increased more slowly by seven-fold, due to the declining proportion of children. The consumer price index increased 122 percent, reducing the real income growth per adult to 320 percent, suggesting that real income per adult has grown at a continuously compounded rate of 7.1 percent per year. Figure 4 plots the annual estimates of the mean log real incomes in 1991 NTs, based on the log of income per household, household income per adult, and household income per member.

The family would seem the appropriate unit to measure welfare inequality, but the formation of families is itself endogenous to income opportunities, to some degree. They can form and subdivide to realize benefits for their members, whether these benefits are observed in income receipts, or are related to economies of scale in consumption or production, or psychic benefits of privacy, diseconomy of scale in some forms of consumption, or a specific matching of individual demands for public goods, such as number and quality of children.

Income per adult normalizes household resources prior to any fertility decisions. It treats as equally well-off two couples that have the same income, regardless of whether they have decided to have, say, one or two children. This approach ignores the extent to which couples have more or less children than they want, for the welfare of couples who do not obtain their desired fertility should be lower than other observationally equivalent couples, i.e., with the same income and fertility. Society may also believe that children should receive a minimum material standard of living. Measures of <u>social</u> inequality based only on income per adult could thereby neglect the extent to which children are disproportionately in poorer

Figure 4

Time Trend in the Log Real Income: Per Household, Per Adult, and Per Member



families ranked by income per adult. By the same logic, society may decide the consumption needs of the elderly should be treated in a different manner from other "prime" adults. But since savings during productive adult years is a means for sustaining consumption in retirement years, the treatment of elderly with other adults, regardless of their current participation in income earning activity, is arguably appropriate. Family income may also be divided by the number of persons in the family, including children as equal claimants to adults on consumption and savings. The per capita and per adult measures of family welfare bounds the inequality that would be measured if some intermediate adult "equivalent" weights were defined for children.

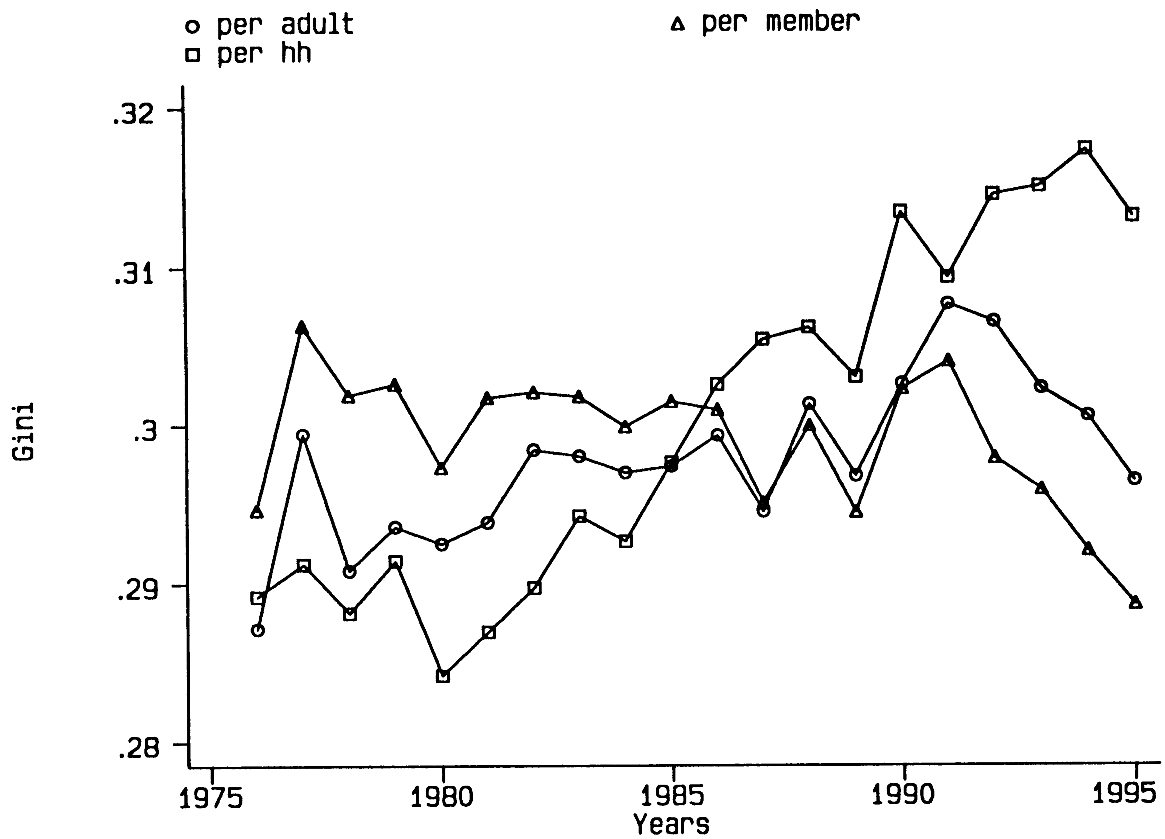
Differential fertility by the level of adult incomes may also be a factor affecting per capita income inequality. The demographic transition in low-income countries caused a period of rapid population growth that could have increased income inequality, if fertility decreased more slowly in the lower income classes than in the higher income classes (Schultz, 1971). Although the survey data analyzed here are not well-designed to measure differential fertility, some insight into these behavioral questions can be gleaned from an analysis of the distribution of children by household income per adult.

5. Changes in Household Income Inequality

The third panel in Table 2 compares the two summary indexes of inequality, using the three measures of economic welfare in the family described above. All annual estimates of the Gini coefficient are plotted in Figure 5 according to the three household bases of welfare. The Gini coefficient for entire households has increased 11 percent from its low in 1980 of

Figure 5

Time Trend in Gini Concentration Ratio of Income: Per Household, Per Adult, and Per Member



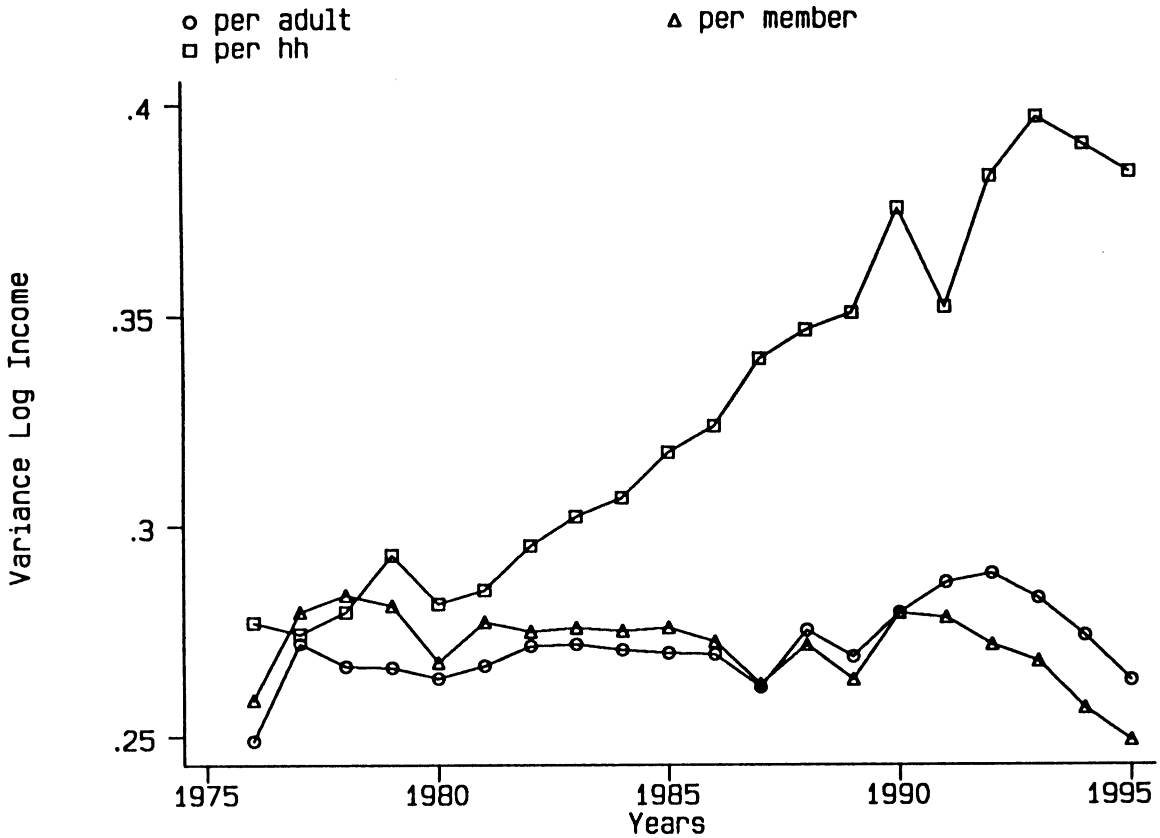
.285 to a peak in 1993 of .315, before stabilizing. The Gini in terms of household income per adult has increased 8.3 percent from 1980 to 1990, and has fallen since 1991. If income per capita in the household is the relevant measure of welfare, the Gini has been nearly constant from 1978 to 1991, when it starts to decline.

Figure 6 plots the annual estimates of the log variance of incomes according to the three methods for normalizing for the composition of the household. With the log variance of total household income there is a sustained increase in inequality of 39 percent from 1976 to 1995. Based on household income per adult, this is a 5.9 percent increase, and on an income per capita basis the log variance decreases 4 percent over the entire period. If we compare the inequality based on household income per adult and per member (adding children), our measure of inequality is higher for per capita inequality in the early years, but after 1987-1990 the addition of children to the welfare comparisons reduces the log variance slightly. Conversely, inequality is smaller when family welfare is represented by either income per adult or per person rather than simply as household income. The important distinction is that when household size, measured either as number of adults or as number of persons, is used to normalize household income, the sharp rise in household inequality is essentially eliminated. <u>The apparent increase in log variance (or Gini) of household incomes in this period appears to be due to changes in the composition of households</u> and does not reflect a clear change in the distribution of economic welfare, just as Kuznets argued in the earlier period of 1964-1975.

One response to the changing composition of households is to contrast the evolution of inequality based on different welfare standardizations of income for composition. But if the trends and patterns, as in Taiwan in this period, are inconsistent across alternative

Figure 6

Time Trend on Log Variance of Income:
Per Household, Per Adult, and Per Member



standardizations, another approach to measuring changes in welfare inequality might be to explicitly endogenize household composition.

Income Effects on the Demand for Household Composition

If individuals modify the composition of households they live in as their income opportunities, prices, and technologies change, it may be possible to describe this demand process determining household formation and composition and possibly improve our understanding of the welfare consequences of the combined changes in income inequality and household composition. Although this paper only presents preliminary evidence of the links between income and household composition, the goal of this line of research would be to infer the welfare gains (losses) arising from changes in household composition. It would then be possible to incorporate these currently unobserved private net benefits along with market income into a broader measure of household welfare, and hence personal inequality.

In addition to the total size of the household, three components of the composition can be usefully distinguished by the age of its members: adult size (15 or more), share of children (less than 14), and share of elderly (65 or more). Many factors have been advanced as a reason for prime-aged adults to live together. The larger household may facilitate specialization between market and home production. Consequently, single men and women are likely to be full-time workers, whereas when married, women are more likely to allocate more of their time to home production and child care, contributing to a decline in market income per adult in the two-adult versus one-adult households. Technological economies of scale can also be realized in a larger household by distributing more widely the fixed costs of housing and other consumption, and perhaps increasing returns to home production. These two factors could yield an inverse relationship between the number of adults in the household and market income per adult that would overstate the welfare loss associated with residing in a household with more adults. A third interpretation of this relationship might be a demand for privacy as a normal good that is foregone when the adult size of a household increases. Adults with more income would, according to this reasoning, demand to live in smaller households and may achieve this outcome in part by subsidizing the expenses incurred by parents and mature children who live apart.

To assess the magnitude and change over time in this possible relationship, households whose head was between the ages of 30 and 50 in 1976 and 1993 were examined from the Personal Incomes Surveys. The estimates of the regression coefficient on log income per adult in a regression accounting for adult size of household are reported in Appendix Table A-1. Evaluated at the sample mean, the elasticity of adult size of household with respect to household income per adult is -.44 in 1976, and -.42 in 1993, where both coefficients are statistically significant at conventional levels, for which the t statistics are -41 and -61, respectively. This inverse relationship holds at each transition of households to two adults (typically through marriage) and to adding a third, fourth, etc., adult. The first and second hypotheses for this inverse relationship implies that the omission of nonmarket income and economies of scale in household production would tend to overstate the decline in welfare from examining only income per adult in larger adult sized households. The third hypothesis that stresses the demand for privacy would imply that the decline in income per adult in larger households understates welfare differences across households of different adult sizes.

The second component of household composition is studied as the ratio of children per prime aged adult, and crudely proxies fertility and should parallel the declining youth dependency burden that families bear in the wake of the demographic transition. The average of this variable in the sample of households whose head is between the ages of 30 and 50 declines by a third from 1976 to 1993 from 1.00 to .65. Regressing this fertility proxy on the log of household income per adult implies a positive elasticity at the sample means of .45 in 1976 and .51 in 1993 (Table A-1). Children appear to be a superior good in Taiwan in this period, and households with 20 percent higher incomes than the average, have 9-10 percent more children per adult. This pattern of differential fertility by income class is not what we might have expected if fertility were much lower than average in high income strata of the society.

The third component of household composition is the ratio of elderly persons to those in the prime ages 15-65. This measure of intergenerational extension of coresidential families is observed to be an inverse function of income per adult (Table A-1). The income elasticity of demand for living with your parents or elderly relatives is estimated to be -1.26 in 1976 and was -1.02 in 1993. Whereas the proportion of elderly to prime aged adults doubled from 1976 to 1993 from 5 to 11 percent, the fraction of elderly living with their children is falling substantially in this period, as illustrated in Appendix Table A-2.[7]

Table 3 decomposes the log variance of income per adult, my preferred index of welfare inequality, in the first and last year of my data, according to groups of households defined by the age of the head of household. The first column reports the percentage of all households in each age group. The next two columns report the mean of log incomes and log

Table 3

Decomposition of Log Variance of Household Incomes per Adult by Age Weighted by Number of Adults in Household

	1976					1995				
	Percent of Adult Population	Mean Log Wage	Variance of Log Wage	Contribution of Group to Log Variance		Percent of Adult Population	Mean Log Wage	Variance of Log Wage	Contribution of Group to Log Variance	
				Within	Between				Within	Between
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
All Ages	100.00	10.433	.2488	-	-	100.00	12.587	.2634	-	-
15-19	0.62	10.103	.1568	.0010	.0007	0.34	12.089	.1708	.0006	.0008
20-24	3.28	10.231	.1861	.0061	.0013	2.99	12.348	.1491	.0045	.0017
25-29	9.54	10.488	.2339	.0223	.0003	7.66	12.561	.1519	.0116	.0001
30-34	10.40	10.650	.2530	.0263	.0049	12.82	12.714	.2148	.0276	.0020
35-39	13.01	10.616	.2613	.0340	.0044	15.34	12.790	.2704	.0415	.0063
40-44	16.18	10.402	.2288	.0370	.0002	17.69	12.589	.3001	.0531	.0000
45-49	18.84	10.355	.2073	.0391	.0011	14.93	12.486	.2463	.0368	.0015
50-54	13.07	10.363	.2115	.0276	.0006	9.63	12.565	.2179	.0210	.0000
55-59	8.28	10.365	.2412	.0200	.0004	7.31	12.610	.2320	.0170	.0000
60-99	6.77	10.303	.3007	.0204	.0011	11.28	12.400	.2953	.0333	.0040

Notes: Column (4) = Col.(3)* Col.(1)/100.
Column (5) = [(Col.(2)-Col.(2 for all ages))**2]*Col.(1)/100.

variance of incomes within the age group, where the mean log income and log variance for the sum of all ages is identical to that in Table 2. Columns (4) and (5) show the share of the overall log variance that is accounted for by the within age cohort log variance weighted by the population share, and the between age cohort and overall mean log income, squared and weighted by the population share (See Table notes). The sum of the figures in columns (4) and (5) add up to the log variance for all ages combined at the top of column (3).[8]

Several common regularities in income inequality across age groups can be seen from Table 3. In 1976 one observes the usual increase in relative inequality in income with increasing ages from .16 for those age 15-19, to a peak .26 for ages 35-39, declining then before it rises again to .30 after retirement for those over age 59 who remain a household head. This lifecycle pattern in within age-cohort inequality has become more equal by 1995 through age 30-34, but thereafter it has become slightly less equal from age 35-39 to age 50-54. The mean log income also increases steadily until age 35-39 in both years, and then declines slowly, until around retirement. Because the mean income profile is relatively flat across ages, increasing by only about 40 percent from age 20-24 to age 35-39 and back to retirement, the between age group component contributes a relatively small share to the overall log variance (col. 5), and most of that is due to the two highest-wage groups in their thirties. The within age group variance component (col. 4) becomes more substantial for the middle aged and elderly. As the age composition of the population in Taiwan has shifted toward the older ages, the log variance of income may have thus tended to increase.

To quantify this effect of the changing age composition of households related to the demographic transition, assume that the within and between age-cohort inequality components from 1995 were weighted by the 1976 age distribution of households. Then the resulting 1976 counterfactual log variance would have been .2537 compared with the actual .2634. Alternatively, if the cohort inequality components from 1976 are weighted by the 1995 age distribution, the resulting counterfactual log variance for 1995 would have been .2566 compared with the actual .2488. Thus, of the actual increase of 5.9 percent in the log variance in adult incomes across all ages from 1976 to 1995 from .2488 to .2634, 2.0 percentage points of the increase in overall log variance would have occurred, due to the change in age distribution, holding constant the within and between cohort components of inequality at their initial levels, or conversely, 2.7 percentage points of the increase could be attributed to the age composition change evaluated at the final levels. One-third to one-half of the increase in log variance of income per adult across households in Taiwan in this period was thus due to the changing age composition associated primarily with the demographic transition. The increases in inequality due to the age groups 35 to 44 and 60+ substantially outweigh the inequality decreases in the intermediate ages. Because Taiwan absorbed an unusually large immigration of adults in the 1940s and 1950s, the nearly doubling of the proportion of households over age 60 from 1976 to 1993 is larger than might be expected in a more typical, closed population that is experiencing a rapid demographic transition.

These data for Taiwan show that changes in inequality in the distribution of household income per adult impact similarly the Gini and log variance. One reason for this parallelism is that the lognormal distribution is a good approximation for the household distribution of income per adult (Cf. figures 2 and 3). The correspondence is close between the actual and fitted frequency distribution of households by income per adult, and tests of normality based on joint consideration of skew and kurtosis cannot reject the hypothesis that log income is normally distributed at the 10% level in either year (D'Agostino, Balanger and D'Agostino, Jr., 1990).

6. Changing Time Allocations of Women and Household Full Income

The share of women age 15-65 who are in the labor force in Taiwan increased from 37.6 percent in 1976 to 44.9 percent in 1993 (Directorate General, 1994, Table 27) and the share of women working as full-time employees doubled from 1976 to 1995 (cf. later Tables 6 and 7). This increased participation of women in the labor force may have been associated with the decline in fertility and a reduction in the time mothers allocate to child care. Could the disposable income of families, after providing for market child care substitutes for the working mother's time, be less equally distributed in 1995 than in 1976? Because my statistics on market income attach no value to the leisure activities of adults or the productivity of their time outside of the labor force, the increased participation of women in the labor force might contribute to a more equal distribution of market income while adding to the inequality in nonmarket time.

To quantify the impact of women's increased labor force participation on the distribution of household welfare, I estimate in this section the shadow value of the household's resources, before the members of these households make their decisions on market labor supply. My objective is to approximate the household's "full income" endowment (Becker, 1965). To implement this approach I must infer the shadow wage for all men and women, and then attribute the value of their time to all adults in the sample, regardless of their actual work decisions, and then add nonearned income to these full-time shadow wages to infer what the "full income" of the household might have been if all adults had worked in the labor force full time. For those who are primarily a recipient of entrepreneurial income that exceeds their estimated shadow full-time wage (only a few percent), they are assumed to retain their larger entrepreneurial income and do not receive their estimated shadow wage, because a part of entrepreneurial income may be a return on capital and risktaking. For individuals over age 64, actual earnings are retained and no imputations of full-time earnings is attempted, because a significant share of these individuals may not be capable of working full time, due to exogenous health limitations. Despite the weakness of such an exercise that simulates a counterfactual outcome, it may provide some insights into how the changing allocation of women's time affects the distribution of market income and ultimately the distribution of economic welfare.

First, the logarithm of earnings is estimated for all full-time wage earners (those who receive their largest source of labor income from full-time employee compensation) between the ages of 15 and 64 (Table A-3, Cols. 1 and 2). This sample is used because time allocated to work is not explicitly reported to calculate a wage rate, and the full-time employees are the majority of the labor force. The logarithm of earnings is estimated conditional on years of education, years of postschooling potential experience, and experience squared, separately for men and women.[9] Because these Mincer (1974) earnings functions explain only about a third of the variance in log wages, the predicted earnings has a log variance that is only a third the size of the full-time earnings in the estimation sample. A random error is therefore added to each individual's predicted wage that is drawn from a normally distributed random variate with zero mean and variance equal to the actual sample log variance of earnings multiplied by one minus the R^2 in the estimated earnings equation. According to this procedure, the variance in the simulated log wage is approximately equal to the variance of the actual earnings in the estimation sample. This method is then implemented to simulate full-time earnings for all prime-aged adults in the sample, except for entrepreneurs and the elderly as noted. After summing the full-time earnings of all adults age 15-64 in the household, each household is allocated the actual household property, transfer, and other income receipts and elderly earnings, to obtain the simulated household's full-income.

A positive correlation between the earnings potential of husbands and wives increases the inequality in full income across households, and might not be fully reflected in my initial simulation of full incomes (Kremer, 1997). Marital partners may be matched both on observable variables (e.g., education and experience) that already enters into my wage predictions, and also matched on unobservable traits that could influence their shadow wage. Consequently, in a second set of estimates of full income the earnings estimation sample is restricted to married couples who are both full time wage earners (Table A-3, Cols. 3 and 4).[10] It is possible then to calculate for this sample the correlation between the log full-time earnings between spouses, which is .59 in 1976 and .56 in 1995. Education alone is correlated across all spouses even more strongly, at .66 in 1976 and has increased to .75 by 1995.[11] My predicted wages based on observables are correlated across spouses at .74 in 1976 and .75 in 1995. Finally, as expected, the residuals in the two spouses' earnings equations (i.e., unobservable factors) are also significantly correlated across couples at .27 in 1976 and .25 in 1995. The shadow wage estimates based on these full-time earner couples are therefore attributed two random errors: the first is a couple-specific (shared) error that corresponds to the unobservable productive traits reflected in the cross-spouse residual correlation, and the second is a random error that is assumed independent across all individuals. It is then necessary to scale down the size of the second iid wage error attributed to each matched spouse who has already been imputed a couple-specific error.

To incorporate in this setup the couple-specific covariance in unobservables, two assumptions are being maintained. The sample of couples who are both full-time wage earners is a representative sample of the universe of all adult couples in terms of their shadow wages, in order to avoid a sample selection bias in estimating for all person's a shadow earnings. The wage structure estimates are in fact similar for all full-time earners and matched couple full-time earners, as reported in Appendix Table A-3. The covariance of couple earnings for the joint full-time earning couples is also assumed to be an unbiased estimate of this couple-specific wage heterogeneity for all matched working and nonworking couples.

To assess the robustness of results to these potentially restrictive assumptions, I report both estimates of full income in Tables 4 and 5 are based on two sets of working assumptions: estimates based on the earnings function for all full-time <u>individual</u> men and women workers by sex and ignores the differences between married and unmarried individuals in their shadow wages; estimates based on the earnings functions for <u>married couples</u> who are both full-time earners and includes the covariance in unobservables for the wages simulated for all matched couples.

The simulated-<u>individual</u> Gini coefficients for full incomes of households are

Table 4

Income Inequality Across Households by Age of Head, According to Actual Income Receipts and Two Simulations of Full Income: 1976

	Age Group										
Index of Inequality and Concept of Household Income	All Persons over Age 14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
1. Number/Proportions											
Households	9,441	.006	.030	.106	.133	.162	.154	.163	.110	.071	.066
Adults	30,557	.006	.033	.095	.104	.130	.162	.188	.131	.083	.068
Persons	49,501	.005	.026	.089	.130	.176	.171	.171	.109	.067	.055
2. Gini Ratio/Household											
Actual Income	.289	.222	.256	.271	.276	.261	.259	.267	.304	.338	.421
Simulated/Individual	.300	.286	.311	.313	.287	.263	.251	.267	.289	.315	.394
Simulated/Couple	.322	.286	.313	.320	.310	.283	.279	.298	.321	.319	.400
3. Gini Ratio/Adult											
Actual Income	.287	.216	.247	.274	.285	.286	.274	.261	.262	.287	.338
Simulated/Individual	.224	.211	.193	.215	.226	.243	.210	.214	.209	.225	.259
Simulated/Couple	.213	.209	.187	.212	.239	.237	.204	.196	.188	.204	.244
4. Gini Ratio/Person											
Actual Income	.295	.203	.262	.296	.309	.282	.268	.270	.282	.324	.374
Simulated/Individual	.283	.259	.254	.283	.295	.271	.247	.258	.265	.274	.314
Simulated/Couple	.297	.224	.256	.291	.314	.280	.270	.272	.266	.271	.303

Table 4 cont.

Index of Inequality and Concept of Household Income	Age Group										
	All Persons over Age 14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
5. Log Variance/Household											
Actual Income	.277	.182	.209	.229	.223	.211	.221	.236	.328	.416	.582
Simulated/Individual	.336	.277	.337	.314	.251	.232	.219	.256	.349	.439	.806
Simulated/Couple	.382	.323	.345	.326	.296	.262	.283	.324	.442	.459	.816
6. Log Variance/Adult											
Actual Income	.249	.157	.186	.224	.253	.261	.229	.207	.212	.241	.301
Simulated/Individual	.161	.147	.116	.146	.160	.189	.133	.138	.141	.158	.276
Simulated/Couple	.151	.161	.112	.146	.180	.177	.131	.122	.122	.134	.263
7. Log Variance/Person											
Actual Income	.259	.122	.208	.270	.279	.243	.221	.221	.246	.307	.365
Simulated/Individual	.266	.221	.215	.270	.277	.238	.204	.216	.236	.232	.343
Simulated/Couple	.305	.162	.232	.288	.318	.259	.253	.256	.257	.250	.330

Table 5

Income Inequality Across Households by Age of Head, According to Actual Income Receipts and Two Simulations of Full Income: 1995

	Age Group										
Index of Inequality and Concept of Household Income	All Persons over Age 14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
1. Number/Proportions											
Households	14,706	.003	.025	.072	.136	.179	.170	.118	.077	.066	.153
Adults	43,409	.003	.030	.077	.128	.153	.177	.149	.096	.073	.113
Persons	57,699	.003	.025	.071	.147	.200	.192	.129	.079	.060	.093
2. Gini Ratio/Household											
Actual Income	.313	.231	.256	.235	.258	.262	.271	.277	.306	.352	.438
Simulated/Individual	.288	.224	.266	.269	.258	.228	.223	.229	.250	.298	.440
Simulated/Couple	.294	.221	.267	.262	.260	.240	.232	.234	.260	.306	.441
3. Gini Ratio/Adult											
Actual Income	.297	.229	.221	.222	.264	.296	.322	.294	.268	.272	.316
Simulated/Individual	.220	.154	.165	.167	.194	.217	.225	.209	.194	.203	.303
Simulated/Couple	.221	.168	.156	.174	.200	.228	.226	.204	.192	.201	.294
4. Gini Ratio/Person											
Actual Income	.289	.246	.233	.240	.278	.290	.289	.285	.280	.291	.319
Simulated/Individual	.245	.202	.193	.225	.240	.235	.227	.215	.212	.227	.306
Simulated/Couple	.248	.207	.183	.223	.248	.249	.231	.212	.214	.226	.295

Table 5 cont.

Index of Inequality and Concept of Household Income	Age Group										
	All Persons over Age 14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
5. Log Variance/Household											
Actual Income	.384	.187	.233	.184	.218	.223	.243	.270	.358	.509	.582
Simulated/Individual	.386	.243	.286	.261	.221	.173	.185	.219	.257	.363	.760
Simulated/Couple	.396	.201	.278	.252	.224	.193	.203	.239	.284	.396	.737
6. Log Variance/Adult											
Actual Income	.263	.171	.149	.152	.215	.270	.300	.246	.218	.232	.295
Simulated/Individual	.168	.079	.083	.094	.124	.147	.151	.129	.115	.128	.384
Simulated/Couple	.168	.093	.078	.099	.131	.162	.152	.126	.112	.129	.359
7. Log Variance/Person											
Actual Income	.249	.193	.166	.177	.236	.251	.244	.240	.239	.260	.298
Simulated/Individual	.198	.127	.123	.174	.180	.174	.166	.147	.143	.159	.363
Simulated/Couple	.206	.148	.112	.170	.195	.196	.174	.147	.148	.162	.338

somewhat larger in 1976 than the actual income Gini coefficients, .300 versus .289, but become more equal by 1995 than the actual incomes of households, .288 versus .313. The same is true for the log variances of households, for which the full income inequality across households grew more unequal from 1976 to 1995. Using the preferred household income per adult as the welfare indicator, the full or actual income Gini inequality is essentially unchanged starting in 1976 at .224 for full income versus .287 for the actual income, and reaching by 1995 .220 for full income versus .297 for the actual income. The log variance of income per adult is in 1976 much lower for full income than for actual income, .161 versus .249, and both have increased slightly by 1995, to .168 and .263, respectively. Families with higher income per adult tend to have more full-time market workers, suggesting that lower income groups have relatively more time for nonmarket activities, such as childrearing and leisure. On a per capita basis the full income individual Gini ratio is slightly less than the Gini of actual income, .283 and .295, whereas in terms of the log variance of per capita income, the full income is slightly more unequal than the actual in 1976. But the secular trend downward is stronger for the log variance in per capita full income than for the actual income receipts (.266 to .198 for full income and .259 to .249 for actual income).

Full income inequality levels increase slightly in 1976 for household income and per capita income when the working couples are used to estimate the imputing wage equation for household or per capita income comparisons rather than when all full time wage earners are used. However, with the covariance in heterogeneity added for all matched couples, the log variance (and Gini) per adult income declines, and is now 40 percent smaller than for the actual income, .151 versus .249 in 1976, and .168 versus .263 in 1995. The Gini changes less.

It would appear that nonmarket time is available in greater supply for lower-income households than for higher-income households. This empirical regularity is consistent with a tendency for the market labor supply of individuals and households to be an increasing function of their shadow wage. In other words, the own-wage effects on labor supply (not compensated for income) tend to be positive in Taiwan during this period. Inequality in full income or economic opportunities per adult, my preferred measure of inequality, including the matching of spouses on unobservables, indicates that the Gini has increased slightly from .213 to .221 in the twenty year period 1976 to 1995, and the log variance of incomes per adult has increased from .151 to .168. Although these time trends are probably not significant in a statistical sense, the levels of inequality are distinctly lower for full income per adult by 1995 than for actual income, and based on the log variance the inequality in full income per adult is already lower than actual income in 1976, the initial year.

The comparison of inequality estimates based on full-income and actual income suggest that individuals with higher wage earning opportunities are more likely to work in the market labor force and work more hours in this capacity. This tendency has become more pronounced over this twenty year period. The Personal Income Surveys in Taiwan do not ask questions about the numbers of hours worked, but do distinguish between working as a full-time employee, part-time employee, entrepreneur, or unpaid family worker. Linear probability functions are estimated to determine into which of these four categories an individual falls (or which job source of earnings is largest), with the residual fifth category being individuals who had no reported labor market attachment, conditional on their predicted individual based full-time log earnings, as used above to impute the first measure of full income.[12] Tables 6 and 7 report these employment type regression coefficients on this log earnings variable, and the mean participation rates in 1976 and 1995 for the four job-type categories, as well as the earning coefficient from regressions for the sum of all four work activities, called "All Working". I disaggregate the samples between single and married men and women age 15 to 64, given the empirical tendency for labor supply responses to be larger for married women than for the three other demographic groups.

In 1976 men are much more likely to be full-time employees if their market wage opportunities are greater, although even for men the All Working effect is a sum of a negative effect on working as an entrepreneur (mostly small-scale, low-paid businesses) or unpaid family worker, and a much larger positive effect on full-time and even part-time employee categories. For single women a similar pattern emerges, but for married women the net effects of improved market wage opportunities is to reduce family and entrepreneurial employment (self employed family businesses) more than it is to increase work as an employee. But by 1995, married women are responding on balance to an increase in their market wage opportunities by working much more as a full-time employee. It may be noted that while only one in six married women age 15-64 were full-time employees in 1976, the fraction had doubled to one in three by 1995, while married women working in family unpaid jobs had proportionately declined. In 1976 an increase in women's opportunity wages, due perhaps to their increased education, would have had no effect on total participation (all working) of women in the labor force, increasing participation among single women and decreasing it among married women. Two decades later, both marital groups are entering into employment outside of the family in response to improvements in their wage opportunities, as

Table 6

Labor Force Participation Response to Own Wages of Women and Men by Type of Employment and by Marital Status: 1976

	All Persons		Single		Married	
	Wage Coefficient[a]	Mean Participation Rate	Wage Coefficient[a]	Mean Participation Rate	Wage Coefficient[a]	Mean Participation Rate
Women Age 15-64						
Full-Time Employees	.239	.259	.285	.409	.183	.167
	(19.2)		(12.0)		(13.5)	
Part-Time Employees	.0031	.002	.0006	.003	.0039	.002
	(2.18)		(.20)		(2.44)	
Entrepreneurs	-.0268	.049	-.0295	.032	-.0269	.059
	(4.16)		(3.18)		(3.11)	
Unpaid Family Workers	-.222	.159	-.204	.146	-.242	.167
	(20.4)		(11.0)		(18.1)	
All Working	-.0068	.469	.0519	.591	-.0822	.395
	(.46)		(2.17)		(4.60)	
Men Age 15-64						
Full-Time Employees	.407	.608	.167	.555	.461	.638
	(24.6)		(4.59)		(24.9)	
Part-Time Employees	.0449	.017	.0455	.013	.0453	.019
	(9.94)		(5.22)		(8.34)	
Entrepreneurs	-.388	.245	-.100	.093	-.498	.332
	(27.0)		(4.65)		(27.5)	
Unpaid Family Workers	-.0288	.053	-.0963	.144	-.0037	001
	(3.77)		(3.61)		(2.91)	
All Working	.0351	.922	.0163	.806	.0043	.989
	(3.95)		(.57)		(1.04)	

[a] Wage coefficient from predicted log wage of full-time employees in linear probability function for primary participation in employment type. Elasticity of participation with respect to wages is obtained by dividing wage coefficient by mean participation rate. Also included in the specification is a quadratic in age and an intercept.

Table 7

Labor Force Participation Response to Own Wages of Women and Men by Type of Employment and by Marital Status: 1995

	All Persons		Single		Married	
	Wage Coeffi-cient[a]	Mean Partici-pation Rate	Wage Coeffi-cient[a]	Mean Partici-pation Rate	Wage Coeffi-cient[a]	Mean Partici-pation Rate
Women Age 15-64						
Full-Time Employees	.302	.411	.213	.558	.318	.345
	(26.2)		(11.1)		(23.3)	
Part-Time Employees	.0139	.009	.0331	.014	.0058	.006
	(6.03)		(5.65)		(2.54)	
Entrepreneurs	-.0503	.064	-.0545	.059	-.0502	.066
	(8.23)		(5.09)		(6.75)	
Unpaid Family Workers	-0.15	.100	-.0267	.040	-.129	.126
	(14.1)		(2.94)		(13.1)	
All Working	.161	.583	.162	.672	.144	.543
	(13.4)		(8.74)		(9.80)	
Men Age 15-64						
Full-Time Employees	.278	.633	.266	.696	.281	.609
	(19.9)		(7.00)		(18.5)	
Part-Time Employees	.0366	.021	.0526	.017	.0358	.022
	(8.43)		(4.80)		(7.41)	
Entrepreneurs	-.213	.234	-.0648	.095	-.248	.288
	(17.0)		(2.65)		(16.9)	
Unpaid Family Workers	-.0098	.022	-.0242	.048	-.0068	.013
	(2.16)		(1.32)		(1.83)	
All Working	.0916	.911	.230	.856	.0615	.932
	(11.1)		(7.82)		(7.96)	

[a] Wage coefficient from predicted log wage of full-time employees in linear probability function for primary participation in employment type. Elasticity of participation with respect to wages is obtained by dividing wage coefficient by mean participation rate.

observed in most labor supply studies in high-income countries. These regularities in uncompensated wage effects on labor supply are consistent with the evidence presented earlier that household inequality in income per adult is more equal when value is assigned to the time not spent in the labor force. Full income inequality is distinctly more equal than market income inequality in Taiwan by 1995.

7. Summary and Conclusions

There are several findings from this study of personal income distribution in Taiwan that might warrant more study. First, measured change in the distribution of income across households from 1964 to 1995 are sensitive to how adjustments are made in income for the changing composition of households. If no adjustment is made or households are all treated as the same in terms of how their welfare depends on their income, inequality decreased slightly from 1964 to 1975 and increased from 1980 to 1993. This is the general time series pattern reported in the literature on Taiwan's income distribution. But as illustrated in Figures 5 and 6, when household income is divided by household size, inequality changes across households substantially, and the marked time trends in inequality of household incomes in both periods are eliminated. If economic inequality is arguably better approximated by household income <u>per capita</u>, many stylized facts regarding aggregate changes in personal income inequality in Taiwan and in other developing countries may have to be reappraised.

In standardizing household income for household composition it is useful to consider three types of decisions that affect the size and composition of households, all of which could respond to household income, as well as relative prices, cultural factors, and heterogeneous preferences. Consequently, the composition of household is endogenous to the process determining the distribution of income, and both must be explained jointly in future work. First, there is the fertility decision which is reflected most clearly by the presence in the household of dependent children, defined simply as persons under age 15. Second, there is a decision to support elderly within the household, who may be dependent on their adult children for consumption of market goods and for the provision of physical care. Third, there is the propensity for adults to live together to realize economies of production and consumption as well as sharing of public goods, such as children. All three of these processes are complex and examined here in only cursory fashion. But all three would appear to adapt to income levels, and thus not be exogenous across households with regard to the distribution of income. The challenge raised by this paper is how might the social statistician adjust family income for family composition to better approximate the welfare opportunities of its members. Only when this challenge has been met squarely, can confidence be attached to empirical regularities that suggest the household distribution of economic resources in a society has become more or less unequal.

One simple step is to separate the fertility decision from the household income distribution, and one can then proceed to analyze household income <u>per adult</u>. This market income per adult may contribute to couples getting married or not, how many children they have, how much they invest in each of their children that could be closely related to their fertility choice. Household income per adult is thus an improved indicator of income opportunities of adult decision makers in a population. It is shown that both in 1976 and 1993 the estimated relationship between household income per adult and fertility is positive, and the elasticity has not changed much in this two decades, although the level of fertility has fallen sharply.

However, the total of economic resources available to adults, or the decisionmakers in the household, is not necessarily identical to the household's market income. Time of adults not spent in market labor force activity may increase the economic welfare of household members. This time is not only consumed as leisure, but also may be employed in home production of goods and services, including children. In this time period in Taiwan, fertility is declining and the labor force participation of women is increasing, particularly outside of agriculture and outside of the home or self employment in the home. This reallocation of women's time from the home to the market wage work might mask basic shifts in social inequality.

To explore this possibility, an empirical approximation for full income is proposed. I have attempted to impute to all adults 15 to 65 the market earnings they could earn if they were full-time wage earners. An exception was made for entrepreneurs if they earned more than this imputed full-time earnings, in which case the entrepreneur's actual income receipts are attributed to the household. Also a special allocation rule was adopted for the elderly, over age 64, for whom their actual earnings are attributed to the household rather than the imputed fulltime earnings, because exogenous variation in health status may widely affect the allocation of time by the elderly to market work. Following this strategy for allocating earned income to households, actual nonearned income and transfers are then attributed to the households.

Inequality in full income per capita is decreasing in Taiwan across households from

1976 to 1995, whether based on the Gini or log variance and whether the imputation of earnings is based on individuals or also couples. The Gini in full income per adult has also decreased marginally in this time period, based on the individual imputed earnings. Inequality in full income tends to be smaller than inequality in market income, especially by the end of the period. This suggests that persons with higher wage opportunities are increasingly likely to be working more of their time in the labor market. Thus, inequality in market income is more unequal than inequality in full economic opportunities across households, or stated differently, the poor have more nonmarket time than the rich. This pattern is also evident if household income is standardized by all persons, including children, or not standardized at all. The earlier noted positive correlation between market per capita income and fertility is not greatly affected when actual income is replaced by the imputed values of full household income per adult.

Another component of family composition is the extension of the family to share housing with additional generations, or specifically, to have mature children coreside with their elderly parents. The frequency of such extended family arrangements is diminishing in Taiwan as in many other advanced economies, and simple regression analysis indicates that the elderly are less likely to live with their children, if the children and elderly parents have more income per adult. Thus, if these cross sectional patterns indicate how coresidential behavior changes over time, the large increase in income levels per adult in Taiwan (Figure 1) should have contributed to the increasing propensity of the elderly to live in separate households. The increased life expectancy of the elderly in Taiwan probably also signals that the elderly are healthier than they were in the past, and thus less limited by health in their capacity to attend to their daily care and consumption needs.

The demographic transition in Taiwan has changed the age composition of the population, increasing the share of the population in the older age groups. The increase in income has contributed to the increased likelihood that the elderly are heads of their own households, rather than living with their children. Both the demographic aging and the economic growth of Taiwan has increased the share of households headed by elderly in the surveys examined here. Many studies suggest that income inequality tends to increase at older ages in a cross sectional survey, and when repeated cross sections are compared, it is common to find that inequality also increases within cohorts as they become older. But in Taiwan, this is evident only among cohorts between the ages of 35 and 54, and the margin of increase in inequality with aging is modest (Table 3). Nonetheless, the increasingly older age distribution of heads of households has contributed in Taiwan to a slight increase in measured aggregate household income inequality. This effect of the changing age composition does not imply that later born cohorts as they live out their lives will encounter a greater level of inequality, but only that economic resources of the old are more unequally distributed than those of the young, and the old are becoming an increasing share of the heads of households in Taiwan as they are elsewhere. This change in the age composition of household heads in Taiwan can account for a third to a half of the small increase in aggregate log variance of household market income per adult from 1976 to 1995. It is a relatively small effect compared to that contributed by changes in size and composition of households.

Notes

1. Only a few countries outside of Europe, North America, Oceania and Japan started their demographic transition earlier than Taiwan. Exceptions are Argentina and Uruguay, with their large European settlements, that experienced a decreasing level of fertility before the rest of Latin America.

2. Kuznets (1962) had earlier noted a similar pattern in the United States where household income inequality increased from 1945 to 1955, and explained it in terms of an "undoubling" of multigenerational households after World War II when the stock of housing began to catch up with consumer demands that had been rationed by wartime mobilization efforts. In this decade of increasing incomes there was a large decline in large households (multigenerational) but little change in household per capita income inequality. The same pattern is noted in Taiwan in the period from 1980 to 1995.

3. In this shorter period of observation, consumption may be preferable to income as a measure of welfare, if households have the capacity to smooth their consumption according to their lifetime budget constraint. The sum of household expenditures on consumption, including imputed values for home produced consumer goods, may thus measure more accurately welfare inequalities than current income receipts.

4. One approximation for average individual welfare divides household income by the square root of the household size, i.e., twice the income is needed to maintain a four-person household at the same welfare level of consumption as the income for a one-person household (Gustafsson, 1995).

5. After 1982 one can compare empirical results that are based on all coresident couples, and this restriction did not seem important in the patterns discussed in this paper. It is also possible to impute matches of spouses according to age, in those infrequent cases where a married male nonhead of household might be matched with alternative "prospective wives" in the household.

6. From 1976 to 1993 the proportion of elderly men and women (over the age of 64) living with their children (or children-in-law) decreased within various age groups in Taiwan, while the proportion living on their own and remaining heads of households increased, as tabulated in Appendix Table A-2. For example, the proportion of men age 65 to 74 living in a household with their children was 30 percent in 1976 and that proportion had declined more than one-fifth to 23 percent by 1993, while the proportion living on their own as head of household increased from 35 percent to 52 percent. This change in living arrangement could potentially be attributed to improved health among the elderly that allowed more of them to take care of themselves. The economic growth in incomes among the elderly and their children also allowed them to express their preference for the more costly practice of retaining separate living units. Relative prices may also have had a hand in this change.

7. See also endnote 6.

8. This is merely the standard decomposition of a variance into between group and within group components, as developed by R. A. Fisher (1930), which separates the variance ascribable to one group of causes from the variance ascribable to other groups.

9. Other employee income reported in the survey (not full-time employee or part-time employee compensation) is allocated to full-time and part-time earnings in proportion to their reported direct compensation. This treatment of other employee income is based on the assumption that these income flows are related to bonuses and fringe benefits and although they may be a larger fraction of full-time compensation than part-time compensation, a proportional distribution seemed reasonable.

10. Because in the early years of the survey the household members are not unambiguously linked to their spouse except when they are the head of the household or the head's spouse, these earnings equations for couples who are both full-time earners are also restricted to the heads. This preserves the same criteria for selection from 1976 to 1995. Adding in 1995 the sample of couples who were both full time wage earners but are not heads would increase this sample by 6.5 percent. Estimates were made for the larger sample of couples in later years when they can be matched with no substantial noted differences in estimated earnings equations or covariances between spouses or resulting full income estimates.

11. These correlations of spouse education are higher than noted in many other populations. See for example for the United States (Mare, 1981, 1991) and other countries (Shavit and Blossfeld, 1993).

12. Because the dependent variable is binary, these OLS estimates are not as informative as logit or probit estimates, and caution should be used in interpreting the reported t ratios in parentheses beneath the regression coefficients. The standard errors from OLS in this case are biased. On the other hand, retaining the linear specification provides a simpler interpretation of the magnitudes of the coefficients on the log wage variable across the various types of employment.

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Table A-1

Regression of Family Components on Income per Adult, 1976 and 1993[a]

Explanatory Variables	Number of Adults		Ratio of Children to Prime Adults		Ratio of Elderly to Prime Adults	
	1976	1993	1976	1993	1976	1993
Intercept	17.7	19.0	-3.75	-3.53	.715	1.48
	(49.9)[b]	(72.4)	(20.2)	(27.5)	(16.3)	(23.2)
Log Income per Adult	-1.38	-1.27	.449	.333	-.0629	-.109
	(41.2)	(61.0)	(25.6)	(32.6)	(15.2)	(21.5)
	[-.444][c]	[-.422]	[.447]	[.510]	[-1.26]	[-1.02]
R^2	.2193	.2672	.0977	.0945	.0367	.0434
Dependent Variable:						
Mean	3.11	3.01	1.00	.653	.050	.107
(Standard Deviation)	(1.49)	(1.35)	(.727)	(.594)	(.166)	(.288)
Log Income per Adult						
Mean	10.6	12.6				
(Standard Deviation)	(.506)	(.548)				
Sample Size	6053	16210				

Notes:

[a] sample includes all households or individuals residing separately for whom the household's head was age 30 to 50.

[b] absolute value of t ratio reported in parentheses beneath regression coefficient.

[c] elasticity of compositional variable with respect to income per adult, evaluated at sample mean.

Table A-2

Distribution of Elderly by Age, Sex and Living Arrangements

	50-64		65-74		75+	
1976	Male	Female	Male	Female	Male	Female
Heads or Spouses of Heads	2051	1069	171	97	36	14
Both Living Together	1774	998	142	79	29	7
Only One Living	277	71	29	18	7	7
Living in Household When Child is Head or Spouse of Head	403	706	263	434	92	194
Both Living Together	332	366	179	124	49	16
Only One Living	71	394	84	310	43	178
Living in a Household Where Child is not the Head or Spouse of Head Uncertain of Who Make up a Pair	27	43	14	43	16	52
Total	2935	3647	882	1105	272	468
1993						
Heads or Spouses of Heads	3176	2399	1095	550	272	141
Both Living Together	2893	2171	843	419	166	63
Only One Living	283	228	252	131	106	78
Living in Household When Child is Head or Spouse of Head	1130	1759	941	962	352	461
Both Living Together	1019	1242	770	480	212	78
Only One Living	111	517	171	481	139	383
Living in a Household Where Child is not the Head or Spouse of Head Uncertain of Who Make up a Pair	45	67	56	73	76	156
Total	8659	8383	4128	3096	1323	1360

Table A-3

Earnings Function Estimates for Full-Time Employees and Couples Who Both Are Full-Time Employees

Year Explanatory Variable	All Full-Time Employees		Full-Time Employees who are Couples and Heads of Household	
	Male (1)	Female (2)	Male (3)	Female (4)
1. 1976				
Education Years	.0671	.0891	.0626	.0930
	(46.7)	(38.8)	(21.1)	(23.6)
Post Schooling Experience	.0567	.0237	.0154	.0066
	(40.5)	(11.4)	(3.16)	(1.12)
Experience^2(x10^{-2})	-.0901	-.0303	-.0351	.0055
	(30.6)	(6.15)	(3.58)	(.44)
Constant	9.74	9.44	10.33	9.55
	(459.)	(326.)	(141.)	(116.)
R^2	.323	.329	.390	.419
(n)	(7789)	(3360)	(1108)	(1108)
2. 1980				
Education Years	.0697	.0890	.0710	.1002
	(62.1)	(49.5)	(32.2)	(35.0)
Post Schooling Experience	.0600	.0287	.0180	.0156
	(59.1)	(19.1)	(5.93)	(4.07)
Experience^2(x10^{-2})	-.0983	-.0460	-.0317	-.0095
	(47.7)	(13.2)	(5.44)	(1.22)
Constant	10.41	10.10	10.89	10.09
	(627.)	(432.)	(219.)	(172.)
R^2	.346	.336	.393	.445
(n)	(12792)	(6144)	(2242)	(2242)
3. 1995				
Education Years	.0756	.0982	.0703	.1056
	(67.1)	(60.5)	(37.8)	(43.7)
Post Schooling Experience	.0577	.0313	.0307	.0205
	(63.5)	(29.3)	(13.1)	(7.53)
Experience^2(x10^{-2})	-.0912	-.0349	-.0516	-.0089
	(50.5)	(14.8)	(11.8)	(1.58)
Constant	11.51	11.10	11.95	11.13
	(668.)	(472.)	(290.)	(239.)
R^2	.407	.375	.382	.402
(n)	(12194)	(7725)	(3410)	(3410)