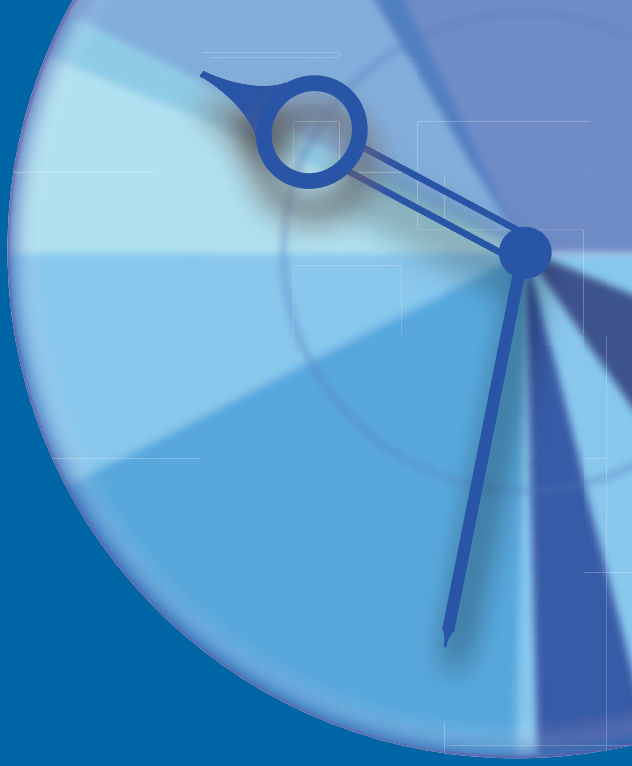

THE MEASUREMENT OF TIME AND INCOME POVERTY IN KOREA

The Levy Institute Measure of Time and Income Poverty

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Final Report

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Preface

This report presents findings from the research project "Public Employment Policies for the Poor" conducted by the Levy Economics Institute in collaboration with the Korea Employment Information Service. At the Levy Institute, the research was conducted jointly by scholars in the *Distribution of Income and Wealth* and *Gender Equality and the Economy* programs. The central objective of the project is to develop a measure of time and income poverty for the Republic of Korea that takes into account household production (unpaid work) requirements. Based on this new measure, estimates of poverty are presented and compared with those calculated according to the official income poverty lines.

Policies that are in place in Korea to promote gender equality and economic well-being need to be reconsidered. The reconsideration should be based on a deeper understanding of the linkages between the functioning of labor markets, unpaid household production activities, and existing arrangements of social provisioning—including social care provisioning. Our hope is that the research reported here and the questions it raises will contribute to this goal.

We wish to express our gratitude to the Korea Employment Information Service for its financial and intellectual support without which this undertaking would not have been possible. The results reported here represent our first step in contributing to the understanding of gender inequality and constraints faced by low-income households in Korea. We plan to conduct additional research on Korea alone, as well as in developing comparisons between Korea and other countries as a part of our work on the Levy Institute Measure of Time and Income Poverty.

Executive Summary

Official poverty lines in Korea and other countries ignore the fact that unpaid household production activities that contribute to the fulfillment of material needs and wants are essential for the household to reproduce itself as a unit. This omission has consequences. Taking household production for granted when we measure poverty yields an unacceptably incomplete picture, and, therefore the estimates based on this omission provide inadequate guidance to policymakers.

Standard measurements of poverty assume that all households and individuals have enough *time* to adequately attend to the needs of household members, including, for example, caring for children—tasks absolutely necessary for attaining a minimum standard of living. But this assumption is false. For numerous reasons, some households may not have sufficient time, and they thus experience "time deficits." If a household officially classified as nonpoor has such a time deficit and cannot afford to cover it by buying market substitutes (e.g., hiring a care provider), that household will encounter hardships not reflected in the official poverty measure. To get a more accurate calculus of poverty, we have developed the Levy Institute Measure of Time and Income Poverty (LIMTIP), a two-dimensional measure that takes into account *both* the necessary income and household production time needed to achieve a minimum living standard.

Our estimates for 2008 show that the LIMTIP poverty rate of employed households (i.e., households in which either the head or spouse is employed) was about *three times higher* than the official poverty rate (7.5 versus 2.6 percent). The gap between the official and LIMTIP poverty rates was notably higher for "nonemployed male head with employed spouse," "single female-headed" and "dual-earner" households. Our estimates of the size of the hidden poor suggest that ignoring time deficits in household production resulted in a serious undercount of the working poor. The LIMTIP estimates also expose the fact that the income shortfall of the poor is greater than implied by the official statistics (₩434,000 compared to ₩246,000 or 1.8 times greater). Just as with the incidence of poverty, the income shortfall was also greater among dual-earner and single-headed households. These findings suggest that serious consideration should be given in the design of income support programs to ensure that they (1) broaden their coverage to include the hidden poor, and (2) increase the level of support to offset the income

shortfall emanating from time deficits. There was a stark gender disparity in the incidence of time poverty among the employed, even after controlling for the hours of employment. Time poverty is minuscule among part-time (defined as working less than 35 hours per week) male workers while it is sizeable among part-time female workers (2 versus 18 percent). Among full-time workers, the time poverty rate of women is nearly twice that of men (36 versus 70 percent). This suggests that the source of the gender difference in time poverty does not lie mainly in the difference in the hours of employment; it lies in the greater share of the household production activities that women undertake.

The widespread use of childcare services in Korea allows us to assess the impact of the use of these services on time and income poverty. When we account for the use of childcare services in our estimates, we see that the income poverty rate of employed households that outsource childcare falls from 5.9 percent to 3.1 percent, and that time poverty rates also fall, although more so for income-nonpoor households than for income-poor households. We also find that time poverty rates for employed individuals with young children that outsource childcare falls drastically (from 54 percent to 29 percent). Employed men and women in such households benefit as the incidence of time poverty fell from 43 to 26 percent and from 78 percent to 37 percent, respectively, for men and women.

Rates of time poverty are also markedly different across the (LIMTIP) income poverty line. Time poverty among income-poor households is much higher than among income-nonpoor (80 versus 55 percent). Similar patterns can also be observed for employed men (71 versus 50 percent) and employed women (85 versus 74 percent). Since other types of social and economic disadvantages tend to accompany income poverty, it is quite likely that the negative effects of time poverty will affect the income-poor disproportionately compared to the income-nonpoor.

We also examined the effectiveness of job creation for poverty reduction via a microsimulation model. The simulated scenario assigns each nonemployed but employable adult a job that best fits (in a statistical sense) their characteristics (such as age and educational attainment). Under the prevailing patterns of pay and hours of employment, we found that a substantial number of individuals would escape income poverty as a result of nonemployed persons receiving employment: 6.4 percent of individuals (15 to 70 years of age) are in income poverty after the

simulation, compared to 8.2 percent before simulation. It is noteworthy that the simulated rate is considerably higher than the actual official income poverty rate of 4.3 percent. A large proportion of those assigned employment in the simulation enter into the ranks of the time-deficient working poor or near-poor.

Tackling the problems of gender inequality and challenges in the economic well-being of the low-income working population requires, in addition to creating more jobs, progress toward establishing a regime of decent wages, regulating the length of the standard workweek, and adopting other measures, such as childcare provisioning. The crucial problem of income and time deficits can only be adequately dealt with in such a coherent and integrated manner.

1 INTRODUCTION

Two financial crises and the period of jobless growth that followed them have transformed the economic and social foundations of modern Korea. Massive firm closures and the adoption of liberal labor market policies since the 1997 Asian financial crisis have undermined the employment and living conditions of millions of workers.

The liberalization of the labor market has led to the emergence of a new class of "irregular" workers: those who hold fixed-term, part-time employment, or work via an indirect hiring arrangement. They perform the same tasks as "regular" workers but without the corresponding workers' benefits or job security (Kim and Park 2006). Irregular workers, despite the inclusion of part-time in the definition of this type of arrangement, on average spend almost the same amount of time on the job every week as "regular workers." For instance, in 2009, the average daily workload was 8.5 hours among regular workers, while it was 8.2 hours among irregular workers. However, despite the similar workloads, irregular workers earn around 60 percent of regular workers' hourly wages, after controlling for sex, age, education, and job experience and duration, according to the annual Survey on Working Conditions by Type of Employment.[1]

Irregular employment has quickly become dominant, as seen in Table 1: the ratio of irregular to regular employed workers was 36.7 percent in 2001 and grew to 58.7 percent by 2004, after which the ratio gradually declined to 47.7 percent in 2013, in part due to the weak labor demand in recent years (Seong 2013). Nonetheless, the ratio remains much higher than in 2001, when the data was officially published for the first time.

As earnings from employment constitute the most important source of income for the majority of households, the deteriorating conditions in the labor market raised the poverty rate among workers (Lee et al. 2008). Most of the working poor consist of irregular workers, and the fact that the poverty rate of employed persons rose from 8.8 to 9.7 percent between 2006 and 2010 likely reflects a strong effect of irregular employment on poverty (Kim et al. 2011). Yoon (2010), Seok (2010), and Lee (2010) found evidence that irregular employment with low wages

[1] Source: 2009 Survey on Working Conditions by Type of Employment, Ministry of Employment and Labor, South Korea.

increased the likelihood of being poor and lowered the chances of transitioning out of poverty, even when the irregular worker was not a primary earner in the household.

This transformation of the Korean economy has necessitated more women to enter the labor market. As a result, women's labor market participation rate followed a gradual upward trajectory: it was 47.1 percent in 1997, 53.9 percent in 2009, and continued its growth to 55.6 percent in 2013. During the same period, men's participation rate remained between 77 and 78 percent. The increase in women's participation rate was associated with the increase in their employment rate from 45.2 to 52.2 percent between 1997 and 2009, and reaching 53.9 percent in 2013. Despite the growing presence of women in the labor market, these numbers are still below the Organisation for Economic Co-operation and Development (OECD) averages of 62 percent and 57 percent for participation and employment rates, respectively. This is partly due to the influence of the unequal division of household production on women's employment as evidenced by the differences in female labor force participation rates by age group. While almost 70 percent of women in their late 20s and 65 percent of women in their 40s are economically active, only 55 percent of women in their 30s are (Economically Active Population Survey, 2010). Gender inequality in the labor markets has also manifested in women's presence among irregular workers: half of them or more were women in most years since 2001 (Table 1), while this portion has been less than 38 percent among regular workers. Gender inequality is also observed in household production: among the employed persons working 36 hours or more a week, women spent more than 2 hours a day on household management and caring for other family members while men spent only around 30 minutes a day in 2009. The inequality is just as striking among those who worked less than 36 hours a week: 3 hours and 26 minutes for women versus 51 minutes for men.

Table 1 **Ratio of Irregular Employment and the Share of Women**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Irregular	36.7	37.7	48.3	58.7	57.8	55.2	56.0	51.1	53.7	50.0	52.1	50.0	47.7
Women	52.3	49.5	50.4	49.4	50.1	50.4	49.0	50.4	53.4	53.4	53.4	53.7	53.8

Source: Economically Active Population Survey (labor force survey) from various years.

The increase in women's participation in long hours of paid work, coupled with the low wages of irregular employment, has surely increased the incidence, as well as the depth, of time

deficits among employed persons: too little time is available for the household activities needed to maintain the minimum quality of life. Time deficits pose a greater challenge for poor households, which may not be able to afford to substitute for the insufficient time with goods and services purchased from the market. As women perform the bulk of household production, regardless of their paid work hours, the time deficits of employed women are large and their consequences for the quality of life of employed women are likely to be significant.

However, the official poverty measurement in Korea does not account for time deficits and their effect, as it is based solely on income. The official poverty threshold is intended to represent the minimum cost of living and is estimated from the household expenditure survey. It is periodically updated, as the threshold serves as the baseline for public transfers to poor households. The official measure does not recognize the need for the time to process and produce goods and services at home, which otherwise are to be purchased in the market. To the extent that the long hours of paid work interfere with household production, the well-being of households and their members is expected to be compromised. The consequent degradation of the quality of life should therefore be accounted for in the measurement of poverty. To the best of our knowledge, no systematic attempt to account for the time dimension in poverty measurement has been made in the case of South Korea.[2]

We believe that the recent transformations in the conditions of employment and poverty in Korea warrant, more than ever, a reconsideration of the official measure of poverty. Policies to combat poverty and promote equality require a deeper and more detailed understanding of the linkages between conditions of employment, unpaid household production, and existing arrangements of social provisioning—including social care provisioning. This nexus creates distinct binding constraints for different types of households and individuals, and especially for men and women. Anti-poverty policies will be much more effective if they take this nexus into account.

[2] Noh and Kim (2010) applied the framework of Vickery (1977) to the 1st wave of the Korean Welfare Panel Study that contains recall data on approximate time spent on household activities. The data, however, suffers from a severe recall bias. Their study also did not consider the role of household composition in determining the required time for household production.

Our measurement framework is used in an attempt to lay bare the time-income nexus and provide an empirical picture of the problems that it can produce. Customarily, income poverty incidence is judged by the ability of individuals and households to gain access to some level of minimum income based on the premise that such access ensures the fulfilment of basic material needs. However, this approach neglects to take into account the necessary (unpaid) household production requirements, without which basic needs cannot be fulfilled. In fact, the two are interdependent and evaluations of standards of living ought to consider both dimensions. Households differ in terms of their household production requirements because of demographic differences—principally in terms of size and composition—among them. Households also differ in terms of the time their members have available to meet the requirements, and it should not be assumed that all households can meet these requirements. In order to promote gender equality, it is imperative to understand how labor force participation and earnings interact with household production responsibilities, as it is already well-established that women contribute a disproportionate share of unpaid work time.

The rest of the report has the following structure. In the next section, we discuss our measure of time and income poverty (Section 2). This section also discusses the data and empirical methodology. Key findings regarding the patterns of time and income poverty are presented and discussed in Section 3. We then discuss the findings from our microsimulation of the scenario in which all employable adults in income-poor households receive employment (Section 4). The concluding section (Section 5) considers the policy implications of the study.

2 MEASUREMENT FRAMEWORK AND EMPIRICAL METHODOLOGY

The purpose of this section is to describe the model underpinning our measurement of time and income poverty. We also describe the sources of data and methodology that we employed in implementing the measure.

2.1 A model of Time and Income Poverty

Our model builds on earlier models that explicitly incorporate time constraints into the concept and measurement of poverty (Vickery 1977; Harvey and Mukhopadhyay 2007). The key differences between our approach and the earlier models are that we explicitly take into account intrahousehold disparities in time allocation and do not rely on the standard neoclassical model of time allocation. A detailed comparison of the alternative models has been discussed elsewhere (Zacharias 2011). The empirical methodology followed to implement the model has been elaborated in the context of three Latin American countries (Zacharias, Antonopoulos and Masterson 2012).

We undertook a revision of the basic model in order to account for the outsourcing of childcare. Let the time deficit/surplus faced by the working-age individual i in household j be denoted as X_{ij}; minimum required time for personal care and nonsubstitutable household activities as M; the minimum amount of substitutable household production as R; the fraction of the threshold hours of household production that falls upon the individual as α_{ij}; and, L_i is the time spent on income generation (wage or own-account employment).

To account for the impact of outsourcing of childcare, we also introduce B_j^f to represent the free (i.e., requiring no monetary outlays by the household) outsourced hours of childcare, B_j^p the purchased hours of childcare and γ_{ij} the share of outsourced hours that goes toward relieving the childcare obligations of the individual. We can then express the individual's time deficit as:

$$X_{ij} = 168 - M - \alpha_{ij}R_j - L_{ij} + \gamma_{ij}(B_j^f + B_j^p) \quad (1)$$

In the equation above, L_i, the time spent on income generation, is defined so as to also include the time spent on commuting to work, simply to avoid clutter. The threshold value of personal care reflects the time requirements for certain basic activities such as sleeping, eating and drinking, personal hygiene, some minimum rest, etc. We also make allowance for some minimal requirement of time for certain nonsubstitutable household activities (i.e., activities that are, in general, hard to outsource). The combined total requirements of personal care and nonsubstitutable activities is represented by M.[3]

As we discussed earlier, income poverty thresholds in Korea, as in other countries, do not take into account the fact that people with poverty-level income may not have enough time to engage in the household production activities that they need to perform in order subsist with that level of income. The amount of substitutable household production time that is implicit in the poverty line (R) varies among households depending on the number of adults and children in the household.

Numerous studies based on time use surveys have documented that there are well-entrenched disparities in the division of household production tasks among the members of the household, especially between the sexes. Women tend to spend far more time in household production relative to men. Studies based on time use surveys in Korea have shown that women spent over 3 hours a day on household production while men spent only 37 minutes in 2009, according to a 2009 Korean time use survey. Although women's burden declined from over 4 hours a day in 1999 while men's time remained unchanged, the gender gap remains remarkably high (Kwon 2007; Lee, Kawaguchi and Hamermesh 2012). The parameter α_{ij} is meant to capture these

[3] Vickery (1977, p.46) defined this as the minimum amount of time that the adult member of the household is required to spend on "managing the household and interacting with its members if the household is to function as a unit." She assumed that this amounted to 2 hours per day or 14 hours per week. Harvey and Mukhopadhyay (2007) made no allowance for this. Burchardt (2008, p.57) included a minimal amount of parental time for children that cannot be substituted. It is arguable that the inclusion of activities of "managing the household" in this category might be double-counting, if we include household management activities in the definition of household production. However, it can also be argued that most of the nonsubstitutable time consists of the time that the household members spent with each other and that the poverty-level household production (discussed in the next paragraph in the text) does not include a "realistic" amount of time for household management. In practice, this is a relatively small amount of time and, therefore, either methodological choice would have no appreciable effect on the substantive findings.

disparities. It is the share of an individual in the total time that their household needs to spend in household production to survive with the poverty level of income.

Free (unpaid) childcare (B_j^f) can be rendered by non-household members (e.g., relatives or friends). Some time use surveys do collect information on care rendered by the respondent to non-household children but information on hours spent on (unpaid) care of household children by non-household members is generally not collected.[4] Free childcare can also be provided by the government either via direct provisioning or noncash transfers. Hours of care received in this manner are generally not recorded in time use surveys because of their focus on collecting information on how respondents spend their time. In the Korean context, the government operated a means-tested voucher system to enable families to utilize the services of childcare centers for their children.[5] Purchased hours of childcare (B_j^p) are also generally not available in time use surveys.[6]

Both free and purchased hours of childcare can relieve the time deficits that the individual may face. Hence, they are entered in our equation for time deficit (equation (1) above) with a plus sign. However, the extent of such relief can differ among the individuals in the household. For example, sending the child to a childcare center may relieve the caring responsibility shouldered by a mother more than a father. The parameter γ_{ij} aims to capture such intrahousehold differences in the apportionment of outsourced childcare.

The difference between the total hours in a week and the sum of the minimum required time that the individual has to spend on personal care and household production, net of outsourced hours

[4] Kim et.al (2011) are some of a few that have attempted to estimate time use of such childcare arrangements, using the Korean Longitudinal Survey of Women and Families of 2008. They find that only a small percentage of households, 6.7 percent, use childcare by non-household members. However, there is no information as to if the care is provided for free or not. Given the insignificant contribution of the particular type of childcare in aggregate terms, we do not explicitly take it into account in our conceptual model.

[5] In 2008, the childcare subsidies were offered to households with income below 100 percent of average urban households, with varying degrees of support by income levels. As of the end of September, 575,771 children under age 5 received the subsidies (source: 2008 Childcare Statistics, Bureau of Childcare Policies, Ministry of Health and Welfare).

[6] There is a strong rationale for collecting information regarding the hours of outsourced hours of care (free and purchased) in time use surveys because they exert a strong influence on individual and family time allocation. Since this information cannot be collected via the time diaries of the respondents, it has to be collected via a series of carefully designed questions.

of childcare, is the notional time available to them for income generation and "leisure." We have defined the time deficit/surplus accruing to the individual as the excess or deficiency of hours of income-generating activity compared to the notional available time. To derive the time deficit at the household level, we add up the time deficits of the n individuals in the household:

$$X_j = \sum_{i=1}^{n} \min(0, X_{ij}) \tag{2}$$

Now, if the household has a time deficit (i.e., $X_j < 0$) then it is reasonable to consider that deficit as a shortfall in time with respect to R_j; that is, we assume that the household does not have enough time to perform the minimum required amount of substitutable household production.

A crucial point to note in this expression is that we are not allowing the time deficit of an individual in the household to be compensated by the time surplus of another individual in the same household. This is a sharp contrast to the usual assumption of "unitary" households found in the mainstream literature. The significance of the difference can perhaps be illustrated by considering the time allocation of the husband and wife in a hypothetical family where both are employed. Suppose that the wife suffers from a time deficit because she has a full-time job and also performs the major share of housework; and, suppose that the husband has a time surplus because after returning home from work he does very little housework. Adding up the husband's time surplus and the wife's time deficit to derive the total time deficit for the household would be equivalent to assuming that the husband automatically changes his behaviour to relieve the time deficit faced by the wife. In contrast, we assume that no such automatic substitution takes place within the household, since we do not observe this substitution in operation in the time use data that we use.

If the minimal assumptions behind the equations set out above are accepted as reasonable, then it follows that there is a fundamental problem of inequity that is inherent in the poverty thresholds if the deficits in the necessary amounts of household production are not taken into account. Consider two households which are identical in all respects, and which also happen to have an identical amount of money income. Suppose that one household does not have enough

time available to devote to the necessary amount of household production while the other household has the necessary available time. To treat the two households as equally income-poor or income-nonpoor would be inequitable towards the household with the time deficit.

The problem of inequity can be resolved by revising the income thresholds. If we assume that the time deficit in question can be compensated by market substitutes, the natural route is to assess the replacement cost. Since we do take purchased hours of childcare into account, we also have to include the expenditures incurred for this purpose in altering the thresholds. Specifically, the purchased hours of childcare to be included in the adjustment of the income threshold should be capped at the time deficit that the household would have faced without any childcare expenditure.[7]

If we let $B_j^{'}$ denote the purchased hours of childcare to be taken into account in the modification of the income threshold and $\widetilde{X_j}$ denote the household time deficit in the absence of purchased childcare we can express the notion discussed above as:

$$B_j^{'} = \min(-\widetilde{X_j}\,, B_j^p) \tag{3}$$

where:

$$\widetilde{X_j} = \sum_{i=1}^{n} \min(0, \tilde{X}_{ij}), \tag{4}$$

and

$$\tilde{X}_{ij} = 168 - M - \alpha_{ij} R_j - L_{ij} + \gamma_{ij} B_j^f \tag{5}$$

[7] In the absence of such a cap, we would raise the income threshold of households that can afford to spend on childcare beyond the hours required to eliminate the time deficit; potentially, we might end up classifying some officially nonpoor and time-nonpoor households as falling below the LIMTIP income threshold. This would be self-contradictory in the sense that the LIMTIP income poverty threshold is meant to add to the ranks of the income-poor only a subset of households that have incomes above the official poverty line and are time-poor.

The income poverty threshold is now the sum of the standard poverty line, monetized value of time deficit, and cost of purchased hours (capped at the time deficit that would have existed in the absence of purchased hours):

$$y_j' = \overline{y}_j - X_j p^h + B_j' p_j^c \quad (6)$$

In the equation above, y_j' is the adjusted (LIMTIP) income threshold, $\overline{y}_j$ the official poverty line, p^h is the hourly replacement cost of household production and p_j^c is the hourly cost of childcare. We allow the cost of childcare to vary across households because the number of young children requiring childcare can differ across households; there are other factors, too, that can enter into play here, e.g., the possibility that while some may pay a subsidized rate, others may pay the average market rate.

The thresholds for time allocation and modified income threshold together constitute a two-dimensional measure of time and income poverty. **We consider the household to be income-poor if its income, y_j, is less than its adjusted threshold, and we term the household as time-poor if any of its members has a time deficit**:

$$y_j < y_j' \Rightarrow \text{income-poor household; } X_j < 0 \Rightarrow \text{time-poor household} \quad (7)$$

For the individuals in the household, **we deem them to be income-poor if the income of the household to which they belong is less than the adjusted threshold, and we designate them as time-poor if they have a time deficit**:

$$y_j < y_j' \Rightarrow \text{income-poor person; or } X_{ij} < 0 \Rightarrow \text{time-poor person} \quad (8)$$

The LIMTIP allows us to identify the "hidden" income-poor—households with income above the standard threshold but below the modified threshold—who would be neglected by official poverty measures and therefore by poverty alleviation initiatives based on the standard income thresholds. By combining time and income poverty, the LIMTIP generates a four-way classification of households and individuals: (a) income-poor and time-poor; (b) income-poor

and time-nonpoor; (c) income-nonpoor and time-poor; and (d) income-nonpoor and time-nonpoor.

2.2 Empirical Methodology and Data

2.2.1 Statistical Matching

The measurement of time and income poverty requires microdata on individuals and households with information on time spent on household production, time spent on employment, and household income. Given the importance of intrahousehold division of labor in our model, it is necessary to have information on the time spent on household production by all persons[8] in multi-person households. Good data on all the relevant information required are not available in a single survey. But, good information on household production was available in the time use survey (KTUS 2009), and good information regarding time spent on employment and household income was available in the Korean welfare panel survey of 2009.[9] Our strategy was to statistically match the welfare survey and KTUS surveys so that hours of household production can be imputed for each individual aged 10 years and older in the welfare survey.[10] Basic information regarding the surveys is shown in Table 2.

***Table 2* Surveys Used in Constructing the Levy Institute Measure of Time and Income Poverty**

Survey subject	Name	Sample size
Income and earnings	Korea Welfare Panel Study, 2009	16,255 persons in 6,207 households. There were 14,502 individuals aged 10 years or older.
Time use	Time Use Survey, Korea, 2009	22,812 persons in 10,639 households. Completed time diaries were available for 20,263 individuals that were 10 years or older.

[8] Our basic concern is that we should have information regarding household production by both spouses (partners) in married-couple (cohabitating) households, and information on older children, relatives (e.g., aunt), and older adults (e.g., grandmother) in multi-person households.
[9] More information on the preparation of the two data files for the purposes of our study is in the report "Documentation on Data Cleaning and Alignment" (by Kijong Kim) that we submitted earlier.
[10] The universe of the KTUS 2009 consisted of persons 10 years and older.

The surveys are combined to create the synthetic file using constrained statistical matching (Kum and Masterson 2010). The basic idea behind the technique is to transfer information from one survey ("donor file") to another ("recipient file"). In this study, the donor file is the time use survey and the recipient file is the welfare survey. Time allocation information is missing in the recipient file but is necessary for our research purposes. Each individual record in the recipient file is matched with a record in the donor file, where a match represents a similar record, based on several common variables in both files. The variables are hierarchically organized to create the matching cells for matching procedure. Some of these variables are considered as strata variables (i.e., categorical variables that we consider to be of the greatest importance in designing the match). For example, if we use sex and employment status as strata variables, this would mean that we would match only individuals of the same sex and employment status. Within the strata, we use a number of variables of secondary importance as match variables. The matching progresses by rounds in which strata variables are dropped from matching cell creation in reverse order of importance.

The matching is performed on the basis of the estimated propensity scores derived from the strata and match variables. For every recipient in the recipient file, an observation in the donor file is matched with the same or nearest neighbour based on the rank of their propensity scores. In this match, a penalty weight is assigned to the propensity score according to the size and ranking of the coefficients of strata variables not used in a particular matching round. The quality of match is evaluated by comparing the marginal and joint distributions of the variable of interest in the donor file and the statistically matched file (see Appendix A for a detailed description of the statistical matches).

2.2.2 Estimating Time Deficits

We estimated time deficits for individuals aged 18 to 70 years. We restrict our attention to individuals in this age group because they perform the overwhelming bulk of paid work (98 percent) and account for most of the household production labor performed in the economy (84 percent).

To estimate time deficits (see equation (2) above), we require information on:

1. weekly hours of *required* personal maintenance and nonsubstitutable household production;
2. weekly hours of *required* substitutable household production;
3. *actual* weekly hours of free and purchased childcare;
4. *actual* weekly hours the individual spends on income generation; and
5. *required* weekly hours of commuting.

The hours of required personal maintenance were estimated as the sum of minimum necessary leisure time (assumed to be equal to 14 hours per week)[11] and the weekly average (for all individuals aged 18 to 70 years) of the time spent on essential activities of personal care, estimated using data from the time use survey.[12] We assumed that the hours of nonsubstitutable household activities were equal to 7 hours per week. The resulting estimates are shown below in Table 3. The line labelled "Total" is our estimate of the weekly hours of required personal maintenance and nonsubstitutable household production, and applies uniformly to every adult.

Table 3 **Thresholds of Personal Maintenance and Nonsubstitutable Household Activities (Weekly Hours, Persons Aged 18 to 70 Years)**

Personal maintenance	90
Personal care	76
Sleep	54
Eating and drinking	12
Hygiene and dressing	8
Rest	2
Necessary minimum leisure	14
Nonsubstitutable household activities	7
Total	97

Source: KTUS 2009

[11] It should be noted that 14 hours per week was approximately 17.5 hours less than the median value of the time spent on leisure (sum of time spent on social, cultural activities, entertainment, sports, hobbies, games and mass media). We preferred to set the threshold at a substantially lower level than the observed value for the average person in order to ensure that we do not end up "overestimating" time deficits due to "high" thresholds for minimum leisure.

[12] The KTUS contained two diaries for each respondent. We multiplied the time allocated (measured in minutes) to each activity in each diary by a conversion factor and then added up the amounts of time spent on the activity over the two diaries. The conversion factor was set equal to: (a) 3.5 if both diaries were completed on weekdays or weekends (Saturday and Sunday); and (b) 5 for the weekday diary and 2 for the weekend diary if the two diaries were completed, respectively, on a weekday and weekend day (Saturday or Sunday). We converted the total weekly minutes spent on each activity into weekly hours by dividing by 60.

The hours of required household production depend on the household-level threshold of household production and the individual's share in the household-level threshold. The thresholds for household production hours are set at the *household* level; that is, they refer to the total weekly hours of household production to be performed by the members of the household, taken together. In principle, they represent the average amount of household production that is required to subsist at the poverty level of income. The reference group in constructing the thresholds consists of households with at least one nonemployed adult and income around the poverty line. Our definition of the reference group is motivated by the need to estimate the amount of household production implicit in the official poverty line. Since poor households in which all adults are employed may not be able to spend the amount of household production implicit in the poverty line, we excluded such households from our definition of the reference group.

Unfortunately, our preferred source of data for estimating the thresholds, the time use survey, did not contain any information regarding the income poverty status of households. Therefore, we had to impute membership in the group of households with income around the poverty line. We did this by using the predicted probability of being within the poverty band by means of a probit estimation.

We begin by constructing a household income measure for households in the time use data. For each individual, we create a personal income variable using the midpoint of the categories of the existing personal income variable, and replacing the top category (over ₩5,000,000) with ₩6,000,000. The household income is then created by summing these across all members of the household. This results in a household income distribution in the time use data that has a substantially lower mean than that in the welfare data (₩2.6 million versus ₩3.5 million). We normalize the household income data in the welfare and time use data separately, in order to produce similar distributions for the probit estimation and prediction.

We then proceed to run probit estimations on each of the reference group categories for the required household production (12 combinations of number of adults [one to three or more] and number of children [zero to three or more] in the household) in the KWPS. The dependent variable is an indicator of presence in the poverty band and the independent variables are

standardized household income, number of persons in the household, a set of dummies for seven regions of the country, the sex of the household head, the age and square of age of the household head, dummies for family type, dummies for tenure status, dummies for the type of housing unit, the number of earners in the household, and the level of education of the household head. The results of the estimation are used to predict the presence of the household in the poverty band for all household records in both the time use and the welfare data. We estimate the latter in order to assess the quality of the procedure. The results for the procedure are presented in Table 4. As we can see, the rate of misprediction is quite low, at 8.5 percent. In addition, the highest income of those households in the welfare data that were miscategorized as being within the poverty band was ₩3.5 million, which is not too far above the maximum poverty line for welfare data of ₩2.2 million. This gives us confidence in our estimates and imputed membership status of households in the poverty band was used to identify the reference group in the time use survey.

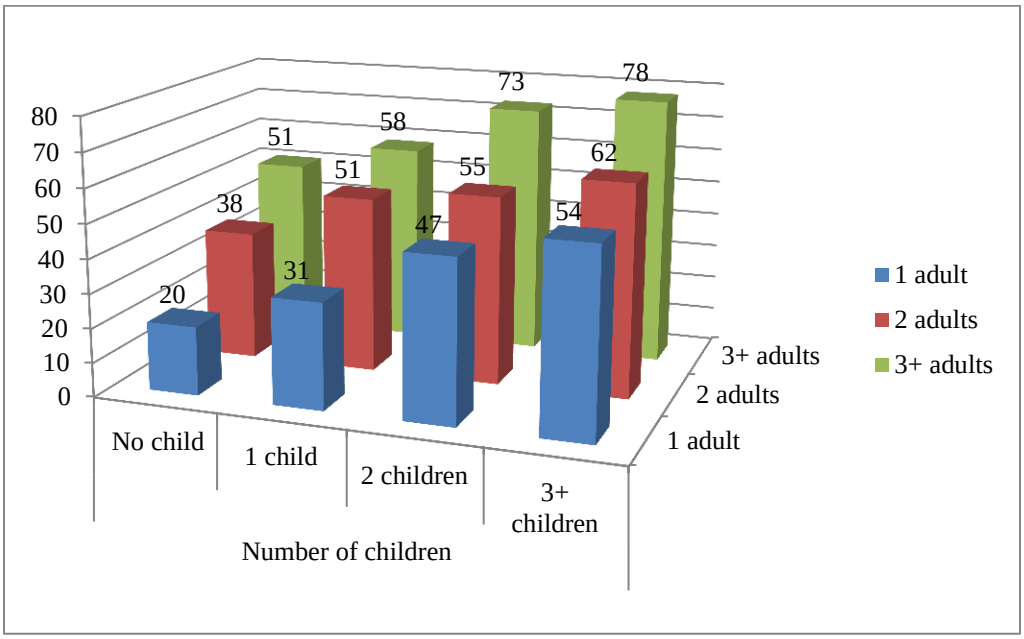
Table 4 **Comparison of Membership in the Poverty Band and Predicted Presence in the Poverty Band in KWPS 2009**

Poverty Band	Predicted Poverty		Total
	0	1	
0	80.63	4.05	84.68
1	4.44	10.88	15.32
Total	85.07	14.93	100

Note: "0" indicates nonmembership and "1" indicates membership in the poverty band.

We divided the reference group into 12 subgroups based on the number of children (0, 1, 2, and 3 or more) and number of adults (1, 2, and 3 or more) for calculating the thresholds. The thresholds were calculated on the basis of the average values of the time spent on household production by households in each subgroup of the reference group. The estimates obtained are shown below in Figure 1.

Figure 1 **Threshold Hours of Household Production (Weekly Hours Per Household)**



Source: KTUS 2009, with the Levy Institute's imputation of membership in the income-poverty band

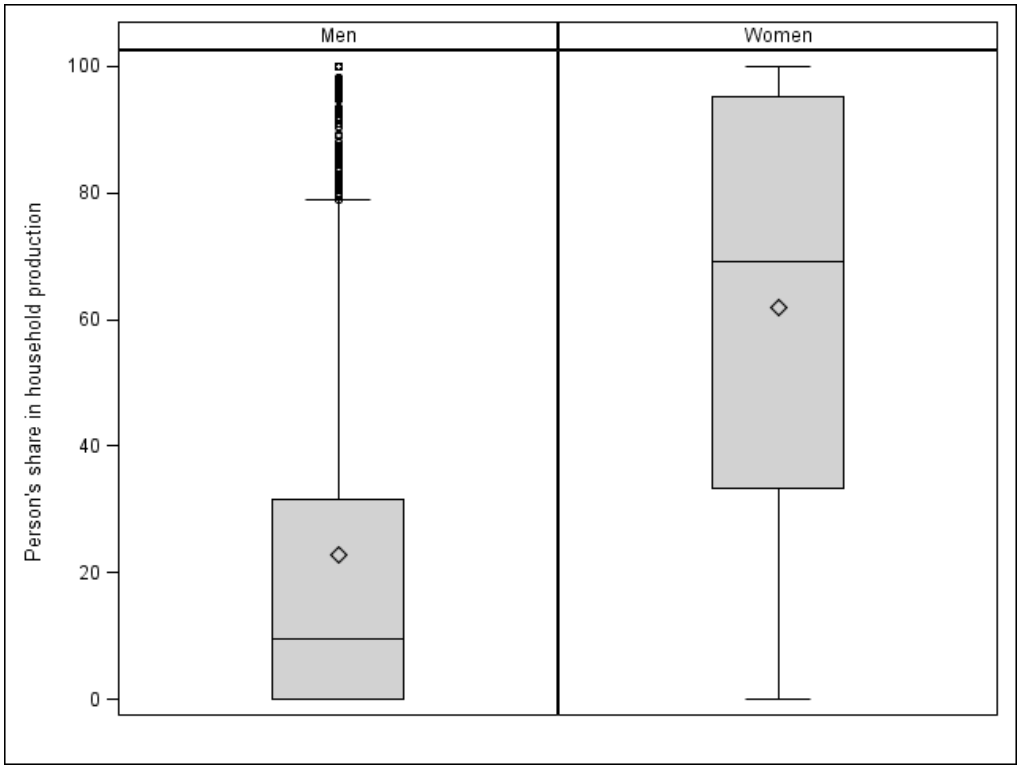
Our assumption is that the required hours should show a positive gradient with respect to adults and a positive gradient with respect to children. That is, the hours of required household production for the household as a whole should increase when there are more adults in the household, and when there are more children in the household. We think that this is a reasonable assumption. Actual hours estimated from the sample data, however, did not satisfy our assumption in a few cases. This could be due to a variety of reasons.[13] The estimates shown in Figure 1 were therefore derived on the basis of some adjustments. The first adjustment was regarding households with one adult and three or more children, which constituted only a small fraction of all households (about 0.3 percent in 2009). In this case, instead of the estimates obtained for the reference group, we obtained the threshold by adding to the threshold amount of the 1-adult+2-kids group, the difference between the threshold amounts of the 2-adult+3-kids and 2-adults+2 kids subgroups in the reference group. The second adjustment was made for households with three or more adults and 2 or 3+ children. The number of observations in the reference group for these subgroups was far too small. To overcome this problem, we relaxed the criteria for the reference group: enough observations can be found when we drop the

[13] Such as small numbers of observations for some of the subgroups in the reference group.

requirement of having incomes in the poverty band. In other words, for these subgroups we use the average values for households with at least one nonemployed adult.[14]

After we estimated the threshold hours of household production, we determined the share of each individual in the household in household production. This was done using the matched data. We assumed that the share of an individual in the threshold hours would be equal to the share of that individual in the observed total hours of household production in their household. Consider the hypothetical example of a household with only two adults. If the matched data showed that the adults spent an equal amount of time in household production, we divided the threshold value of 38 hours equally between them. However, the equal sharing of housework between the sexes is the exception rather than the norm, as indicated in Figure 2.

Figure 2 **Person's Share in the Total Hours of Household Production (Percent) by Sex, Persons 18 to 70 Years of Age**



Source: Authors' estimate from the Levy Institute's synthetic file created from KWPS and KTUS

[14] Overall, the adjustments described above affected the thresholds of about 5 percent of households in the sample.

The bottom and top edges of the box indicate the intra-quartile range (IQR), i.e., the range of values between the 25th and 75th percentiles. The marker inside the box indicates the mean value. The line inside the box indicates the median value. The picture clearly shows that men's share is much lower, as most of the distribution for men lies beneath most of the distribution for women.

Actual weekly hours of free and purchased childcare (B_j^f and B_j^p) were obtained via a process of imputation based on the reported values of out-of-pocket expenditures on childcare (out-of-pocket costs, or OOPCs) and childcare vouchers received by the household. We carried out the imputation for households that had at least one young child (i.e., a person 6 years or younger). From a policy standpoint, because the voucher system is available only to young children, it makes sense to examine the effects that it has on the time and income poverty of households with young children. As a practical matter, it is also the case that the overwhelming portion of childcare expenditures is incurred by households with young children. Thus, making adjustments to their income and time poverty status in light of outsourced childcare is likely to have a considerable impact compared to other households.

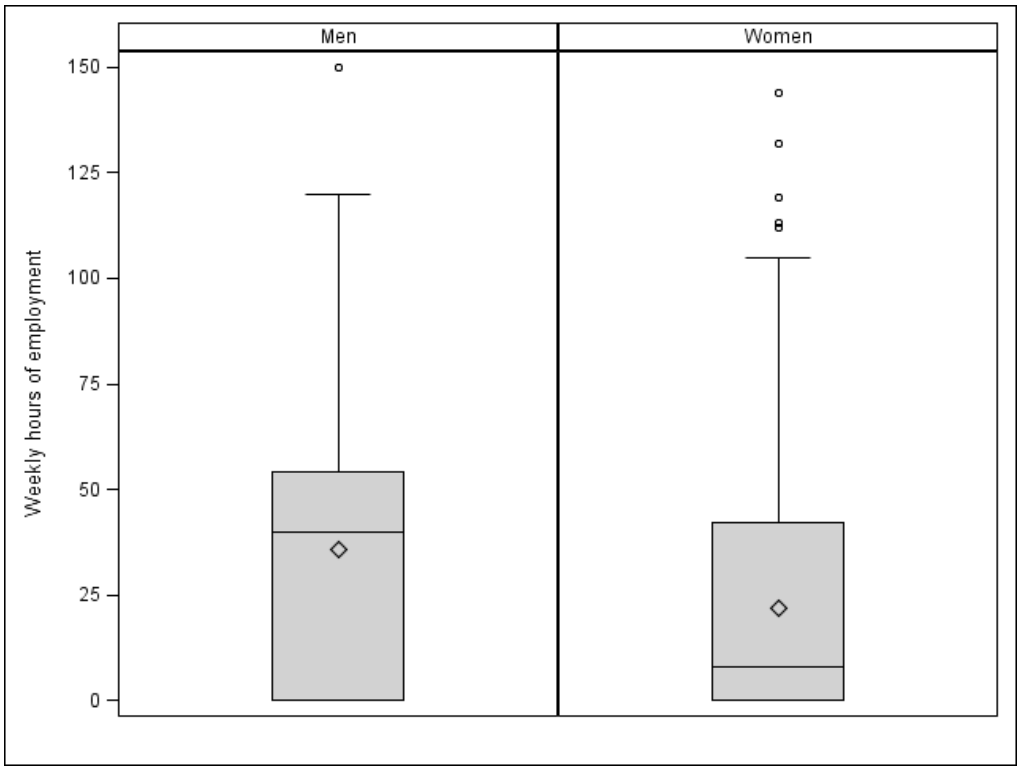
We imputed the hours in successive stages by utilizing the information on OOPCs and the value of vouchers. First, we derived an estimate of the average hourly cost of unsubsidized care per child (of a given age). This hourly cost was used to construct an hourly cost for all children in the household because OOPC is not reported separately for individual children in the household. Using the latter, we calculated the hours of care obtained by OOPC. In the next stage, we derived the hours of care financed by vouchers as a residual from the maximum hours of full-time care for households that incurred OOPC and received vouchers. Then, the hours of care financed by vouchers for households that received only vouchers were imputed on the basis of the hours of such care obtained by households that, in addition to receiving the vouchers, spent very little of their own money on childcare. Finally, the share of outsourced hours that goes toward relieving the childcare obligations of the individual (γ_{ij}) were approximated by the actual share of the individual in the total household hours of childcare. Full details of the procedure are provided in Appendix B.

We derived the thresholds for commuting time to work from the time use survey. Our exploratory analysis showed that the hours of employment had an important impact on the hours of commuting. Since we cannot reasonably assign commuting time for each possible hour of employment, we assigned thresholds based on the full-time versus part-time employment status of the worker. We considered a worker as a part-time worker if their weekly hours of work were 35 hours or less. Our estimates showed that the average commuting time for part-time and full-time workers (in the age group 18 to 70 years) were respectively, 4.40 and 7.15 hours per week. We assumed that they constitute the threshold values of commuting.

The final step in calculating the time deficits for individuals consists of obtaining the actual weekly hours of employment. About 30 percent of employed persons did not report weekly hours of employment; instead, they reported average daily hours of work. There is no information about average days worked in a week; but, average days worked during a month is available in the data file for all employed persons. We first multiplied the daily hours with days worked per month to obtain monthly hours; then, we converted them into weekly hours by dividing by 4. We assume that the resulting variable represents the weekly hours of employment for those who did not report it. For those who reported it, we used the values in the datafile.[15] As is well known, women have much lower levels of labor market activity in Korea: for those in the age group of 18 to 70 years, the median value of weekly hours of employment for women was 7 compared to 42 for men (Figure 3).

[15] Over 90 percent of those who did not report weekly hours were "full-year worked," i.e., they worked for 12 months.

Figure 3 **Weekly Hours of Employment by Sex, Persons 18 to 70 Years of Age**



Source: Authors' estimates from the KWPS

The steps described above yielded information sufficient to estimate the time deficits for all individuals aged 18 to 70 years. The household-level value of time deficits can then be obtained in a straightforward manner by summing the time deficits of individuals in the household.

2.2.3 Adjusted Poverty Thresholds

We employed the thresholds constructed by the Korea Institute for Health and Social Affairs as our "official" poverty thresholds. The thresholds are shown in Table 5.

***Table 5* Official Poverty Line, 2008**

Household Size	Poverty Line
1	463,047
2	784,319
3	1,026,603
4	1,265,848
5	1,487,878
6	1,712,186
7	1,936,494
8	2,160,802
9	2,385,110
10	2,609,418
11	2,833,726

Source: Kim et al. (2010)

Accounting for time deficits requires the modification of the official threshold (equation (4). The modification consists of adding the monetized value of household time deficit, net of the cost of purchased childcare hours (capped at the time deficit that would have existed in the absence of purchased hour) to the threshold. We assume that the hourly value of time deficit (p^h) is equal to the average hourly wage of domestic workers, an assumption that is widely made in research on the valuation of household production. Unfortunately, detailed occupational coding was not available in the Korean microdata on workers to identify domestic workers directly.[16] A further difficulty was posed by the fact that the survey with the largest sample size and most detailed industry and occupation classification—the economically active population survey—did not collect information on earnings. As a result, we had to resort to using the average hourly wage estimated from a survey of firms (Wage Structure Survey in Korea). The hourly wage amounted to ₩6,316. It is quite likely that the hourly wage of domestic workers employed by firms is higher than that of domestic workers that work informally. As a result, the

[16] Ideally, we would have preferred to use the wages of workers classified as "domestic and related helpers, cleaners and launderers" (ISCO code 913).

value of time deficits estimated by our method is perhaps biased upwards. The derivation of our estimate of the hourly cost of purchased childcare (p_j^c) is discussed in Appendix B.

Both the official poverty line and poverty line adjusted by the value of time deficits are compared against a measure of household income to assign poverty status. For our purposes here, we use gross money income as the relevant measure. We constructed the gross money income in the welfare survey by adding up the following sources of household income: wage and salaries; business income; capital income; social security; social insurance and assistance; and private transfers including transfers by other family members, private insurance, and other organizations.

3 INCOME AND TIME POVERTY

3.1 Hours of Employment, Time Deficits and Earnings

The distinctive feature of our approach to the understanding of low-income persons and households is the focus on time deficits. Therefore, the natural starting point is to examine the nature and extent of time deficits among persons. It may be recalled from the earlier discussion that we estimated time deficits for persons between 18 and 70 years of age because they form the overwhelming bulk of the labor force.

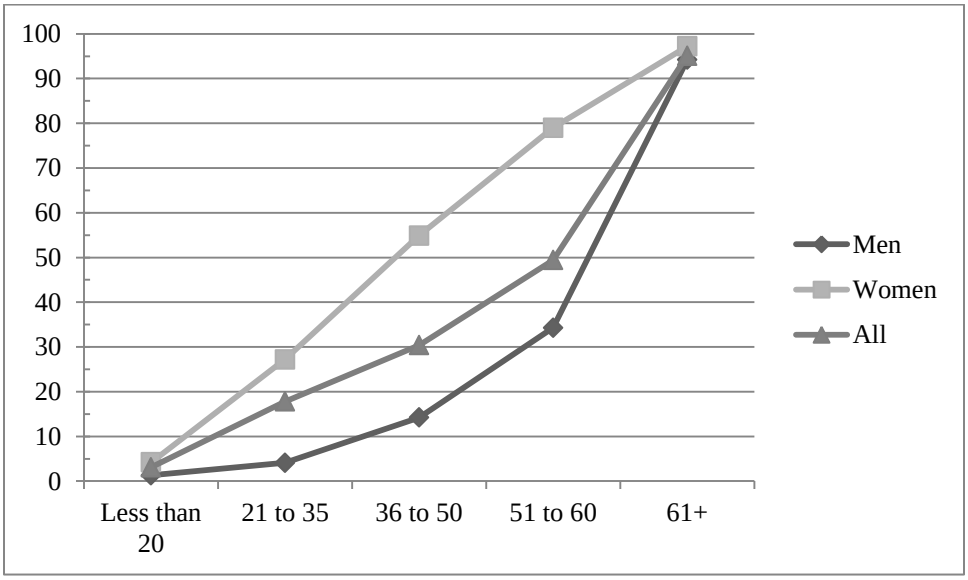
Time poverty among persons in Korea is almost exclusively a phenomenon restricted to employed persons. As in many other countries, there is a notable gender gap in the employment rates of men and women in Korea: 75 versus 51 percent among persons between the ages of 18 and 70 years, our study population. The labor force participation of men and women are trending in opposite directions. While the participation rate of men over 15 years old declined from 74.7 to 73.3 percent, the women's rate increased from 49.0 to 49.9 percent between 2003 and 2012. While women's participation in their 20s is as high as that of men, it drops to 56 percent among women in their 30s and does not reach back to the premarital level. Lee, Kang, and Sarkar (2008) find that marriage and family formation play a large role in women's withdrawal from the labor market. Kum and Yoon (2011) find that married women's participation has increased since the Asian financial crisis. The increase in double-earner households amid decreasing employment stability signifies the need to maintain an adequate level of income. The supplementary motive of women's participation is evident, especially among the low-income households.

For employed individuals, time deficits occur when their hours of employment exceed the time available to them, after setting aside the time needed for personal care and necessary household production from the physically fixed number of hours (168 hours per week), and adding the outsourced hours of childcare (see equation 1).[17] There were roughly 9.4 million time-poor persons and the majority of them (nearly 4.9 million or 55 percent) were women.

[17] Our measurement framework allows for another type of time poverty, which occurs when the time available to the individual, even before taking into account their hours of employment, turns out to be negative. An earlier study

As we would expect, the rate of time poverty increases as the weekly hours of employment rise for both men and women. But, the gender gap in incidence was fairly large: 33 percent for men versus 55 percent for women. The gender gap is visible in every hours interval, except in the very bottom (less than 20 hours) and top (61 hours or more) intervals (Figure 4). Roughly half of men and women workers worked 36 to 50 hours per week. Here, the rate of time poverty among women was 3.9 times as high as among men. The contrast between men and women in terms of hours of employment lies in the greater incidence of part-time (less than 35 hours) work: about 25 percent of women workers work part-time compared to only 11 percent of men.[18] Some studies have attributed the greater incidence of part-time work among women to their greater responsibilities at home (e.g.,Hwang 2004; Jeong 2010). However, it is also quite clear that the dramatic growth in part-time work occurred after the 1997–1998 crisis.

Figure 4 **Incidence of Time Poverty by Weekly Hours of Employment and Sex (Percent)**

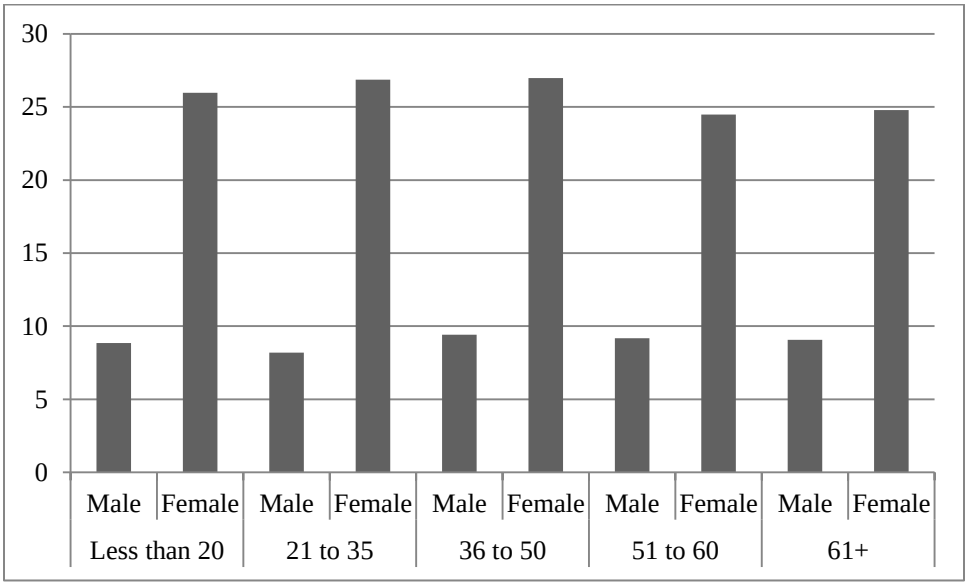


using the framework found that in Argentina and Mexico, such individuals (almost entirely women) made up roughly 20 percent of all time-poor individuals while, in Chile, they constituted a smaller fraction at 13 percent (Zacharias, Antonopoulos and Masterson, 2012:54). This type of time poverty can be thought of as a "housework time-bind" because it results *exclusively* from the higher burden of household production that falls upon women.

[18] This ILO definition may not coincide with the hourly- and full-day employment by contract used in the Korean Labor Force Survey. For the purpose of estimating time deficit, it was necessary to utilize the information related to work hours rather than to contractual characteristics of employment. Based on the contractual characteristics of employment, the part-time rates are 12.7 and 4.0 percent for women and men in 2008, which are less than half of the ratios based on the usual hours of work.

One potential reason behind the higher rate of time poverty of one group vis-à-vis another group could be the difference in the hours of required household production (see equation 1). For example, if people with higher weekly hours of employment also faced higher hours of required household production relative to those with lower hours of employment, then the latter would also contribute toward a higher incidence of time poverty. In the Korean case, however, this does not seem to be the case. As shown in Figure 5, the weekly hours of required household production for women and men were roughly stable at 25 and 9 hours, respectively, across the intervals of hours of employment. Longer hours at the job rather than higher housework burdens appear to lie behind the positive correlation between hours of employment and time poverty rates. On the other hand, the gender disparity in the incidence of time poverty *within* each interval of hours of employment was accompanied by a stark difference in the hours of required household production.

Figure 5 **Weekly Hours of Required Household Production, by Weekly Hours of Employment and Sex**

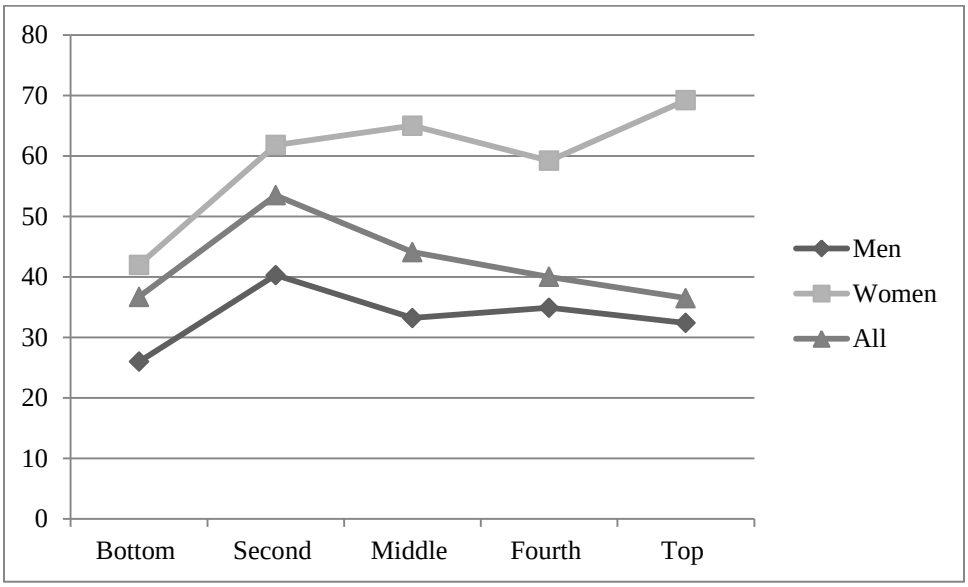


In the context of our two-dimensional measure, being time-poor can affect the income poverty status of the individual and their household. High-income families can "buy out" their time deficits, i.e., purchase market substitutes (e.g., restaurant meals and housekeeper services) while low-income families may not be able to afford them, at least to the extent that the rich can. The monetized value of time deficits can raise the income threshold to an extent that those who are

above the official threshold can now appear to be income-poor. For those are already below the official poverty line, time deficits can make their income deficit (i.e., the difference between poverty line and income) larger. Given the poverty line, the impoverishing effect of time deficits depends on the level of household income. For most employed individuals and their families, the principal determinant of their income is the level of earnings. Hence, it is also important to examine the incidence of time poverty across the earnings distribution.

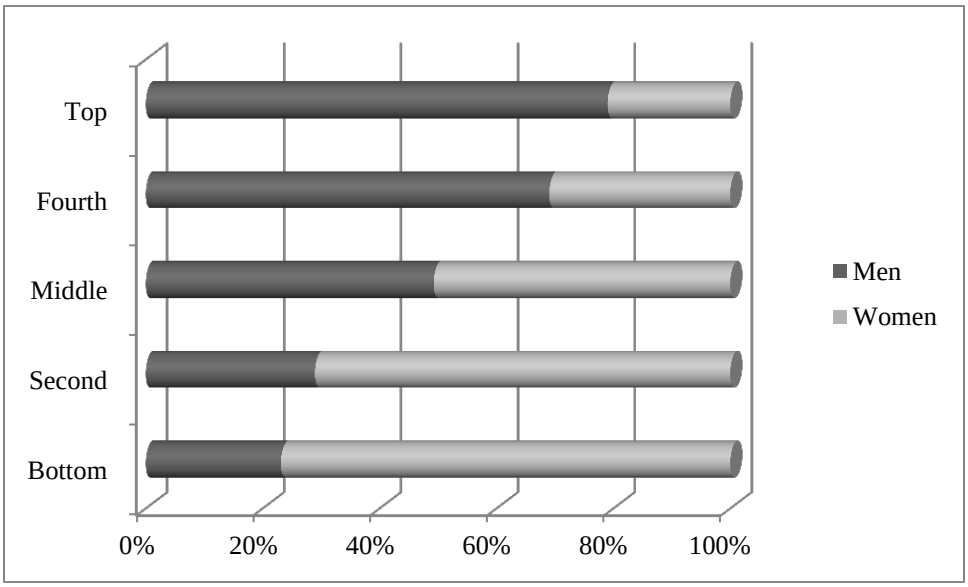
Just as there was a marked difference between men and women in time poverty rates within intervals of hours at the job, we also found large difference *within* quintiles of earnings. Time poverty among women exceeded men by substantial margins ranging from a difference of 16 percentage points in the lowest quintile to 37 in the top quintile (Figure 6). The overall time poverty rate rises between the first and second quintiles and then decreases gradually over the top three quintiles. While there is a declining trend in time poverty from the second to the top quintile for men, no such decline is observable for women. This suggests that the gradient of the overall time poverty rate with respect to earnings is a reflection of the gender composition of the quintiles. At the bottom two rungs of the earnings distribution, the overall time poverty rate and the rate for women were quite close because women constituted over 70 percent of all workers in these rungs (Figure 7). The share of women drops sharply in the middle quintile to 50 percent and continues to decline in the top two quintiles, with the highest quintile containing only 21 percent women.

***Figure 6* Time Poverty Rate by Earnings Quintile and Sex (Percent)**



Note: Earnings quintiles were calculated using the data on all employed persons with positive earnings. However, time poverty rates and composition of quintiles were calculated using the data on all employed persons.

***Figure 7* Composition of Earnings Quintile by Sex (Percent)**

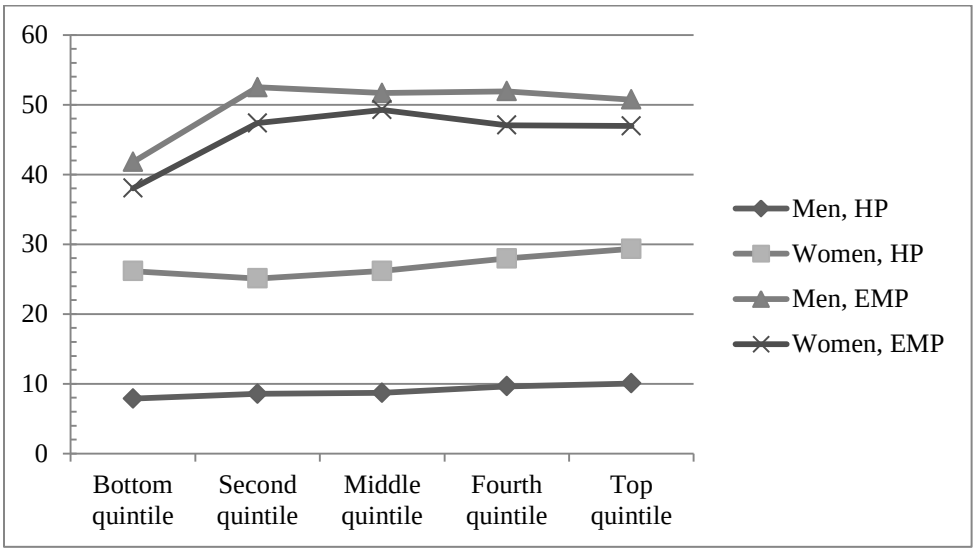


Note: Earnings quintiles were calculated using the data on all employed persons with positive earnings. However, time poverty rates and composition of quintiles were calculated using the data on all employed persons.

The higher time poverty rate of women was accompanied by higher hours of required household production. Differences in average hours of employment between men and women do not help much in accounting for the sizeable gender difference in the incidence of time poverty within each quintile of the earnings distribution. As shown in Figure 8, the average hours of required

household production across quintiles fall between 8 and 10 hours for men and between 26 and 29 hours for women. The average hours of employment were also fairly uniform across the quintiles (except for the relatively low values in the bottom quintile): 51 to 52 hours for men and 47 to 49 hours for women. Clearly, the gap in hours of employment was not sufficient to cover the difference in hours of household production. Hence, employed women carry a greater *total* work burden (household production plus employment) than men in all quintiles, and the extra work hours fell between 11 and 15 hours per week.

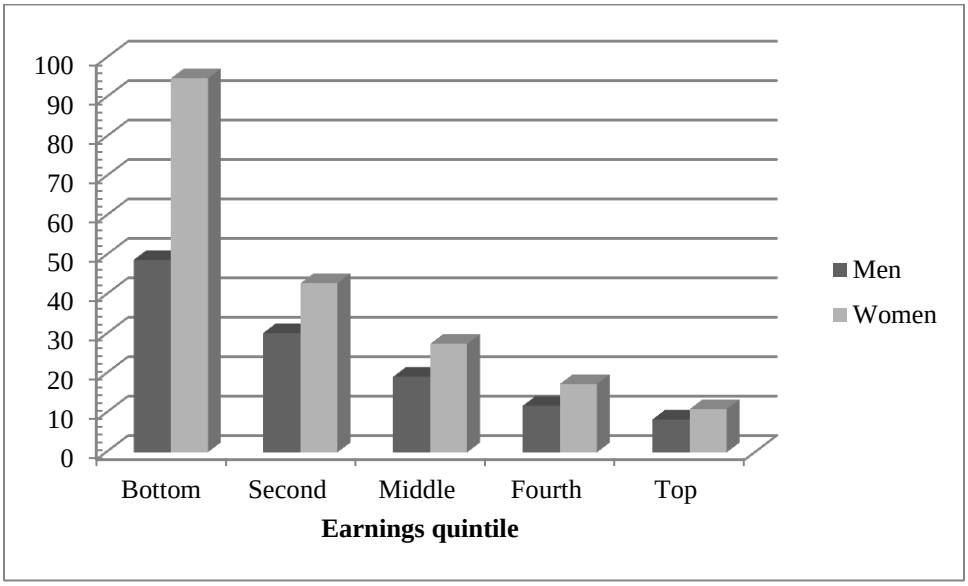
Figure 8 **Weekly Hours of Employment and Required Household Production, by Sex and Earnings Quintile (Average Values)**



Key: HP=required hours of household production; EMP=hours of employment

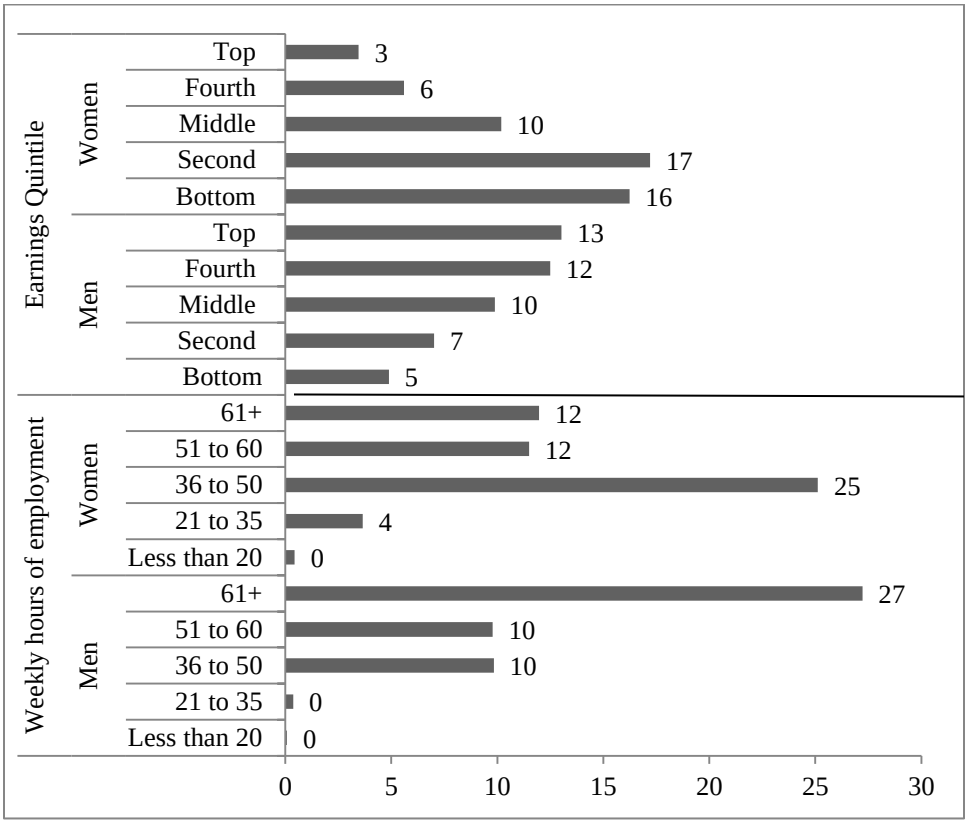
The potential impact that time deficits may have on the income poverty status of low-income earners and their families can be seen by considering the ratio of monetized value of the time deficit to earnings, expressed in percentage terms (Figure 9). In order to escape time poverty, the average female worker in the bottom quintile would have to spend almost all (95 percent) of her earnings on purchasing market substitutes while her counterpart in the second quintile would have to spend about 43 percent. The average male workers in the bottom two quintiles also have fairly substantial median values of the value-of-time-deficit-to-earnings ratio, though they are not as high as their female counterparts on account of the lower time deficits and higher earnings of men. Even for those with "middle-class" earnings (i.e., those in the middle quintile) the ratio was as high as 19 percent for men and 27 percent for women.

Figure 9 **Median Values of the Ratio of Monetized Value of Time Deficit to Earnings, by Sex and Earnings Quintile**



In sum, time poverty is pervasive among the employed population—42 percent of employed persons are time-poor. As we saw, the incidence is higher for women than men irrespective of how many hours they are at the job or their position in the earnings distribution. Hours at the job do seem to be the principal proximate factor behind the time poverty of men. For women, too, hours at the job do matter. Roughly, 95 percent of the employed time-poor were at the job for 35 hours or more (Figure 9). However, the higher vulnerability of women that spent similar number of hours on the job as men was due to the higher hours of required household production. Nearly half of the employed time-poor belong to the bottom two quintiles of the earnings distribution. Further, the monetized value of their time deficits formed a substantial percentage of their earnings. Both these factors are suggestive of the potential impoverishing effects that time deficits may have on low earners and their families.

Figure 10 **Composition of the Time-poor by Weekly Hours of Employment, Earnings Quintile and Sex (Percent)**



3.2 Household Structure, Time Poverty and Income Poverty

We now shift the focus from the individual to the household. Because time deficits are observed only among the employed, our interest is in "employed" households. We consider a household to be an employed household if either the head or spouse or both are employed. Employed households made up about 85 percent of all households in our study population.[19] Certainly, employed individuals do live in households where neither the head nor spouse is employed; but, such individuals constitute less than 5 percent of the total number of employed persons. Thus, omitting them and their households will not affect our results in a notable fashion.

The link between individual-level and household-level poverty is complex. For example, suppose that the entire employed population consists only of a time-nonpoor man and a time-

[19]It may be recalled that our study population consists of individuals between the ages of 18 and 70 years of age and their households. Our definition of employed households is based on applying the same age restriction to heads and spouses.

poor woman. If they lived together in a household then the time poverty rate of households will be 100 percent; but, if they lived in separate households the rate will be 50 percent. More generally, because employed women are much more prone to time poverty than men, the household time poverty rate would depend on the proportions of dual-earner households and single female-earner households relative to the male-only-earner (traditional "male-breadwinner") type of households. We employed the following typology of employed households to identify the effects of household structure:

Table 6 **Household Structure, Rates of Time Poverty and Composition of Time-poor Households by Household Type (Percent)**

Type of household	All households	Time-poor	Share of Time-poor
Married[20]			
Male head with nonemployed spouse	35	34	21
Employed head and spouse	39	78	52
Nonemployed male head with employed spouse	5	57	5
Single			
Male	10	60	11
Female	10	58	10
All	100	58	100

Note: Column 1 shows the share of each type of household in the total number of employed households (i.e., households in which either the head or spouse or both are employed); the rate of time poverty is shown in the middle column; and, the share of each type of household in the total number of employed, time-poor households is shown in the last column.

The most preponderant type of household (39 percent) was the "dual-earner" household in which both the head and spouse are employed, followed by the "male-breadwinner" type (35 percent).[21] About 20 percent of all employed households were headed by unmarried persons, of

[20] We considered the head to be married if they had a spouse in the same household. Among the married-couple households, there was an additional group consisting of households with a female employed head and nonemployed spouse. Because of their very small size, we left them out of the analysis.

[21] It should be noted that our definitions do not preclude the possibility of the presence of earners other than the head and spouse. Thus, for example, our definition of the "male-breadwinner" household may also include a household that has an adult daughter of the head who is an earner. In fact, about 16 percent of the male-

which half were women and half men. A clear majority of the single-headed households consisted of single-person households (58 and 56 percent, respectively, for male and female heads). Households headed by a nonemployed male and including an employed spouse—"female-breadwinner" families constituted a small proportion of all households (about 5 percent).[22]

The time-poverty rate was the highest for dual-earner households (78 percent), followed by single-headed households and female-breadwinner families (around 60 percent). The incidence was substantially lower for male-breadwinner households (33 percent). As we noted earlier, time poverty was practically nonexistent among the nonemployed in Korea and among the employed the incidence of time poverty was much higher for women than men. Both these factors account for the substantially lower degree of time poverty among male-breadwinner households than among dual earners. On the other hand, the rate is similar for single-male and single-female headed households because heads in both types of households can be expected to shoulder the lion's share of household production, in addition to being the sole earner.

The division of required household production tasks within the household plays a crucial role in determining the differential incidence of time poverty status across the types of households. To see this clearly, let us first consider the difference in time poverty rates among male heads in the three types of households: male-breadwinner, dual-earner, and single (Figure 11). The average hours of employment were virtually identical for the three groups at about 50 hours per week. As we would expect, because of the larger average household size, the household-level requirements of household production (shown in the figure by bars labelled "HH-total") were higher for married-couple households than single-headed households. But, the requirements falling upon single heads were, on average, much greater than their married counterparts because the latter were able to have their wives bear the bulk of the requirements. Hence, the rate of time poverty for married heads was substantially lower than that of single male heads (30 versus 57 percent, approximately).

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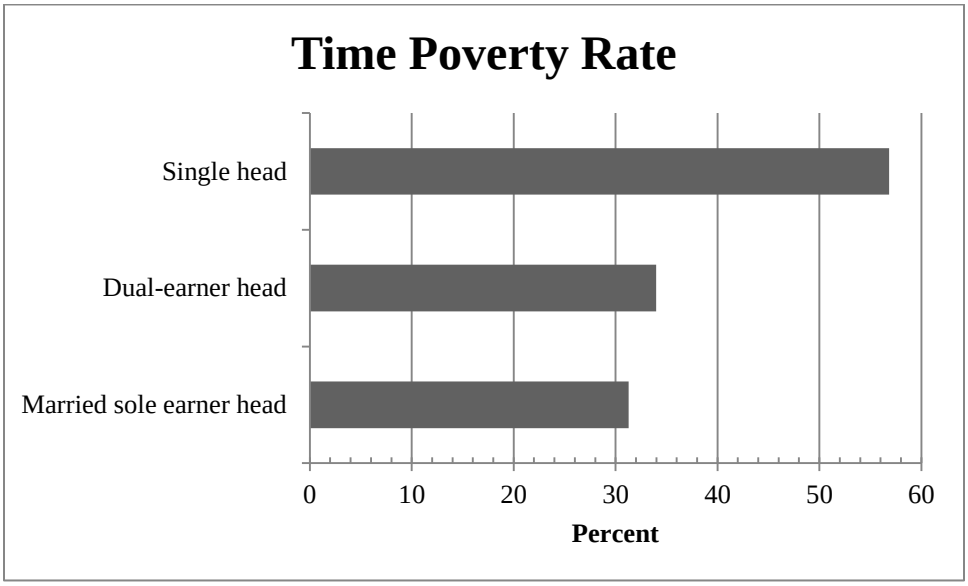
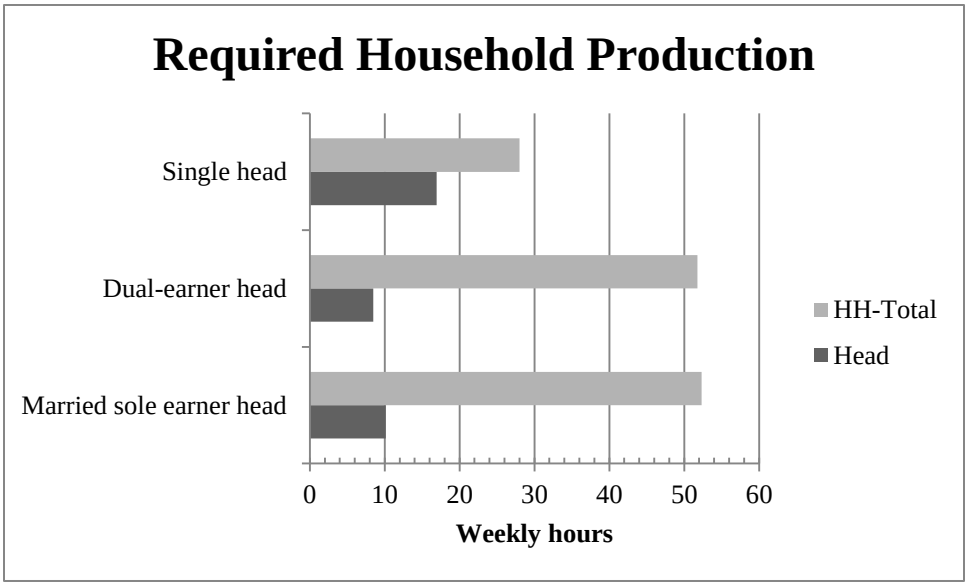
breadwinner and dual-earner households included households with earners other than the head or spouse. The proportion was somewhat higher for single-headed households.

[22] The impact of the presence of children on household time and income poverty is discussed separately in section 3.2.2.

Figure 11 **Time Poverty Rate of Male Employed Heads and Household Production Requirements by Type of Household (Persons 18 to 70 Years of Age)**





Note: (1) Married sole earner head is the head of a married-couple household where only the male head is employed; (2) Dual earner head refers to the head of a married-couple household where only the male head and his wife are employed; and (3) Single head is the head of single male-headed household where only the head is employed. These definitions represent more stringent criteria than those employed in the typology of Table 4. See also Note 21.

The flipside of the lower requirements of household production encountered by the male heads in married-couple households is the higher requirements faced by their wives. Strikingly, the average hours of required household production were almost the same for nonemployed wives in male-breadwinner families and employed wives in dual-earner families (Figure 12). Since the

household-total hours of required household production were identical across the two types of families, this outcome can be considered as a reflection of the "double shift" that Korean working wives have to contend with. The average hours of household production for single female heads were lower compared to wives in the other two groups as a result of the lower household-level requirements.

Figure 12 **Hours of Required Household Production of Women (18 to 70 Years Old) by Type of Household**

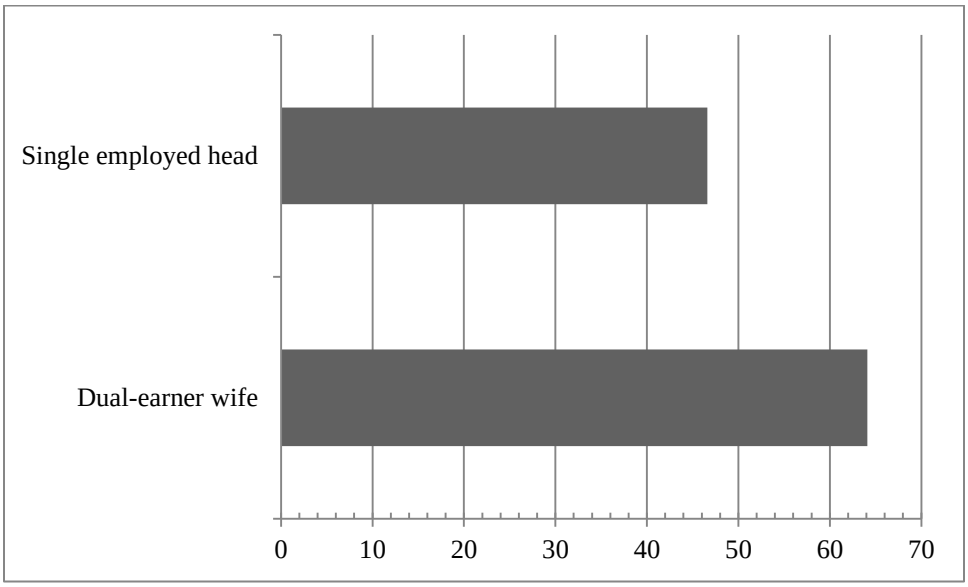
Note: (1) "Single, employed head" is the head of single female-headed households where only the head is employed; (2) "Dual-earner wife" refers to the wife in a married-couple household where only the male head and his wife are employed; (3) "Nonemployed wife, employed husband" refers to the wife in a married-couple household where only the husband/head is employed; and (4) These definitions represent more stringent criteria than that employed in the typology of Table 4. See also Note 21.

In fact, the lower hours of required household production of the female breadwinners was responsible for their lower rate of time poverty compared to wives in dual-earner households (Figure 13) because, on average, both had similar weekly hours of employment (43 hours). Similarly, the time poverty rate among employed wives in dual-earner households was higher than employed single female heads mainly because the wives had greater hours of required household production than single heads, reflecting the smaller average household size among the latter.[23] It does not appear that the difference in the average hours of employment between the

[23] We have chosen to discuss household time poverty in relation to the time poverty of the head and spouse of the household here because the overwhelming proportion of households in the sample are time-poor because either the

two groups (43 hours for wives compared to 46 hours for single heads) can account for a large chunk of the difference of 17 percentage points in the time poverty rate.

Figure 13 **Time Poverty Rates of Employed Single Female Heads and Wives in Dual-Earner Families (18 to 70 Years, Percent)**



The pattern of incidence of time poverty and the lower average earnings of women we have described so far would, other things being equal, lead us to expect that the impoverishing effects of time deficits would be higher among dual-earner and female-headed households. This was indeed the case (Table 5). Once time deficits were taken into account, a substantial group of hidden poor (i.e., those considered as nonpoor by the official measure but poor by LIMTIP) becomes visible. Our estimates of the size of the hidden poor suggest that ignoring time deficits in household production resulted in a serious undercount of the poor among all types of households. *Overall, the number of employed poor households increased nearly three-fold when time deficits were taken into account*. The hidden poverty rate—the difference between the LIMTIP and official rate—was notably higher for "nonemployed male head with employed spouse," single female-headed, and dual-earner households. On the other hand, it was lowest among the male-breadwinner families while the hidden poverty rate of another type of male-

head or spouse is time-poor. Households that were designated as time-poor because a member other than the head or spouse was time-poor constituted only 7 percent of all time-poor households. Time-poor households in which neither the head nor spouse were time-poor generally had adult sons or daughters in time poverty. A separate analysis of this subgroup of time-poor households is not possible here because of the small sample size.

headed household, those headed by a single male, was comparable to the average hidden poverty rate among all employed households.

Table 7 **Poverty of Employed Households by Type of Household: Official vs. LIMTIP**

Type of household	Rate (percent)			Number (thousands)		
	Official	**LIMTIP**	**Hidden poor**	**Official**	**LIMTIP**	**Hidden poor**
Married male head with nonemployed spouse	2.1	3.9	1.8	95	179	84
Employed head and spouse	1.9	7.5	5.6	96	382	286
Nonemployed male head with employed spouse	7.9	21.8	13.9	54	150	96
Unmarried employed male head	2.3	7.3	5	30	98	68
Unmarried employed female head	4.7	12.3	7.6	58	154	95
All	**2.6**	**7.5**	**4.9**	**341**	**980**	**639**

Note: We have excluded the statistics for the small group of married-couple households headed by an employed female and nonemployed spouse, though they are also included in the totals (i.e., in the line labeled "All").

Similar increases can also be observed for men, women, and children in employed households. The poverty rate of individuals was lower than that of households because, on average, poor employed households had fewer members than nonpoor households. Children had a higher poverty rate compared to that of adults because families with children had a higher poverty rate than all households (see below).

Table 8 **Poverty of Individuals in Employed Households: Official vs. LIMTIP**

	Rate (Percent)			Number (Thousands)		
	Official	**LIMTIP**	**Hidden Poor**	**Official**	**LIMTIP**	**Hidden Poor**
Men	2.3	6.8	4.5	360	1,067	707
Women	2.5	6.8	4.3	394	1,052	657
Children	2.6	7.1	4.5	255	698	443
All	2.5	6.9	4.4	1,010	2,817	1,807

Note: Children refer to persons less than 18 years old. Men and women include persons 18 to 70 years old.

The hidden poverty rate of households depends on the proportion of households that are officially classified as income-nonpoor but face some level of time deficits in the total number of households. If there were no time-poor households among the officially income-nonpoor, the official and LIMTIP poverty rates would be identical. The difference between the official and the LIMTIP rates is also a function of the proportion of households with income below the LIMTIP threshold in the total number of time-poor households that are officially classified as income-nonpoor. Clearly, if everyone in the latter group (time-poor and officially income-nonpoor) had high enough income to compensate for the monetized value of their time deficits, then the official and LIMTIP poverty rates would be identical.[24]

Our estimates showed that the majority of all employed households (56 percent) were time-poor and officially income-nonpoor (Table 7). This was also true of all types of households with the exception of male-breadwinner households in which the share was about one-third (34 percent). Dual-earner and households with a nonemployed head and an employed wife had the highest proportion (a little over three quarters) of time-poor and officially income-nonpoor households. But, the difference in the average number of earners per household between the two types of households (as well as other factors) resulted, for the dual-earners, in a higher percentage of households with income below the LIMTIP poverty line in the total number of time-poor, dual-earner households that are officially classified as income-nonpoor. As a result, the hidden poverty rate of dual-earners was higher than households with a nonemployed head and employed wife. A similar explanation also lies behind why the hidden poverty rate of single female-headed households was higher than that of single female-headed households.

[24] Let N be the total number of households, H the total number of "hidden-poor" households and S the total number of officially income-nonpoor households that are time-poor. Further, let P and P^* represent, respectively, the official and LIMTIP income poverty rates. Then: $P^* - P = (S/N)(H/S)$.

Table 9 **Factors Affecting the Hidden Poverty Rate (LIMTIP Minus Official Poverty Rate) of Employed Households (Percent), by Household Type**

Type of Household	Time-poor and Officially Income-nonpoor Households / All Households	Hidden-poor / Time-poor and Officially Income-nonpoor Households	Hidden Poverty Rate
Married male head with nonemployed spouse	33.5	5.4	1.8
Employed head and spouse	76.7	7.3	5.6
Nonemployed male head with employed spouse	54.0	25.8	13.9
Unmarried employed male head	58.7	8.6	5.0
Unmarried employed female head	55.5	13.7	7.6
All	**56.4**	**8.6**	**4.9**

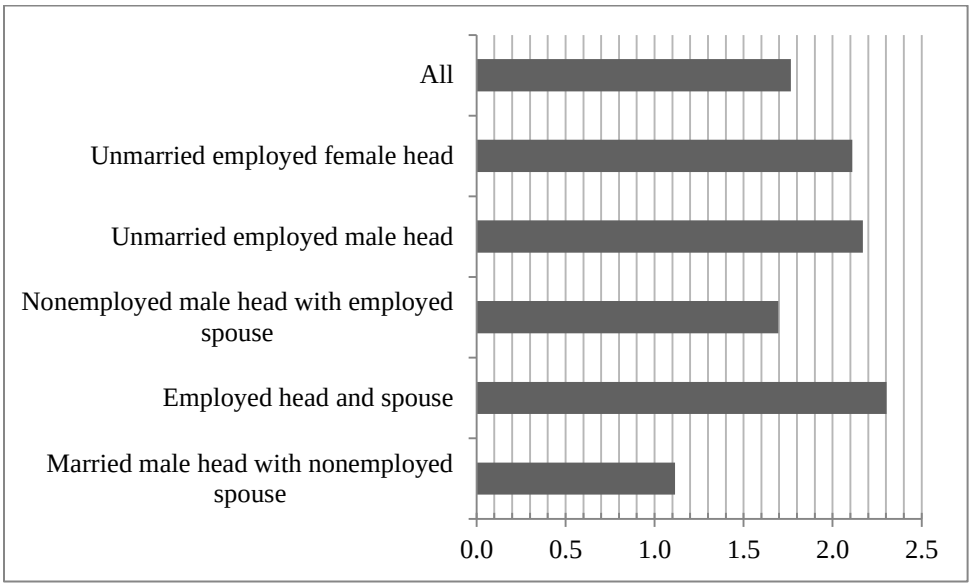
Taking time deficits into account affects not only the measured rate of income poverty (as we saw above in our discussion of the hidden poor) but also the depth and severity of income poverty. In other words, a different picture emerges regarding the unmet income needs of the poor. For the officially income-poor households with time deficits, the addition of the monetized value of time deficit to their poverty line increases their income deficit (the difference between the poverty line and income). This has the effect of increasing the average income deficit of all poor households under the LIMTIP definition relative to the official definition. The average deficit is also affected by the addition of the hidden-poor, though its effect on the overall average deficit is hard to predict *a priori*. Needless to say, the officially income-poor households without time deficits would experience no change in their deficit because their poverty lines are not affected by the monetization of time deficits. The average deficit of all poor households would thus be the weighted average of the average deficits of the three groups, where the weights are their respective shares in the income-poor population.

Table 10 The Composition of the Income-poor and Average Monthly Income Deficit (in ₩10,000 and as a Percentage of the Poverty Line) by Type of Household

Type of household	Official			LIMTIP		
	Share (Percent)	Deficit		Share (Percent)	Deficit	
		Amount	Percent		Amount	Percent
Married male head with nonemployed spouse						
Income-poor, time-nonpoor	66	34.5	30	35	34.5	30
Officially-poor, time-poor	34	38.0	31	18	61.1	42
Hidden income-poor				47	35.7	17
All income-poor	100	35.7	30	100	39.8	24
Employed head and spouse						
Income-poor, time-nonpoor	50	20.0	17	13	20.0	17
Officially-poor, time-poor	50	26.2	24	12	59.5	42
Hidden income-poor				75	57.6	22
All income-poor	100	23.1	21	100	53.1	23
Nonemployed male head with employed spouse						
Income-poor, time-nonpoor	62	16.0	14	22	16.0	14
Officially-poor, time-poor	38	36.5	33	14	81.4	52
Hidden income-poor				64	40.0	21
All income-poor	100	23.7	21	100	40.2	24
Unmarried employed male head						
Income-poor, time-nonpoor	61	9.8	11	19	9.8	11
Officially-poor, time-poor	39	17.6	26	12	76.0	57
Hidden income-poor				69	24.3	15
All income-poor	100	12.9	16	100	28.0	19
Unmarried employed female head						
Income-poor, time-nonpoor	55	12.4	14	21	12.4	14
Officially-poor, time-poor	45	22.3	22	17	64.1	44
Hidden income-poor				62	35.5	22
All income-poor	100	16.9	18	100	35.6	24
All income-poor						
Income-poor, time-nonpoor	58	21.8	20	20	21.8	20
Officially-poor, time-poor	42	28.4	27	15	66.4	45
Hidden income-poor				65	44.9	21
All income-poor	100	24.6	23	100	43.4	23

Our estimates showed that the average monthly LIMTIP income deficit for all poor households was 1.8 times higher than the official income deficit—₩434,000 compared to ₩246,000 (Table 8). The discrepancy between the two measures was the highest for dual-earner families and lowest for male-breadwinner families (Figure 14). This is a reflection of the much greater incidence of time poverty among the former group compared to the latter. The time-poor (the sum of "officially poor," "time poor" and "hidden poor") made up 88 percent of all LIMTIP income-poor dual-earner families and 63 percent of income-poor male-breadwinner families.

Figure 14 **Ratio of LIMTIP Income Deficit to Official Income Deficit, Employed Households by Type of Household**



Thus, the official measure grossly understates the unmet income needs of the poor population in Korea. From a practical standpoint, this suggests that taking time deficits into account while formulating poverty alleviation programs will alter the focus of both the coverage (including the "hidden poor" in the target population) and the benefit levels (including the time-adjusted income deficits where appropriate). As expected, the sharp increase in the deficits of the officially poor, time-poor households contributed to the wedge between the LIMTIP and official deficit. The LIMTIP deficit of this group was 2.5 times higher than the official deficit for all employed households; among household types, the discrepancy was the lowest for male-breadwinner families and higher among the dual-earner and single-headed households. They were also quite large in terms of their share in the officially income-poor population. Overall,

among employed households, 43 percent of the officially poor households also suffered from time poverty, while among dual-earner households they constituted the majority at 52 percent; the share among other types of households fell between these two values. Overall and for each type of household, the addition of the hidden poor to the ranks of the income-poor appears to have contributed to the widening of the LIMTIP deficit relative to the official deficit because the average deficit of the hidden poor was higher than the official deficit of the time-poor and time-nonpoor households.

3.2.1 The LIMTIP Classification of Households

We now turn to the joint distribution of time and income poverty status among employed households. Overall, given the income poverty rate that we reported above (7.5 percent), the interesting question is about the incidence of time poverty. The largest segment (about half of all households) were income-nonpoor but time-poor, followed by the group that faced neither time nor income poverty (41 percent). At the other extreme, households that encountered both income and time deficits constituted 6 percent of all households. The incidence of time deficits was higher among the income-poor than the income-nonpoor households by a huge margin (80 versus 56 percent), thus dispelling the notion held in some quarters that the "working rich" professional individuals are more prone to time poverty than the working poor. Since other types of social and economic disadvantages tend to accompany income poverty, it is quite likely that the negative effects of time poverty will affect the income-poor disproportionately compared to the income-nonpoor. We found that the income-poor within each of the household types that we considered in our analysis were more susceptible to time poverty than the income-nonpoor by a considerable degree, with the sole exception of dual-earner families where the gap was still 11 percentage points.

Table 11 **LIMTIP Classification of Employed Households and Incidence of Time Poverty Among Employed Households (Percent)**

Type of Household	LIMTIP Classification				Time Poverty Rate	
	Income and Time-poor	**Income-poor and Time-nonpoor**	**Income-nonpoor and Time-poor**	**Income-nonpoor and Time-nonpoor**	**Income-poor**	**Income-nonpoor**
Married male head with nonemployed spouse	3	1	32	64	65	33
Employed head and spouse	7	1	71	21	87	77
Nonemployed male head with employed spouse	17	5	40	38	78	51
Unmarried employed male head	6	1	54	39	81	58
Unmarried employed female head	10	3	48	40	79	55
All	**6**	**2**	**52**	**41**	**80**	**56**

Note: "Employed household" is a household in which the head, spouse, or both are employed. We have excluded the relatively small subgroup of female employed heads with nonemployed spouses from our analysis here.

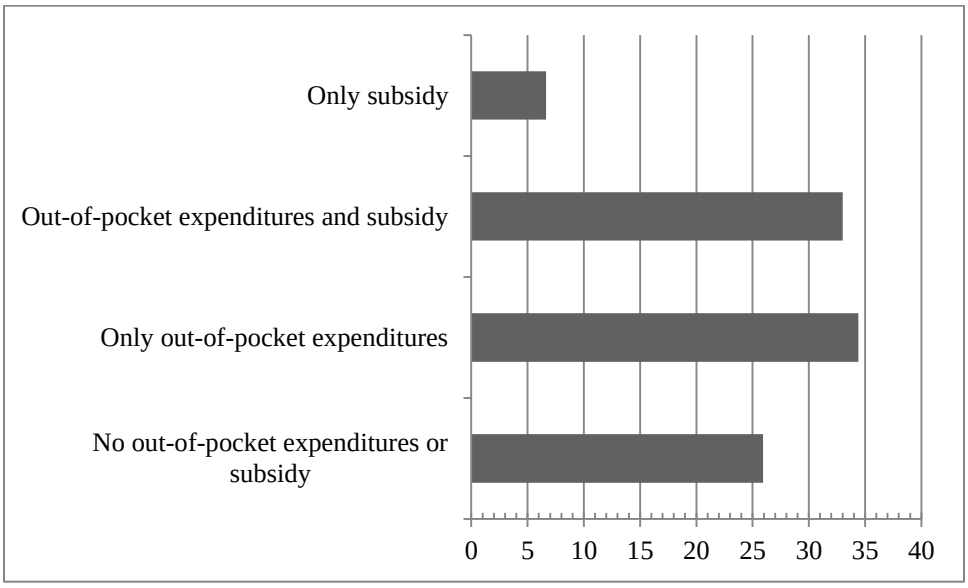
The highest incidence of both time and income poverty (17 percent) was found among female-breadwinner families (nonemployed male head with an employed female spouse), followed by single heads (10 percent) and the dual-earner households (7 percent). In light of their high rates of time poverty it is not surprising that dual-earner couples had the lowest proportion of households that had neither income nor time deficits. In contrast, the low rates of time poverty as well as income poverty enabled the male-breadwinner families to emerge with the highest proportion of households that did not face income or time deficits. As we discussed before, the difference in the time poverty rates between the dual-earner and male-breadwinner households is almost entirely due to the time poverty faced by employed wives in the former group.

3.2.2 The Impact of Childcare Subsidies and Expenditures on Time and Income Poverty

Households with young children (defined as persons not older than 6 years) constitute 22 percent of all employed households. Our accounting of time and income poverty takes into account free childcare (i.e., childcare provided via noncash government transfer) and purchased

childcare obtained by households with young children.[25] Both free and purchased hours of childcare can relieve the time deficits that the individual may face, though the magnitude of the relief can vary across the individuals in the household. This would also translate into a reduction in the household-level time deficit that would have existed without outsourcing of childcare. Roughly 75 percent of all households with young children outsourced childcare (Figure 15), with about the same number of them relying on only purchased childcare services and on a combination of purchased and subsidized childcare. In the remainder of this section, we focus on those households that outsource childcare.

Figure 15 **Type of Childcare Arrangements by Employed Households with Young Children (Percent)**

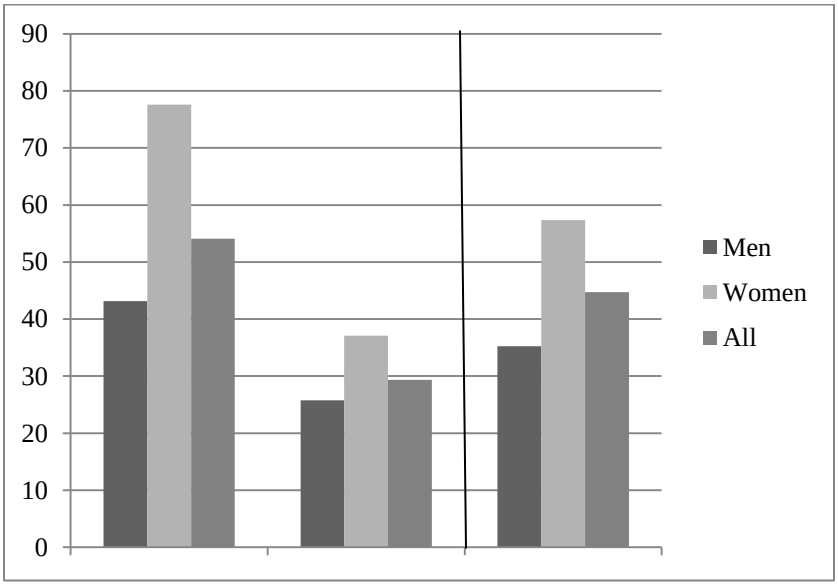


The incidence of time poverty among employed persons in households with young children that outsourced childcare declined markedly when we accounted for childcare outsourcing (Figure 16). For men and women combined, the time poverty rate declined from 54 to 29 percent; for women, the decline was from 78 to 37 percent; and, for men, the decline was from 43 to 26 percent. It should be noted that in our framework, in so far as men do contribute to the caring of young children, they are also assigned some relief in time deficit based on the share of their

[25] A fuller discussion of childcare outsourcing can be found in our public policy brief (Zacharias, Masterson and Kim 2014).

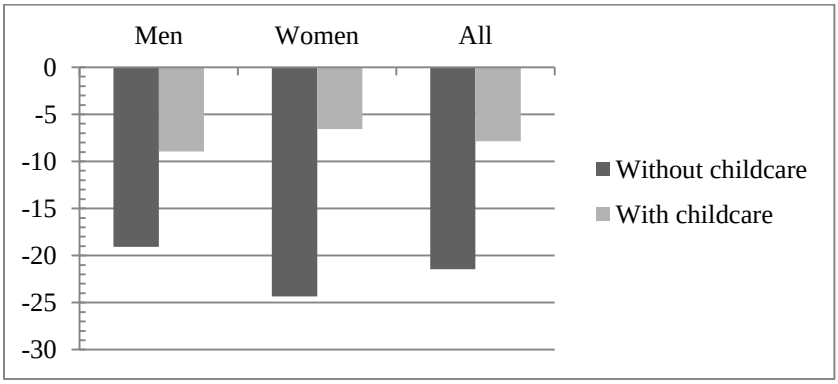
contribution to the total time that all household members spent on caring for young children. Thus, government spending on providing childcare can benefit both men and women.

Figure 16 **Time Poverty Rates of Employed Persons (18 to 70 Years of Age) in Households with Young Children that Outsource Childcare and Other Households (Percent)**



In addition to the decline in the incidence of time poverty, childcare outsourcing also reduces the time deficits faced by time-poor individuals. The decline is particularly notable for women (from a mean value of -24 to -7 hours per week) and, as a result, the gender disparity in the time deficit appears to reverse with men having a greater average time deficit.

Figure 17 **Time Deficit of Time-poor Persons with and without Childcare Outsourcing (Average Weekly Hours)**



Note: The bars "Without childcare" indicate the rates that would have existed if the household did not outsource childcare.

The reduction in time poverty (both its incidence and the size of the deficits) helps to reduce the measured income poverty status of households in our framework because the monetized value of time deficits that is added to the poverty line of time-poor households would be lower with outsourcing of childcare. On the other hand, we also add to the poverty line of households that purchase childcare services, an appropriate amount of childcare expenditures (see pp.12-13 for a discussion of this issue). Therefore, the two modifications to the measurement framework to account for childcare outsourcing have contradictory effects on income poverty that are hard to predict *a priori*.

Table 12 **LIMTIP Classification of Employed Households with Young Children that Outsource Childcare (Percent)**

	LIMTIP Classification				Time Poverty Rate	
	Income and Time-poor	**Income-poor and Time-nonpoor**	**Income-nonpoor and Time-poor**	**Income-nonpoor and Time-nonpoor**	**Income -poor**	**Income-nonpoor**
Without Childcare	5.2	0.7	59.2	34.9	88	63
With Childcare	1.7	1.4	38.0	58.9	55	39

However, our estimates showed that the income poverty rate for employed households with young children that outsourced childcare was lower when we took outsourcing into account (3.1 versus 5.9 percent). A comparison of the change in the joint distribution of time and income poverty status showed that outsourcing reduces the share of the time-poor households in both income-poor and income-nonpoor groups. Nevertheless, the income-poor were still much more prone to time poverty than the income-nonpoor.

4 LABOR FORCE SIMULATION

Using our method for accounting for the use of childcare services in the estimation of time and income poverty in Korea, we simulate the impact of an unspecified employment promotion policy on time and income poverty and on the use of childcare services and public subsidies for them. The simulated scenario assumes that every nonemployed but employable adult (including those who are currently unpaid family workers) in each income-poor household becomes employed in a job that best fits (in a statistical sense) their characteristics (such as age and educational attainment). This exercise is best seen as an aggregation of the marginal impact on each income-poor household of each nonemployed adult receiving the paid employment they are most likely to be able to get given actual labor market conditions. It is *not* a simulation of a full employment economy arrived at through some policy measure, though it is intended to suggest what the impact of employment-promotion policies might be on time and income poverty.

This work extends the framework we have developed in prior projects on fiscal policy impacts as well as the impact of employment generation policies on time and income poverty on previous LIMTIP estimates in Latin America and Turkey. In those prior cases we assigned jobs (and so, earnings) to those who were either not employed or working only part time. This required us to subsequently re-assign household production hours for all individuals in households with job recipients, as the total amount as well as the intrahousehold allocation of household production would certainly be affected by the change in employment status of some of the members of those households. Our accounting for childcare services in our LIMTIP estimates for South Korea presents an additional challenge.

Given the change in employment status inherent in our labor force simulation, we must also deal with changes in the use of childcare services for young children. Because many of the nonemployed adults who we will give jobs in the simulation spend time caring for young children in the household it is reasonable to assume that the use of external childcare services in those households with job recipients will change, almost certainly increasing. Thus changes in employment status will affect the time and income poverty of individuals and households in a number of ways. The first and most obvious way is the additional earnings brought in by the job

recipient(s), which will tend to reduce the income poverty of a household. This increase in income may or may not reduce means-tested transfers being received by the household (although this impact is one that we do not attempt to estimate in this simulation, meaning the results are biased towards poverty reduction). Of course individuals' time deficits (surpluses) in the household, including those who are not job recipients in the simulation, may increase (decrease) as the required household production tasks are re-allocated. A given household's time deficit is therefore likely to increase as well. Thus far the analysis is the same as for previous work in which we did not account for the use of childcare services. In this case, however, we do account for such usage and so changes that will certainly result in their usage as a result of the change in employment status of young children's care-givers must be accounted for as well. An increase in the usage of childcare services will effectively *reduce the increase* in household members' time deficits as a result of more members spending time in paid employment, which means that both household time deficits and the poverty line adjustment will be smaller than they would be without the use of childcare services. Whether the balance of these impacts on time deficits and household income lifts households out of income and/or time poverty is not knowable *a priori*. The simulation we now describe will give us some indication of what we might expect, however.

Previously, we produced labor force simulations by assigning jobs, earnings, and usual work hours in one matching step and then reassigning household production hours for individuals in a second subsequent step, using the results of the first step. Here we add a third step, re-assigning both total household childcare services contracted, as well as total household production and care for young children. While the previous two assignments were at the individual level, this assignment occurs at the household level. Once this assignment is made, we distribute the total hours of household production and care for young children based on the shares calculated from the assignment to individuals in the household in the second assignment. Thus we have a full complement of re-assigned variables (income, time use, and childcare services) as a result of the labor force simulation with which to recalculate the LIMTIP. A more detailed description of the methodology employed in the simulation as well as the quality of the results can be found in the appendix.

By definition the composition of the donor and recipient pools for all three stages of the labor force simulation will be very different (refer to the appendix section on simulations for details of the recipient and donor pools for each stage). The most obvious difference in the first stage, in which the nonemployed are assigned jobs and earnings, is of course the fact the donors are employed and the recipients are not. Secondly, because we limit the recipient pool to those eligible adults without jobs who are in households below the LIMTIP income poverty line, there are relatively few recipients compared to donors, who are all of the employed (see Table 13, below). But underlying characteristics that are related to differing employment status are also systematically very different. The greatest difference between pools is by sex. Among recipients in the employment simulation, 57 percent are female, while only 39 percent of the donor pool is female. While among males the distribution by age is quite similar in the recipient and donor pools, only 24 percent of females in the recipient pool are under 35 years of age, while 44 percent of those in the donor pool are. The simulation is done by assigning jobs and earnings in a hot-decking process within cells constructed from sex, age, and educational achievement categories. Thus, although the pools are dissimilar along these axes, the matches we find for our recipients are not dissimilar in these characteristics. Because the recipient pool is entirely drawn from the households that are income-poor, and the donor pool is not restricted in this way, earnings and income are the greatest differences between the recipient and donor pools.

Table 13 **Recipient and Donor Pools for Individuals by Sex**

	Jobs and Earnings Assignment		**Time Use Assignment**	
	Recipients	**Donors**	**Recipients**	**Donors**
Male	272,438	10,823,723	727,591	10,203,063
Female	364,219	6,975,762	611,101	10,230,741
Total	636,657	17,799,485	1,338,692	20,433,804
Male	43.1%	60.8%	54.6%	49.9%
Female	56.9%	39.2%	45.4%	50.1%

In the second stage of the simulation, we re-assign weekly hours of household production, care for young children, and commuting time for all adult members of households that contain job recipients in the first stage. Again, the pools are very dissimilar. Most obviously, those in the donor pool are all adults in households in which all eligible adults are currently employed. Again, the donor pool is much larger overall. The difference by sex between the recipient and donor pools is less stark in this round: 45 percent female and 50 percent female, respectively. Again, the matches are done in cells constructed from age, sex, and educational achievement categories, so the matches we make will be similar in these characteristics. In the final stage of the simulation, we reassign total household production weekly hours, total time spent caring for young children, and total childcare hours outsourced, both privately financed and publically subsidized. This stage is done at the household level, and the households in the recipient and donor pools are the households containing recipients and donors in the second stage. There are very many more households in the donor pool than the recipient pool (see Table 14, below). In this stage the matching cells are constructed using the number of children and number of adults in the household, ensuring that the matches will be made between structurally similar households.

Table 14 **Recipient and Donor Pools for Childcare Assignment**

Childcare Assignment	
Recipients	**Donors**
567,743	9,329,819

Once the simulation is complete, we can compare the results to the current situation. Intuitively, the simulation cannot have a great impact on the overall time and income poverty situation in Korea, since the recipient pool is so small relative to the overall population. We can, however, compare the situation of the time- and income-poor before and after the simulation to assess the first order impacts of nonemployed adults receiving a job they are likely to get in the labor market conditions in Korea in 2008.

4.1 Individuals

First we examine the impact of the simulation on rates of time and income poverty for individuals (Table 15, below). The portion of individuals who are income-poor by our measure has dropped from 8.2 percent to 6.6 percent overall. This is a substantial decrease, but the majority (80.3 percent) of income-poor individuals remain so despite the employment simulation. The majority of these hard-core poor individuals (92.6 percent) are in households that did not contain a job recipient in the simulation. In other words there are relatively few nonemployed adults in income-poor Korean households. Of the 2.7 percent of individuals who suffered from time and income poverty, 2.2 percent remained in this position as a result of the simulation. The majority of those escaping this situation escaped income poverty, but half of those did not escape time poverty (0.2 percent). The smallest portion (0.1 percent) escaped time poverty only. Escaping income poverty is no doubt the result of the increased earnings as a result of receiving jobs. The removal of individuals' time deficits is perhaps not an intuitive result, but the reallocation of time within households as a result of the change in employment status may relieve those with time deficits, as others in the household take up more of the burden of required household production. In addition, additional childcare services contracted might take up some of the time deficits. Of the 5.5 percent of individuals in income but not time poverty before the simulation most (3.9 percentage points or 70 percent of the total) remained in that situation. A small portion (0.4 percentage points or 8 percent of the total) dropped into time poverty without relief from income poverty, so 4.3 percent of the original 5.5 percent remained income-poor. Another small portion (0.4 percentage points or 7 percent) escaped income poverty but fell into time poverty as a result. Finally, the largest portion of those with changed time or income poverty status (0.8 percentage points or 15 percent of the total) escaped income poverty without falling into time poverty. So of the income-poor in 2009, 20 percent escaped income poverty as a result of the employment assignment, although 8 percent of those fell into time poverty as well. Although there is a substantial reduction in income poverty as a result of nonemployed persons receiving employment, even given actual labor market conditions in Korea, 6.6 percent of individuals are in income poverty after the simulation, substantially more than the actual official income poverty rate of 4.3 percent. We move on to consider the impact of the employment simulation on individuals' time poverty.

Table 15 **Time and Income Poverty Status of Individuals Before and After Simulation**

LIMTIP classification of persons (15 to 70 years), adjusted for childcare outsourcing	LIMTIP classification of persons (15 to 70 years), adjusted for childcare outsourcing, simulation				
	Income-poor, Time-poor	Income-poor, Time-nonpoor	Income-nonpoor, Time-poor	Income-nonpoor, Time-nonpoor	Total
Income-poor, Time-poor	2.2%	0.1%	0.2%	0.2%	2.7%
Income-poor, Time-nonpoor	0.4%	3.9%	0.4%	0.8%	5.5%
Income-nonpoor, Time-poor			22.3%		22.3%
Income-nonpoor, Time-nonpoor				69.5%	69.5%
Total	2.6%	4.0%	22.9%	70.5%	100.0%

Looking at the changes in the time poverty status of individuals receiving jobs in the labor force simulation, we note that the addition of paid work increases the rate of time poverty to almost 50 percent from its actual rate of just under 14 percent (Table 16, below). This is reflective of the phenomenon mentioned in the previous section of time poverty being restricted mostly to employed persons in Korea.[26] Even with the availability of childcare subsidies, the cost for nonworking people in income-poor households of moving into paid employment is a dramatic increase in the incidence of time poverty. Although some of the time-poor (35 percent or 4.7 percent of the total) moved out of time poverty (as discussed above, this transition is due to the realignment of household production responsibilities concomitant with the employment changes in the recipients' households) implying that the majority (65 percent) remained time-poor. The greater shift was among those who were income-poor and not time-poor, into time poverty. Of those individuals, 48 percent (41.1 percent of the total) became time-poor as a result of the simulation, an intuitive result of adding paid employment to household production requirements.

[26] The time poverty rate of individuals receiving jobs is as high as 14 percent because we assign jobs to those who are currently unpaid family workers. Such workers are normally classified as employed, and we used the same classification in the previous section (Section 3).

Table 16 **Rates of Time Poverty Among Individuals Receiving Jobs, Before and After Simulation**

Time Poverty Status	Time Poverty Status, Simulation		
	Not Time-poor	Time-poor	Total
Not Time-poor	45.4%	41.1%	86.5%
Time-poor	4.7%	8.8%	13.5%
Total	50.1%	49.9%	100.0%

Individuals who received jobs in the simulation had much larger time deficits, on average, than time-poor individuals in general, before and after the simulation (see Table 17, below). Time and income-poor individuals (those who were in the recipient pool of the labor force simulation) had an additional 10.7 hours per week time deficit compared to time-poor individuals on average, or a 57 percent greater time deficit. The median time deficit was 68 percent greater for time- and income-poor individuals. As a result of the simulation, the average time deficit for all time-poor individuals increased by just under three hours per week (a change of 15 percent), while the median was virtually unchanged. The average time deficit for those who received jobs in the simulation was 299 percent (74.8 hours per week) greater than that of all the time-poor. Their own time deficits as a group increased by 45.3 hours per week (a 153 percent increase) although the median for this group fell by 4.3 hours (or 16 percent).

Table 17 **Time Deficits of Time-Poor Individuals Before and After Simulation**

	Time Deficit, Adjusted for Childcare Outsourcing	
	Mean Weekly Hours	Median Weekly Hours
All Time-poor Individuals	-18.8	-15.7
All Time- and Income-poor Individuals	-29.5	-26.4
All Time-poor Individuals, Simulation	-21.6	-15.8
All Time-poor Individual Simulation Job Recipients	-74.8	-22.1

To sum up, because there were relatively few people who received jobs in the simulation, the impact of the simulation on time and income poverty was not very large. However, those individuals who received jobs were likely not to escape income poverty, and to become time-poor, with a greater depth of time poverty than the norm. So although there was a reduction in income poverty, there was a much larger increase in time poverty among the target group of the simulation. We now examine the impact of the simulation at the level of the household.

4.2 Households

We first examine the transition of the households in the adjusted income-poor categories (the target population of the simulation). Of the 9.7 percent of households classified as income-poor according to our childcare outsourcing adjusted income poverty line, 8.3 percent (or 85 percent of income-poor households) remain income-poor despite the simulation (see Table 18, below). This is an outgrowth of the fact noted above, that most of the eligible adults in income-poor households are already employed, so their status and that of all of the households without nonemployed eligible adults will not be changed by the simulation. In fact, 947,000 (62.5 percent) of the 1.5 million households classified as income-poor under our childcare outsourcing adjusted measure had no members in the simulation. Thus, 22.5 percent of income-poor households did have a member in the simulation and yet, did not escape income poverty. This is due to the limited earning potential of the nonemployed members of income-poor households in the actual labor market conditions in Korea, combined with the impact of increased time deficits as a result of increased labor market participation in the affected households. Of those households who are income- and time-poor according to our measure 15 percent (0.8 percent of all households) escaped income poverty, but only 2 percent (0.1 percent of all households) also escaped time poverty. Virtually no households that were time- and income-poor escaped time poverty, but not income poverty. Of those households that were income-poor but not time-poor 14 percent (0.6 percent of all households) escaped income poverty. Of those, 8 percent (0.3 percent of all households) fell into time poverty. Another 14 percent (0.6 percent of all households) fell into time poverty without escaping income poverty.

Table 18 **Household Time and Income Poverty Rates, Before and After Simulation**

Four-way Classification of Households According to LIMTIP, Adjusted for Childcare Outsourcing	Four-way Classification of Households According to LIMTIP, Adjusted for Childcare Outsourcing, Simulation				
	Income-poor, Time-poor	Income-poor, Time-nonpoor	Income-nonpoor, Time-poor	Income-nonpoor, Time-nonpoor	Total
Income-poor, Time-poor	**4.4%**	**0.0%**	**0.7%**	**0.1%**	**5.2%**
Income-poor, Time-nonpoor	**0.6%**	**3.2%**	**0.3%**	**0.3%**	**4.5%**
Income-nonpoor, Time-poor			44.1%		44.1%
Income-nonpoor, Time-nonpoor				46.2%	46.2%
Total	**5.0%**	**3.3%**	45.1%	46.6%	100.0%

Despite the modest impact of the simulation on time and income poverty rates, we can expect that there was substantial change in the time devoted to caring for children and the amount of childcare outsourced by Korean households. In fact we see dramatic shifts in the outsourcing of childcare among households with young children (see Table 19, below). Comparing households with young children that were both income-poor and time-poor in the actual situation to the time and income-poor households in the simulation, we see a modestly lower amount of total hours per week (0.4 hours or 9 percent) devoted to caring for young children in the latter group. However the hours of both privately financed and publically subsidized childcare are much larger for this group (24 and 46 hours per week or 49 percent and 150 percent, respectively). Comparing the income-poor, time-nonpoor group in the actual situation with the same group in the simulation, we see an even larger reduction in the total hours spent caring for young children (5.8 hours or 45 percent), combined with a shift from a majority of publically subsidized childcare to majority privately financed. This is due to the combined impact of an increase of 85 hours (over 300 percent) of privately-financed care and a reduction of 40 hours (35 percent) in publically-subsidized care. This translates to a larger percentage increase in the total amount of privately financed childcare (6.3 percent) than in publically subsidized childcare (0.1 percent). Because there is such minimal transition out of income poverty in the simulation, the numbers for the two income-nonpoor groups are largely unaffected by the simulation. It is interesting to note nonetheless that while, in the actual situation the income-nonpoor households contracted more privately financed childcare than income-poor households, whether time-poor or not, in

the simulation this is reversed. In fact, income- and time-poor households in the simulation contract almost as much childcare in the simulation as income-nonpoor, time-nonpoor households. And while income-poor, time-poor households receive slightly fewer subsidized hours than income-nonpoor, time-poor households in the actual situation, they receive more than twice as many hours in the simulation. There is some circularity inherent in these comparisons of course, since the use of outsourced childcare both relieves time deficits within households, but also puts greater strain on household finances, to the extent that this use is privately financed. So we could just as easily argue that the greater use of outsourced childcare results in the household escaping or avoiding time poverty. The dynamics of the reallocation of childcare between households and childcare centers clearly demand greater attention, as this seems to be the site of the greatest impact due to our employment simulation.

Table 19 **Average Weekly Hours Caring for Young Children and Outsourced Childcare**

	Actual			Simulation		
	Total Caring for Young Children	**Privately Financed Childcare**	**Publically Subsidized Childcare**	**Total Caring for Young Children**	**Privately Financed Childcare**	**Publically Subsidized Childcare**
Income-Poor, Time-Poor	3.3	50.1	30.7	4.3	74.4	76.7
Income-Poor, Time-Nonpoor	6.8	28.4	112.5	7.1	114.1	72.9
Income-Nonpoor, Time-Poor	8.3	66.4	36.4	8.2	66.1	36.5
Income-Nonpoor, Time-Poor	11.3	83.3	59.8	11.3	83.5	59.5

In sum, we assigned jobs to over 636,000 individuals in 568,000 childcare outsourcing adjusted income-poor households in our simulation. We then reassigned household production and outsourced childcare hours in those households. Because there are just over 3 million adult individuals in those households, our simulation can have and has only a limited impact on time and income poverty. However, 658 thousand individuals and 233 thousand households escaped income poverty, though many fell into or remained in time poverty. Indeed, time poverty rates increased dramatically among individuals in the simulation, and the depth of time deficits increased substantially (15 percent overall among time-poor individuals and 153 percent for

time-poor job recipients in the simulation). We find similar changes in time and income poverty rates at the level of the household as a result of the simulation. Perhaps the most striking impact is in the redistribution of childcare outside of the households in the simulation. Income-poor households increased their use of outsourced (both privately financed and publically subsidized) childcare by about 39 hours per month.

5 CONCLUDING REMARKS: SOME POLICY CONSIDERATIONS

Our LIMTIP framework and findings suggest that policies to reduce time-adjusted income poverty must address five interdependent domains: (a) labor market outcomes, reflected in hours of employment and earnings; (b) demographic structures and household composition as they influence the amount of time needed to fulfill household production requirements; (c) levels of direct assistance as they modify incomes; (d) provisioning of social services because they greatly affect the ability to meet household production requirements; and (e) gender norms which are embedded in all of the above mentioned domains. These factors are intertwined and it is their combined effect that determines the (time-adjusted) poverty status of individuals and households. To effect positive transformation, care must be taken so that changes in one domain can work synergistically with the others. If not, there is a danger of trading off one dimension of poverty (income) for another (time deficits).

We find that long hours of market work is the main cause of time deficits and that this characteristic of paid work discourages mainly married women with children from maintaining their ties to or returning to the labor market. Shorter work hours, whether part-time or full-time with fewer hours, are necessary to address the time barrier to work for them. Widespread adoption of flexible work schedules may improve women's employment opportunities. One of the underlying causes of income and time poverty, as suggested by our employment simulation, is that the employment that nonemployed individuals from income-poor households are likely to get will yield low earnings, despite their long working hours. Increasing minimum wage rates to account for the costs of market substitutes these workers have to purchase to meet the long hours at work can reduce time poverty of the low-skill workers. Skills training, properly directed to match local employers' demands, could also improve the earnings of these workers. The employment centers in Korea may need to strengthen career counseling and guidance services to customers in their selection of a training program.

The means-tested childcare voucher program in 2008 is shown to reduce childcare-related time burdens. But many recipient households still make private expenditures to supplement the vouchers, in part due to facing long hours of work. Our findings suggest that the Won amount of the vouchers should increase for low-income households to lower the financial burden

employment carries with it. Moreover, ensuring access to extended-hours childcare service to double-earner households is imperative to promote mothers' reentry into the labor market that demands long hours of work. Expansion of childcare services is necessary to increase employment levels of individuals, especially from low-income households, as our simulation results indicate.

Gender norms entrenched in sharing household production have put pressure on women's time budgets. We observe throughout our results that, despite the fairly extensive childcare program that would reduce the time burden of mothers, women still suffer from unequal distribution of other responsibilities at home that account for two-thirds of all household production hours. Employed female spouses do more of the unpaid work at home, even more than nonemployed male heads. It is challenging to modify individual behavior in this private sphere. Increasing the economic empowerment of women through equitable wage policies and expanded employment opportunities can facilitate movement toward a fairer and more equal sharing of household responsibilities, resulting in the reduction of poverty and the improvement of the quality of life for all.

In the following sections, we discuss in detail the implications of our findings in the areas of employment, wage, and social policies for achieving the reduction of both income and time poverty.

5.1 Employment

The Park administration has announced the goal of raising the employment rate to 70 percent of the active population. From a gender perspective, the policy goal is specifically to encourage women's employment, since the male employment rate has been above the target rate all along. One of the ways to assess the feasibility of reaching the goal is to estimate how many hours a woman may be able to work for pay given her household and individual circumstances. The probable-hour simulation illustrates the scenario in which formerly nonemployed people take up jobs with most likely work hours, rather than ride full-time employment that might be infeasible to them given other responsibilities and commitments related to their demographic and individual characteristics revealed in the data.

The probable-hour simulation highlights the contribution of employment for income-poor, in particular income-poor and time-nonpoor, households. Women account for 57 percent of the total job recipients, and 64.5 percent of those receiving part-time employment. In particular, among married couples with young children, women account for 76 percent of the job recipients. Among the female job recipients, occupational distribution mirrors a strong disparity of jobs by level of education in the labor market: women with a high school education or less tend to be concentrated in the lower end of the occupational ladder (i.e., manual and production workers), while women with college educations all receive jobs in the professional occupations (i.e., teachers, social workers, and other high-end service jobs) with higher wage earnings. The biased occupational distribution applies to men, as well. The occupational segregation by education emphasizes the need for skills training programs to improve the outcome of labor force participation of the less educated population.

5.2 Wage

The employment simulation results show that over 71 percent of the job recipients remain income-poor, which is indicative of a low earnings potential among nonemployed adults in low-income households. In addition, time deficits and associated challenges will be felt differently by levels of earnings. As we have seen, the ratio of monetized value of the time deficit to earnings of individuals vary significantly from almost 40 percent for employed women in the second quintile to just over 5 percent for men in top earnings quintile.[27] Though the usual hours of work do not differ much across the earnings distribution, the percentage of earnings needed to substitute for the time deficit is higher in the lower earnings quintiles. We find that the depth of poverty among the job recipient households increases from ₩450,000 to ₩860,000 per month as a result of the simulated employment. Long hours of work for low wages are found to aggravate their quality of life. These finding indicate that other than public service provisioning to alleviate time deficit of the low earning persons, raising the wage rates of at the low end of the distribution is to be considered. The higher wage rates would enable the individuals either to

[27] Very low usual hours of work (less than 8 hours a week) are attributable to the low earnings. From the second quintile, the usual hours of work of over 40 hours per week do not vary over the earnings distribution.

lower their paid work hours or to increase the purchase of market substitutes to make up for the time deficit.

5.3 Service Provision as a Support for Employment

The hidden poor, those who are time-poor but income-nonpoor in the LIMTIP framework, represent the group for which social service support would be effective to relieve their time deficit, hence, improve their quality of life. Time poverty is almost entirely confined to the employed population. Public provisioning of services that substitute for household production can reduce the time poverty of the employed.

The responsibility of childcare, a strong constraint on mothers' time use, is one of the areas in which public assistance can make a difference for individuals as well as for the public. The childcare voucher program reduces the time deficits of most households with young children, though the program considered in this study is not as universal as the current program. It is especially true for spouses with young children, reducing their time deficits by more than 18 hours a week on average. It also encourages mothers to maintain their employment or to lower the barrier to labor market re-entry, which in turn increases household earnings and lowers poverty rates. Thus the sharing of the responsibility for childcare with the public is an effective measure to address the quality of life, as represented by the rate of time poverty. Given these promising findings, we expect the universal childcare program to improve welfare greatly; the more families that receive the benefits, the more women may participate in gainful employment.

However our findings suggest that the voucher program needs to revamp its support for the low-income families.

5.3.1 Enhancing the Program for Low-income Households

The childcare voucher does not cover the full cost of childcare services. Our findings suggest that nearly 40 percent of care services were covered by private expenditure despite the voucher program existing among the households with a mixed private and public childcare arrangement. Out of pocket expenses of over ₩174,000 per month on average may be a significant burden to income-poor families with young children. This financial burden will limit the use of the service and hinders nonemployed adults, especially women, in families with young children from obtaining more gainful employment. Among households with young children that spend out of

pocket for childcare, the time- and income-poor household spent, on average, ₩280,000 per month, which is 16 percent of their gross income, while the time- and income-nonpoor spent over ₩233,000, 5.9 percent of their gross income. The time-poor and income-nonpoor household that most double-earner households belong to spent ₩201,000 per month, 4 percent of their gross income on the childcare service. The unequal burden of the additional costs associated with the childcare service highlights the need to bolster the support for the low-income households. The maximum amount of the current universal childcare voucher, though expanding coverage, offers a flat rate of support without increasing the amount of support for the low-income households. Incremental rates that favored low-income families would enhance, at least partially, the policy's effectiveness. A program that targeted low-income households and provided more resources for additional children is one modification that could increase the positive impact of the voucher program. Although the vouchers contributed substantially towards the purchasing of childcare services, income- and time-poor households with young children, on average, still spent over ₩276,000 per month, or 16 percent of their own income, compared to about 4 percent for the income-nonpoor, and time-poor households with young children. As the current level of support alone fails to lift time- and income-poor households out of the double poverty status, this modification would strengthen the support for this household group.

5.4 Direct Income Assistance

Our findings suggest that employment alone is not able to lift all households out of poverty. Our simulation results suggest that employment generation alone will have, at best, mixed success. Over 73 percent of income-poor job recipients move out of income poverty, but 60 and 30 percent of income- and time-poor and income-poor and time-nonpoor individuals experience increased time deficits as a result of receiving employment. What is more concerning is that over 28 percent of the income-poor individuals remain income-poor even with employment. These individuals are likely to work in the manufacturing, hotel and restaurant, and personal service sectors as manual or production workers: jobs that pay low wages. Therefore, employment promotion itself will not be enough to lift them out of poverty, especially when the monetized value of their increased time deficits is taken into account. Direct transfers (cash or

in-kind) and/or bolstering earned income tax credit to indirectly subsidize their earnings need to be supplemented for low-income workers.

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APPENDIX A: STATISTICAL MATCHING AND MICROSIMULATION

This appendix describes the construction of synthetic datasets created for use in estimation of the Levy Institute Measure of Time and Income Poverty (LIMTIP) for South Korea in 2009.[28] This work was carried out for a project contracted by the Korean Employment Information Service (KEIS).[29] Construction of the LIMTIP estimates requires a variety of information for households. In addition to basic demographics, the estimation process requires information about income and time use. No single data set has all the required data for South Korea. Thus, in order to produce LIMTIP estimates, a synthetic data file is created by statistically matching two source data sets.[30] We use the Korean Welfare Panel Study (KWPS 2009), the unification of "the near-poor and the poor panel, self-support panel" by the Korean Institute for Health and Social Affairs and the "Korean welfare panel" by the Social Welfare Research Center of Seoul National University as the base data set, since it contains good information on demographics, income, transfers and taxes for a representative sample of households in South Korea. Time use data comes from the Korean Time Use Survey (KTUS 2009), which is also nationally representative.

In order to assess the possible impact of income-poverty reduction strategies founded upon expanding employment on time and income poverty, it is necessary to impute the impact of those strategies on the income, time allocation, and childcare utilization of households. We draw on and extend our work simulating the results of the American Recovery and Reinvestment Act (Zacharias, Masterson, and Kim 2009) and previous LIMTIP employment simulations (Masterson 2012, 2013). In this case, we assume that some unspecified way is found to employ those adults in households below our adjusted income poverty line who are not employed. We then assess the impact this change has on time and income poverty.

This appendix is organized as follows. The source datasets are described and their demographic characteristics are compared. Then the quality of the statistical match is reviewed including

[28] For a description of the theory and methodology behind producing estimates of the Levy Institute Measure of Time and Income Poverty (LIMTIP) see Zacharias (2011).
[29] The project, titled "Employment and Social Policies for Time and Income Poor: Application of LIMTIP in South Korea" is managed by Tae-Hee Kwon of KEIS with co-investigators Ajit Zacharias, Rania Antonopoulos, Thomas Masterson and Kijong Kim of the Levy Economics Institute of Bard College.
[30] See Kum and Masterson (2010) for details of the statistical matching procedure that we use.

diagnostics about the match itself. Next we describe the methodology involved in the imputation of occupation, industry, and employment type, hours of employment and earnings, household income, household production hours, and childcare hours. Finally, we assess the results of the simulation.

Statistical Matching

Data and Alignment

The source data sets for the time use match for the LIMTIP estimates for South Korea are the 2009 KWPS and the 2009 KTUS. We use individual records from the 2009 KWPS file, excluding those living in group quarters or in the Armed Forces. Since the KTUS covers individuals aged 10 years old and over, we discard younger individuals from the KWPS file. This leaves 14,502 records, which represents 43,219,236 individuals when weighted. In the KTUS, we have 20,263 individual records, representing 43,297,959 individuals when weighted.

In order to create the estimates of the time-income poverty measure, we had to construct thresholds for the time spent on household production. The thresholds are defined for the household. The reference group in constructing the thresholds consists of households with at least one nonemployed adult and income around the official income poverty line. We divided the reference group into 12 subgroups based on the number of children (0, 1, 2 and 3 or more) and number of adults (1, 2 and 3 or more) for calculating the thresholds. The thresholds are simply the average values of the time spent on household production by households, differentiated by the number of adults and children. In principle, they represent the average amount of household production that is required to subsist at the poverty-level of income.

For practical purposes, we defined the reference group as households with household incomes between 75 percent and 150 percent of the poverty line (this range is referred to as the poverty band hereafter), and with at least one nonemployed adult. In order to transfer the hours spent by individuals on household production in the reference group as closely as possible, we used the following strata variables in the match: indicators for being within the poverty band, for having one or more nonemployed adults in the household, the number of children, the number of adults, sex, employment status, and household income category.

Estimation of the poverty band in the time use micro data

In order to do the time use match required for the estimation of the LIMTIP for Korea, we need to be able to identify the individuals from households within the poverty band. This variable can be directly calculated in the KWPS, but because the KTUS data has limited income variables (only categorical personal income), we have to impute a household's presence in the poverty band in the time use data. We do this by using the predicted probability of being within the poverty band by means of a probit estimation.

We begin by constructing a household income measure for households in the time use data. For each individual, we create a personal income variable using the midpoint of the categories of the existing personal income variable, and replacing the top category (over ₩5,000,000) with ₩6,000,000. The household income is then created by summing these across all members of the household. This results in a household income distribution in the time use data that has a substantially lower mean than that in the welfare data (₩2.6 million versus ₩3.5 million). We normalize the household income data in the welfare and time use data separately, in order to produce similar distributions for the probit estimation and prediction.

We then proceed to run probit estimations on each of the reference group categories for the required household production (12 combinations of number of adults, one to three or more, and number of children, zero to three or more, in the household) in the KWPS. The dependent variable is an indicator of presence in the poverty band and the independent variables are standardized household income, number of persons in the household, a set of dummies for seven regions of the country, the sex of the household head, the age and square of age of the household head, dummies for family type, dummies for tenure status, dummies for the type of housing unit, the number of earners in the household, and the level of education of the household head. The results of the estimation are used to predict the presence of the household in the poverty band for all household records in both the time use and the welfare data. We estimate the latter in order to assess the quality of the procedure. The results for the procedure are presented in Table 1. As we can see, the rate of misprediction is quite low, at 8.5 percent. In addition, the highest income of those households in the welfare data that were miscategorized as being within the poverty band was ₩3.5 million, which is not too far above the maximum

poverty line for welfare data of ₩2.2 million. This gives us confidence in our estimates, and the matching can proceed.

Alignment of the time use and welfare panel surveys

Table 2 compares the distribution of individuals by these variables in the two data sets. Since both surveys were carried out over roughly the same time period, we would expect them to be well aligned. Unfortunately that seems not to be the case. We see that there are 3 percent fewer individuals in households without children in the KWPS than in the KTUS, while individuals in two children households make up a greater share of those in the income and expenditure survey. Individuals in one-adult and two-adult households are more common in the KTUS and those in three-or-more-adult households are more common in the KWPS, a difference of five percentage points. The ratio of individuals in households with at least one nonemployed adult differs by 7 percent between the two surveys, while the ratio of individuals in households within the poverty band is 4 percent higher in the KTUS. The distribution by household income is noticeably more skewed to the lower end of the distribution in the KTUS compared to the KWPS. The portion of households in the lowest income category is six percentage points higher in the KTUS while the share in the highest income category is eight percentage points lower. This is due to the poor quality of the household income question and data in the time use survey. The nonemployed are under-represented in the KTUS relative to the KWPS (3 percent). The distribution of individuals by sex, at least, is close in the two surveys, with less than one half a percent separating the share of women in the KTUS and the KWPS. So, we have a relatively bad alignment between the two surveys compared to other statistical matches we have done.

Match QC

Turning to the results of the match, we first look to the distribution of matched records by matching round in Table 3. The bulk of the matches, 69.5 percent, occur in the first round. This is lower than in other time use matches (see, for example, Masterson 2010), due to the higher-than-usual number of strata variables used in this match, and their relative misalignment.[31] The rest of the records are matched over an additional 16 rounds, with 1.7 percent receiving no match at all (Round 18). Table 4 provides a comparison of the distribution of weekly hours of

[31] In a typical time use match (as in Masterson 2010), five variables are used, yielding a total of 32 matching cells. In this match, using seven strata variables, the number of matching cells in the first round was 170.

household production in the KTUS and the matched file. The tenth percentile is zero, so two of the percentile ratios are undefined. The remaining percentile ratios are all relatively close, with the ratio of the 75th percentile to the median being exactly equivalent. The Gini coefficient is quite close, 0.625 in the matched file, compared to 0.627 in the KTUS. Table 5 breaks down the mean and median of the three categories of household production and the total in the matched file and the KTUS.[32] We can see that for all four variables the difference in the matched and the source file's mean is very small, with the largest proportional difference, in procurement, being 2.8 percent, but amounting to less than two minutes lower in the matched file than in the KTUS. The total is off by less than one percent, amounting to about eight and one half minutes. Median core and total household production is exactly equal in the matched file.

Examination of the quality of the match within population sub-groups shows generally good results. Figure 1 displays ratios of mean weekly hours of household production between the matched file and the KTUS for the seven strata variables. For almost all the categories, the average weekly hours in the matched file are within 5 percent of the KTUS. One exception is for males, who have 9 percent higher weekly hours in the matched file, although this amounts to a difference of only one half hour. The other is for individuals in households with at least one nonemployed adult, who have about 7 percent lower weekly hours in the matched file. This amounted to a bit over one fewer hour per week. Overall the ratios of the mean weekly household production hours in the matched file to those in the KTUS by the strata variables were quite close to one.

Table 6 has the actual numbers, and we can see that the large percentage differences represent relatively small differences in hours per week. For example, the largest percentage gap among income categories— in the middle income category—we see that the actual amount of time difference is about 45 minutes per week. Notice also that the ratios by category are well-reproduced in the matched file. The largest deviation is by presence of nonemployed adult in the household, as we would expect given the misalignment of this variable between the two surveys. The extent to which the match file reproduces the distribution of weekly hours of

[32] The three categories are care (childcare, eldercare, etc.), procurement (shopping, etc.), and core (cooking, cleaning, laundry, etc.).

household production within reference groups is demonstrated in Figure 2 and Table 7.[33] We can see very little difference between the matched file and the KTUS in the distribution of weekly hours for individuals in Figure 2. Table 7 shows the ratio of household total hours of weekly production for households in the reference group in the matched file to the KTUS. Although the average values of weekly household production hours in the matched file are as much as 38 percent lower than in the KTUS for some categories, those categories have relatively few households in them. Meanwhile, the ratios for the two adult households (the most numerous groups) are all within 10 percent. Thus, the distribution of household production is well preserved in the matching process, even at this level of detail.

Overall, the quality of the match is very good. It has its limitations, but given the overall misalignment of the two source datasets, the results are quite good. The overall distribution is transferred with reasonable accuracy, and the distributions within even small sub-groups, such as one adult with two children, is transferred with good precision.

Labor Market Simulation

Data and Methods

The purpose of the simulation is to assess the first order impacts of policies aimed at alleviating income poverty in Korea via jobs policies—for example, an employer of last resort (ELR) policy. In the case of Korea, substantial subsidies for childcare are used to promote women's labor force participation. These subsidies need to be taken into account in the estimation of time and income poverty. As such, the simulation is a three-step procedure. The first step is imputing the earnings and the hours of employment of those to-be-assigned jobs, and adjusting the household income of households with members who have been assigned jobs. The second step is to impute the new hours of household production of individuals in households affected by job assignments. The third step is to impute the new levels of household total household production, as well as childcare hours, both privately paid for and subsidized, for the households with job recipients. Using these three steps, we can estimate the impact of a given policy on time and income poverty, both overall and on individual households. We first discuss the policy scenario, then the steps involved in constructing the estimated outcome of the policy.

[33] For the sake of clarity of the plot, only the number of children and number of adults are used.

Policy Scenario

A very simplified job assignment scenario is envisioned in the LIMTIP Korea project: that all eligible adults[34] in households below the adjusted income poverty line that are not working receive paid (either regular or irregular) employment.[35] The donor pool contains all adults currently working for pay. After eligible adults are assigned a job, with hours and earnings, the household income of households with eligible adult(s) is recalculated by adding the imputed amount of household earnings to the previous amount of household income. We assume that none of the other components (i.e., other than earnings) of household income undergo any change, so we incorporate the maximum income effect of additional employment in our simulation. This assumption is, obviously, unrealistic for households that receive means-tested income transfers or receive income transfers that depend on employment status. Thus the effect of this assumption is to bias the results of our simulation in the direction of greater income poverty alleviation, since we are adding earnings but not subtracting transfers that might be lost as a result.[36]

Once the employment and income simulation is complete, the hours of household production of individuals needs to be estimated in all households that contain job recipients. The recipient pool contains all adults living in households that contain at least one job recipient. The donor pool contains all adults living in households in which all eligible adults are engaged in employment. The final step is imputing new total household production hours in combination with childcare hours contracted, both privately paid for and publically subsidized, for the households that included job recipients. The unit of analysis in this final step is the household itself. The donor pool contains all households that have all eligible adults working for pay. The recipient pool comprises all households with a recipient of a job in the first step. When we reassign total household production hours, we divide these hours up and assign them to individuals within the household using the shares of household production calculated with the results of the second step. Once all these steps have taken place, we can recalculate LIMTIP

[34] Eligible adults are defined as all individuals between the ages of 18 and 54 who are not disabled, retired, or in school.
[35] An exception will be noted in the discussion of the labor force simulation.
[36] The average total transfers for individuals in adjusted consumption-poor households receiving transfers is 221 thousand Won per month, compared to the average adjusted poverty line for such individuals of 1.5 million Won per month.

using the imputed values for time use, income, and childcare services contracted. We now describe the method for each step in detail.

Labor Force Simulation

This simulation follows the method developed in prior research on time and income poverty, which built on research done at the Levy Institute to estimate the impact of the American Recovery and Reinvestment Act of 2009 on US income inequality. The problem here is to assign hours and earnings to individuals receiving paid employment. The method for assigning hours and earnings is a hot-decking procedure (for a review of hot-decking, see Andridge and Little 2010). We use a nearest-neighbor method called affinity scoring to get a pool of records from which to match each record within matching cells determined by age, sex, and education. Before the hot-decking, we assign an industry and occupation to each job recipient. We also generate imputed wages and hours of work using a three-stage Heckit procedure. These four variables are used in the hot-decking assignment of hours and earnings. In addition to hours and earnings, we assign industry, occupation and employment type (formal or informal).

Industry, Occupation, and Employment Type

The first step in assigning jobs to recipients is to determine what are the likeliest industry, occupation, and employment type for each of the recipients. This is done using a multinomial logit procedure. Industry, occupation, and employment type are regressed on age, age squared, sex, marital status, education and geographic region in the donor pool. The likelihood for each industry and occupation is then predicted in the recipient pool, using the results of the multinomial logit. Then each recipient is assigned the likeliest industry and occupation using those predicted likelihoods.

Imputed Hours and Earnings

The imputations for the earnings and usual weekly hours of paid work are performed using a three-stage Heckit procedure (Berndt 1996, p. 627) separately for each combination of six age categories and sex. The first stage is a probit estimation of labor force participation:

$$lf_i = \alpha_1 + \beta X + \varepsilon_i \qquad (0)$$

The vector of explanatory variables, *X*, comprises the number of children aged less than 1, 1–2, 3–5, 6–12, and 13–17 in the household, the individual's education, and the individual's spouse's age, education, and labor force status. The regression is run on the universe of all eligible adults. The Mills Ratio is calculated for all individuals using the results of the first stage regression:

$$\lambda = f\left(\frac{-\hat{lf}}{\sigma_{\hat{lf}}}\right) \Bigg/ \left(1 - F\left(\frac{-\hat{lf}}{\sigma_{\hat{lf}}}\right)\right) \qquad (0)$$

Where *f* is the normal density function, *F* is the normal distribution function, $\hat{lf}$ is the estimated probability of labor force participation, and $\sigma_{\hat{lf}}$ is the standard deviation of $\hat{lf}$.

The second stage is an OLS estimate of the log of hourly wage:

$$\ln w_i = \alpha_2 + \gamma_2 Z + \theta_2 \lambda + \mu_i \qquad (0)$$

The regression is run only on those individuals that are actually employed for pay. The vector of explanatory variables, *Z*, in this stage includes the individual's education, age, marital status, industry, occupation, employment type, spouse's labor force status, and finally, λ, the Mills Ratio calculated in the first stage. Inclusion of the Mills Ratio corrects for the selection bias induced by limiting the regression to those in paid employment. The imputed log of wage is predicted for donors and recipients from the results of the regression, with industry, occupation, and employment type replaced for the latter by the assigned industries, occupations, and employment types from the first step.

The third stage is a regression of usual hours of paid work per week:

$$h_i = \alpha_3 + \gamma_3 Z + \omega \hat{\ln w_i} + \theta_3 \lambda + \eta_i \qquad (0)$$

The regression is once again run only on those in paid employment. The vector of explanatory variables, *Z*, in this stage is the same as the previous stage, with the addition of the number of children aged less than 1, 1–2, 3–5, 6–12, and 13–17 in the household. Finally, the imputed

wage predicted in the second stage and the Mills Ratio calculated in the first stage are included. Imputed hours per week are predicted for donors and recipients using the results of the regression, replacing the industry and occupation of the latter with their assigned values. The results of the last two stages give us the remaining variables with which we perform the hot-decking procedure to assign earnings, hours, industry, occupation and employment type.

Jobs Assignment

We can now assign earnings, usual hours of work, industry, occupation and employment type to those individuals in the recipient pool. The assignment method is statistical matching with hot-decking. The matches are performed within cells formed from combinations of age, sex and educational attainment. The variables used to assess nearness of match are family type; marital status; spouse's labor force status; educational attainment; full-time/part-time status; assigned industry; occupation; employment type; the number of children aged less than 1, 1–2, 3–5, 6–12, and 13–17 in the household; and the two imputed variables—log of wage and hours worked. Industry and occupation are the most heavily weighted variables with employment type as the next most heavily weighted variable. Next are imputed hours and wage, followed by family type and spouse's full-time/part-time status, then marital status and spouse's education and labor force status, and then the variables detailing the number of children in the household. The selection of matches is done using affinity scoring.

Once the hot-decking is finished, we compare new earnings to previous earnings. In this employment simulation, there were a small number of individuals who actually reported earnings and who ended up with simulated earnings that were lower than their actually reported earnings. We removed these records from the pool of recipients and left their employment-related data unchanged. For the remaining recipients, we revised their household income by adding the total of the difference between the imputed amount of earnings and the actually reported earnings in the household (the sum of earnings differences of all recipients in the household) to the pre-simulation amount of household income.

Time Use Reallocation

We assume that as a result of the job assignment, the time use pattern of each adult individual in the households that contain one or more job recipients (as adjusted) from the first stage will

change. All adults in the recipient households are considered "eligible" for time use reallocation. We use a second round of hot-decking to assign new weekly hours of household production, new hours caring for young children (since we will be reassigning childcare hours contracted in the next stage), and new commuting hours to each of the adults, based on updated labor force participation variables for the recipients of jobs in the first stage. The method is the same as the first stage, with the exception of the matching variables used and their relative weighting in the procedure. In this stage, the variables used to assess nearness of match are family type, marital status, spouse's full-time/part-time status, number of adults, number of children, and the number of children aged less than 1, 1–2, 3–5, 6–12, and 13–17 in the household; household income; the income share of each individual;[37] and the two imputed variables from the first stage—earnings and usual weekly hours of employment. Household income and labor force status are updated to reflect the increased earnings and the new job assignments received in the previous stage. In this round of hot-decking, the number of children and number of adults in the household are weighted most heavily of all the variables. The next most heavily weighted variables are family type and imputed usual hours of paid employment from the first stage. These are followed by three variables detailing the number of young children in the household, household income, and income share followed by the remaining four employment-related variables assigned in the previous hot-decking step, and then the remaining variables detailing the number of older children in the household. For each match, the weekly hours of household production are transferred. We now have the time use variables necessary to recalculate time and income poverty, but we still need to adjust household childcare hours and total household production hours to reflect the new, higher household incomes and hours of paid work of recipient households.

Household Time Use and Childcare Services Reassignment

In order to estimate the change in total household hours of household production and caring for young children as well as childcare services paid for and subsidized for recipient households, we do a third hot-decking procedure, this time at the household level. In this stage we construct cells using the number of children and the number of adults in the household and do all of the

[37] Income share is included to reflect changes in bargaining power within the household and its impact on the distribution of household production work.

assignments within these cells. The matching variables are family type, age and educational achievement of the household head, assigned or actual employment type of the household head, the spouse of the household head's age, educational achievement and assigned or actual employment type, the number of nonworking adults in the household, and the number of young children. In addition, we use the mother of the children in the household's full-time/part-time status (either actual or assigned), as well as the adjusted household income and imputed total household hours of household production and paid work hours. The family type variable was weighted most heavily, followed by the number of young children. The next most heavily weighted variables were the number of earners and nonworking adults in the household, the imputed total household production, paid work hours, and the mother's full-time/part-time status, followed by the imputed household income. Next were the household head's educational status and the head's spouse's employment type.

For each match we transferred household monthly privately purchased and publically subsidized childcare hours, the total hours of household production and the total household hours of caring for young children. Finally we used the imputed or actual shares of household production from the second round of hot-decking to divide up the imputed household total hours of household production among individuals in the household. We then similarly divided up the total hours of caring for young children among household members. The resulting data set can now be used to estimate time and income poverty as a result of the simulation. We move now to an assessment of the quality of the simulation results.

Quality Assessment

Assessing the quality of this type of simulation is difficult since we are producing a counterfactual distribution of earnings, time use, and the number of childcare hours contracted. The assessment is therefore limited to comparing the latter qualities among sub-groups of donor and recipient records. Since the recipient and donor pools are not balanced in terms of underlying characteristics, there is no reason to think that the resulting distributions should be similar to the distributions in the donor pools. Nevertheless, lacking alternatives, we do compare them.

First we compare the compositions of the recipient and donor pools for the first stage in the simulation. Figure A3 presents the breakdown of the recipients and donors by matching cell (based on sex, age and education, with the percentages representing the share of the female and male recipient and donor pools). We can see that among women, the members of the donor pool are somewhat evenly distributed by education and tend to be younger, while those in the recipient pool tend to be on the older side, and concentrated among high school graduates and those with some post-secondary education. Among men, the distribution by age is quite similar for the donor and recipient pools, while recipients are slightly less educated overall. To some extent, the unbalance in the donor and recipient pools will tilt the results of the simulation, especially in the cases where there are significantly fewer donors than recipients. However our method is tailored to make sure that we are matching individuals that are as similar as possible.

We can compare the industry, occupation, and employment type assigned in the employment simulation to the likeliest industry, occupation, and employment type calculated in the first step of our procedure. This comparison is presented in tables A8, A9, and A10, respectively. As we can see, the assignment matched the likely industry in 95 percent of cases, while for both occupation and employment type, the match rate was over 98 percent. Assessing the earnings imputation is less straightforward for the reasons mentioned above. If the recipient pool has characteristics that are associated with lower earnings (as is the case), we would expect lower earnings—not similar earnings—among recipients compared to donors. We do, however, compare the assigned earnings to actual earnings by matching cell to check that the results are plausible. Figure A4 displays the ratio of mean and median assigned monthly earnings to actual monthly earnings for each combination of sex, age and education. The shaded area represents a band of plus or minus 20 percent from equivalence—a sweet spot. The worst ratio is that for women aged 45 to 54 with a college degree. Fortunately, this group represents only 2,100 of the 621,000 recipients in the simulation. Generally, the more populated a cell with donors and recipients is, the closer the results of the simulation are to the donor pool. Figure 5 displays the same ratios for usual weekly hours of work. The results here are clearly superior. It is intuitively obvious that it should be so since there is much lower variation in weekly hours of paid work than in earnings.

Turning to the estimation of weekly hours of household production, caring for young children, and commuting time, we again first compare the recipient and donor pools. Figure 6 shows the comparison by matching cell. The recipient pool has many fewer individuals in the 55 to 64 and 65 and older categories, since the earnings pool was restricted to households with adults who were not working and 55 years old. The donor pool is more evenly distributed, although still more heavily weighted towards younger individuals. Once again, the recipient pool includes relatively more individuals that are less educated than does the donor pool. This is again more pronounced for women, although both donor and recipient pools have a majority of women with high school diplomas or less. Figure A7 presents a comparison based on sex, number of children in the household and number of adults. Here we see that most males and females in both the donor and recipient pools are in households with no children and two or more adults. Large numbers are also found in households with one child and three or more adults and two children and two adults, but the portions are larger in the recipient than the donor pool. The relatively balanced nature of the demographic characteristics in the recipient and donor pools makes the following comparisons perhaps more meaningful.

Figures A8 and A9 contain ratios of recipients' mean and median assigned weekly hours of household production to donors' actual mean and median hours, again by matching cells and by sex, number of children, and number of adults, respectively. The results show that the distribution of assigned weekly hours by matching cell resembles the actual distribution of the donor pool, at least in the case of the more populated subgroups. Among women with high school diplomas or less (comprising 75 percent of the women in the recipient pool), the average weekly hours are off by as much as 33 percent. This is slightly higher than we would like to see, but does not look unreasonable. For men, the averages are all slightly higher in the recipient pool and the medians are much higher, at least in percentage terms. However the denominator is small in all cases, exaggerating the percentage variation, and where it is largest, the cell sizes are small. For example, the worst case is for the median weekly hours of household production for men aged 65 or older with college degrees. The recipient (there is only one record in the recipient pool in this cell) received 46 hours, while the median for the donor pool is 4 hours. Since this record represents only 484 individuals, this variation will not affect the overall results appreciably. Overall, the cases that are the furthest from equivalence are among elderly men and

women, and these cells were, again, lightly populated. The comparison by sex and household composition is even better-looking. The worst case is for single males living alone who received a median of 18 weekly hours compared to the donor pool median of six hours. However, this represents 19,000 recipients out of 1.3 million in the whole simulation.

The final assessment we do is of the total household production and caring for young children, and publically subsidized and privately-paid-for childcare hours. This step happens at the household level. In this case the recipient and donor pools are divided up into cells based on the number of children and number of adults in the household. Figure A10 presents the comparison of the composition of the recipient and donor pools by these matching cells. In terms of the number of children, more donor households have none compared to the recipient households. However, since matching happens within these cells, there is no chance of a childless donor household being matched with a recipient household with 3 or more children. Figure A11 presents the ratio of the mean and median of the variables transferred in the third round of hot-decking in the recipient pool to those in the donor pool. In the most populated groups, especially the two-adult households, we see that most ratios are close to unity. There are some large differences in these groups, such as the two-adult, one-child households, in which the recipients receive about 21 hours of publically subsidized care compared to the 7 hours for the donors. This is unsurprising given the fact that the donors include all households regardless of their income, while the recipients are all adjusted income-poor households. None of the values for the transferred variables seem implausible.

Conclusion

To the best of our ability to judge, the simulation looks like a reasonable approximation of the impact on individual adjusted income-poor households of all eligible adults acquiring paid employment. The results of the simulation will tend to give an optimistic view of the impact of such employment transitions, since we do not account for loss of means-tested transfers. Nevertheless, the results should shed an interesting light on the impact of employment promotion on income poverty in Korea.

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Tables

Table A1 Comparison of Actual and Predicted Presence in the Poverty Band for the KWPS 2009 Data for South Korea

Poverty Band	Predicted Poverty Band		Total
	0	1	
0	80.63	4.05	84.68
1	4.44	10.88	15.32
Total	85.07	14.93	100

Table A2 Alignment of Strata Variables, South Korea

	KWPS 2009	**KTUS 2009**	**Difference**
Population	43,219,236	43,297,959	-78,723
Number of Children in Household			
0	55.65%	58.52%	2.87%
1	17.22%	17.01%	-0.21%
2	23.04%	20.83%	-2.21%
3+	4.09%	3.64%	-0.45%
Number of Adults (18yrs and Over) in Household			
1	17.56%	20.79%	3.23%
2	53.31%	55.21%	1.90%
3+	29.13%	23.99%	-5.14%
Household is within the Poverty Band (y/n)			
No	84.66%	80.40%	-4.26%
Yes	15.34%	19.60%	4.26%
Presence of Non-employed Adult in Household (y/n)			
No	39.62%	46.71%	7.09%
Yes	60.38%	53.29%	-7.09%
Household Income Category			
Less than 1,500,000 won	24.12%	30.36%	6.24%
1,500,000 to 2,499,999 won	18.54%	21.00%	2.46%
2,500,000 to 3,499,999 won	18.31%	19.21%	0.90%
3,500,000 to 4,999,999 won	18.14%	17.08%	-1.06%
5,000,000 won or more	20.88%	12.35%	-8.53%
Gender			
Male	49.76%	49.40%	-0.36%
Female	50.24%	50.60%	0.36%
Individual is Employed (y/n)			
No	46.67%	43.78%	-2.89%
Yes	53.33%	56.22%	2.89%

Table A3 Distribution of Matched Records by Matching Round, South Korea

Round	Matched Individuals	Percent	Cumulative Percentage
1	30,023,820	69.5%	69.5%
2	3,046,900	7.0%	76.5%
3	431,694	1.0%	77.5%
4	2,836,124	6.6%	84.1%
5	368,664	0.9%	84.9%
6	279,794	0.6%	85.6%
7	118,028	0.3%	85.9%
8	224,546	0.5%	86.4%
9	1,287,745	3.0%	89.4%
10	147,355	0.3%	89.7%
11	503,805	1.2%	90.9%
12	318,167	0.7%	91.6%
13	506,900	1.2%	92.8%
14	1,301,080	3.0%	95.8%
15	234,521	0.5%	96.3%
16	597,816	1.4%	97.7%
17	263,293	0.6%	98.3%
18	728,951	1.7%	100.0%
Total	**43,219,202**	100.0%	

Table A4 Distribution of Weekly Hours of Household Production in KTUS 2009 and Matched File

	p90/p10	p90/p50	p50/p10	p75/p25	p75/p50	p50/p25	Gini
KTUS 2009	.	6.225	.	34.125	3.412	10.000	0.627
MATCH	.	6.125	.	27.300	3.412	8.000	0.625

Table A5 Comparison of Mean and Median Time Use Variables in Matched File to KTUS 2009

Average	Core	Procurement	Care	Household Production
KTUS 2009	9.97	1.08	3.47	14.51
MATCH	9.88	1.05	3.41	14.37
Ratio	99.10%	97.22%	98.27%	99.04%
Median	**Core**	**Procurement**	**Care**	**Household Production**
KTUS 2009	4.08	0.00	0.00	6.67
MATCH	4.08	0.00	0.00	6.67
Ratio	100.00%			100.00%

Table A6 Mean and Median Weekly Hours of Household Production by Strata Variable, KTUS 2009 and Matched File

Mean Weekly Hours of Household Production

	KTUS 2009	MATCH	Ratio			
Core	9.97	9.88	99.1%			
Procurement	1.08	1.05	97.2%			
Care	3.47	3.41	98.3%			
Household Production	14.51	14.37	99.0%			
Number of Children					KTUS 2009	MATCH
0 Children	13.22	13.29	100.5%			
1 Child	16.12	15.26	94.7%	**1/0**	1.22	1.15
2 Children	15.74	15.72	99.9%	**2/0**	1.19	1.18
3 or More Children	15.83	15.46	97.7%	**3+/0**	1.20	1.16
Number of Adults						
1 Adult	14.07	14.41	102.4%			
2 Adults	16.54	16.71	101.0%	**2/1**	1.18	1.16
3 or More Adults	11.66	11.80	101.2%	**3+/1**	0.83	0.82
Non-employed Adult in Household (Y/N)						
No	11.49	11.72	102.0%	**Yes/No**	1.46	1.34
Yes	16.83	15.70	93.3%			
Within Poverty Band (Y/N)						
No	14.07	14.03	99.7%	**Yes/No**	1.22	1.20
Yes	17.17	16.77	97.7%			
Household Income Category						
Less than 1,500,000 Won	17.00	17.10	100.6%			
1,500,000 to 2,499,999 Won	15.73	15.44	98.2%	**2nd/1st**	0.93	0.90
2,500,000 to 3,499,999 Won	14.78	15.46	104.6%	**3rd/1st**	0.94	1.00
3,500,000 to 4,999,999 Won	12.50	12.94	103.5%	**4th/1st**	0.85	0.84
5,000,000 Won or More	11.99	12.23	102.0%	**Top/1st**	0.96	0.95
Employed (Y/N)						
No	19.31	18.42	95.4%	**Yes/No**	0.56	0.59
Yes	10.77	10.83	100.6%			
Sex						
Male	23.74	23.14	97.5%	**Fem/Male**	0.21	0.24
Female	5.06	5.52	109.1%			

Median Weekly Hours of Household Production

	KTUS 2009	MATCH	Ratio
Core	4.08	4.08	100.0%
Procurement	0.00	0.00	
Care	0.00	0.00	
Household Production	6.67	6.67	100.0%

					KTUS 2009	MATCH
Number of Children						
0 Children	7.58	7.58	100.0%			
1 Child	7.00	6.42	91.7%	**1/0**	0.53	0.48
2 Children	5.25	5.00	95.2%	**2/0**	0.40	0.38
3 or More Children	4.50	4.17	92.7%	**3+/0**	0.34	0.31
Number of Adults						
1 Adult	10.67	11.67	109.4%			
2 Adults	8.00	7.67	95.9%	**2/1**	0.57	0.53
3 or More Adults	4.08	4.67	114.5%	**3+/1**	0.29	0.32
Non-employed Adult in Household (Y/N)						
No	6.00	6.42	107.0%	**yes/no**	1.17	1.09
Yes	7.00	7.00	100.0%			
Within Poverty Band (Y/N)						
No	5.83	6.00	102.9%	**yes/no**	2.20	2.04
Yes	12.83	12.25	95.5%			
Household Income Category						
Less than 1,500,000 Won	12.50	12.83	102.6%			
1,500,000 to 2,499,999 Won	7.00	7.00	100.0%	**2nd/1st**	0.56	0.55
2,500,000 to 3,499,999 Won	5.33	5.83	109.4%	**3rd/1st**	0.76	0.83
3,500,000 to 4,999,999 Won	4.67	5.00	107.1%	**4th/1st**	0.88	0.86
5,000,000 Won or More	4.67	5.25	112.4%	**Top/1st**	1.00	1.05
Employed (Y/N)						
No	9.33	9.33	100.0%	**Yes/No**	0.62	0.59
Yes	5.83	5.50	94.3%			
Sex						
Male	20.17	19.25	95.4%	**Fem/Male**	0.09	0.12
Female	1.75	2.33	133.1%			

Table A7 Ratio of Matched to KTUS 2009 Average Hours of Household Production for the Reference Groups

Number of Children	Number of Adults		
	1	**2**	**3+**
0	111.3%	99.7%	110.4%
1	71.8%	93.8%	86.9%
2	87.3%	110.1%	94.4%
3+	62.0%	94.8%	88.2%

Table A8 Likely and Assigned Industries for Labor Market Simulation Recipients

Assigned Industry	Likely Industry				
	Agriculture, Forestry, Fishery	**Manufacturing**	**Accommodation and Restaurant**	**All Others**	**Total**
Agriculture, Forestry, Fishery	**9,386**	-	-	-	9,386
Manufacturing	993	**324,786**	5,489	4,594	335,862
Construction	-	5,623	-	-	5,623
Whole/Retail Sale	-	-	4,772	-	4,772
Transportation	-	518	-	-	518
Accommodation and Restaurant	-	-	**54,647**	2,629	57,276
All Others	-	-	1,773	**221,447**	223,220
Total	10,379	330,927	66,681	228,670	636,657
Percent Match	**90.4%**	**98.1%**	**82.0%**	**96.8%**	**95.9%**

Table A9 Likely and Assigned Occupations for Labor Market Simulation Recipients

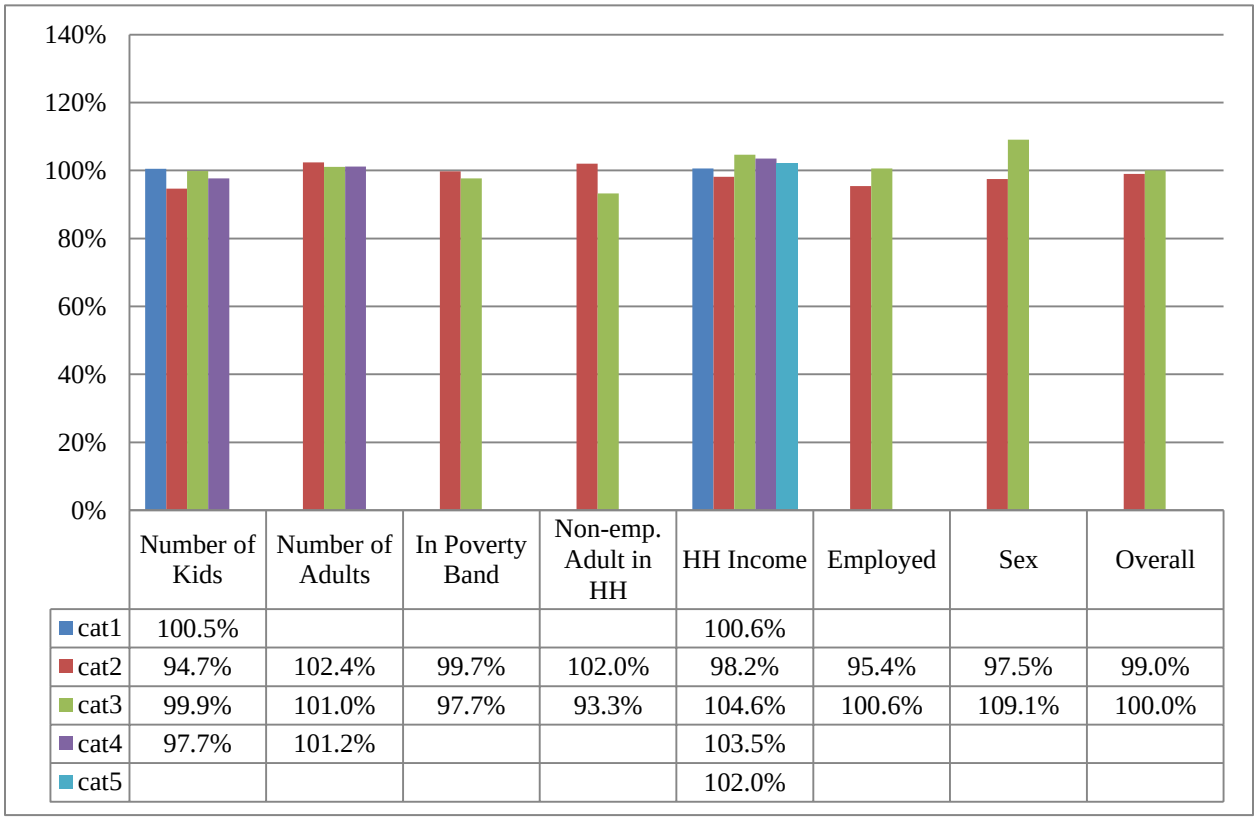
Assigned Occupation	Likely Occupation								
	professional occupations	Office and Administrative Support Occupations	Service Occupations	Sales Occupations	Farming, Fishing, and Forestry Occupations	Craft and Related Occupations	Machine Operation and Production Occupations	Manual Work Occupations	Total
Professional Occupations	**126,142**	-	-	-	-	-	-	-	126,142
Office and Administrative Support Occupations	-	**58,351**	-	-	-	-	-	-	58,351
Service Occupations	-	7,068	**1,609**	-	-	-	-	-	8,677
Sales Occupations	-	-	-	**6,591**	-	-	-	-	6,591
Farming, Fishing, and Forestry Occupations	-	-	-	-	**9,386**	-	-	-	9,386
Craft and Related Occupations	-	-	-	-	-	**31,812**	-	-	31,812
Machine Operation and Production Occupations	-	-	-	-	-	-	**124,889**	3,443	128,332
Manual Work Occupations	-	4,426	-	-	-	-	-	**262,940**	267,366
Total	126,142	69,845	1,609	6,591	9,386	31,812	124,889	266,383	636,657
Percent Match	**100.0%**	**83.5%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**98.7%**	**97.7%**

Table A10 Likely and Assigned Employment Types for Labor Market Simulation Recipients

Assigned Class of Worker	Likely Class of Worker			
	Regular Employee	**Irregular Employee**	**Employer and Self-employed**	**Total**
Regular Employee	363,902	-	-	363,902
Irregular Employee	20,277	244,632	-	264,909
Employer and Self-employed	-	-	7,846	7,846
Total	384,179	244,632	7,846	636,657
Percent Match	**94.7%**	**100.0%**	**100.0%**	**96.8%**

Figures

Figure A1 Ratio of Mean HH Production by Category (Match/KTUS 2009)



	Number of Kids	Number of Adults	In Poverty Band	Non-emp. Adult in HH	HH Income	Employed	Sex	Overall
cat1	100.5%				100.6%			
cat2	94.7%	102.4%	99.7%	102.0%	98.2%	95.4%	97.5%	99.0%
cat3	99.9%	101.0%	97.7%	93.3%	104.6%	100.6%	109.1%	100.0%
cat4	97.7%	101.2%			103.5%			
cat5					102.0%			

Figure A2 Household Production by Reference Groups, KTUS 2009 and Matched File

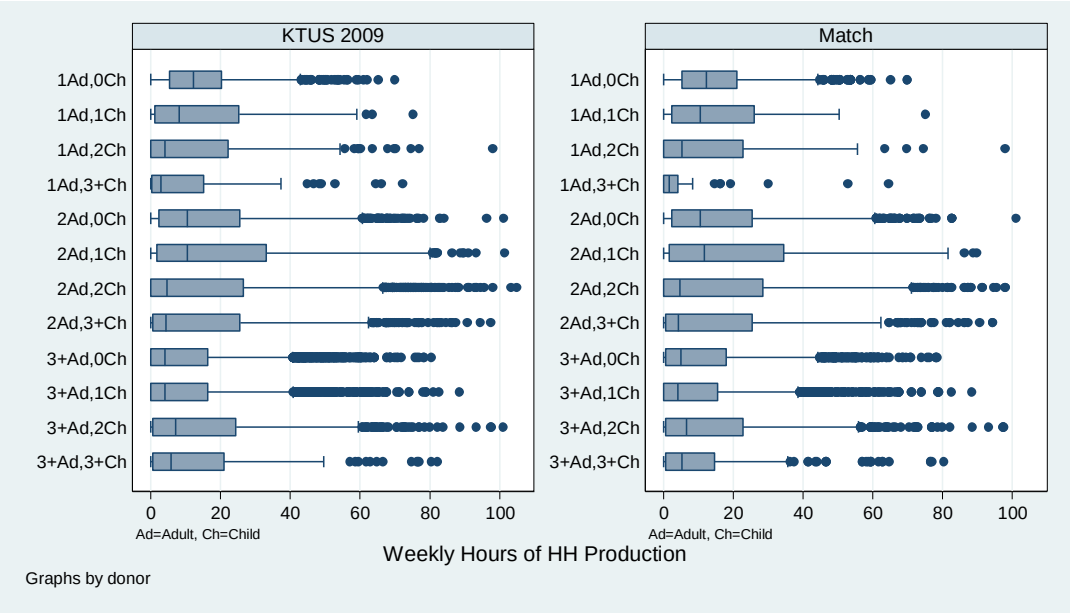


Figure A3 Donor and Recipient Pools for Labor Force Simulation by Sex, Age and Education

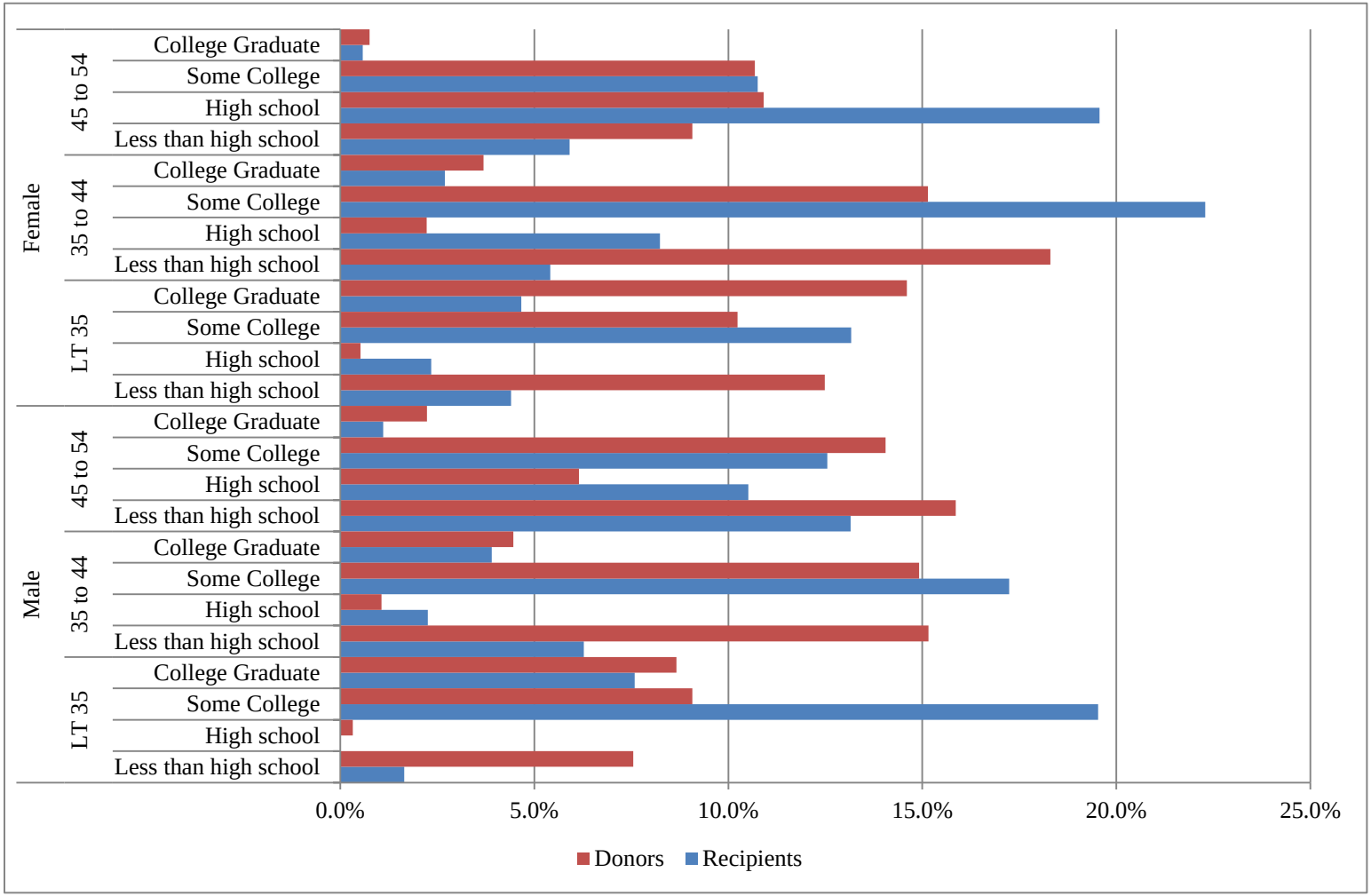


Figure A4 Ratios of Mean and Median Earned Income by Sex, Age and Education

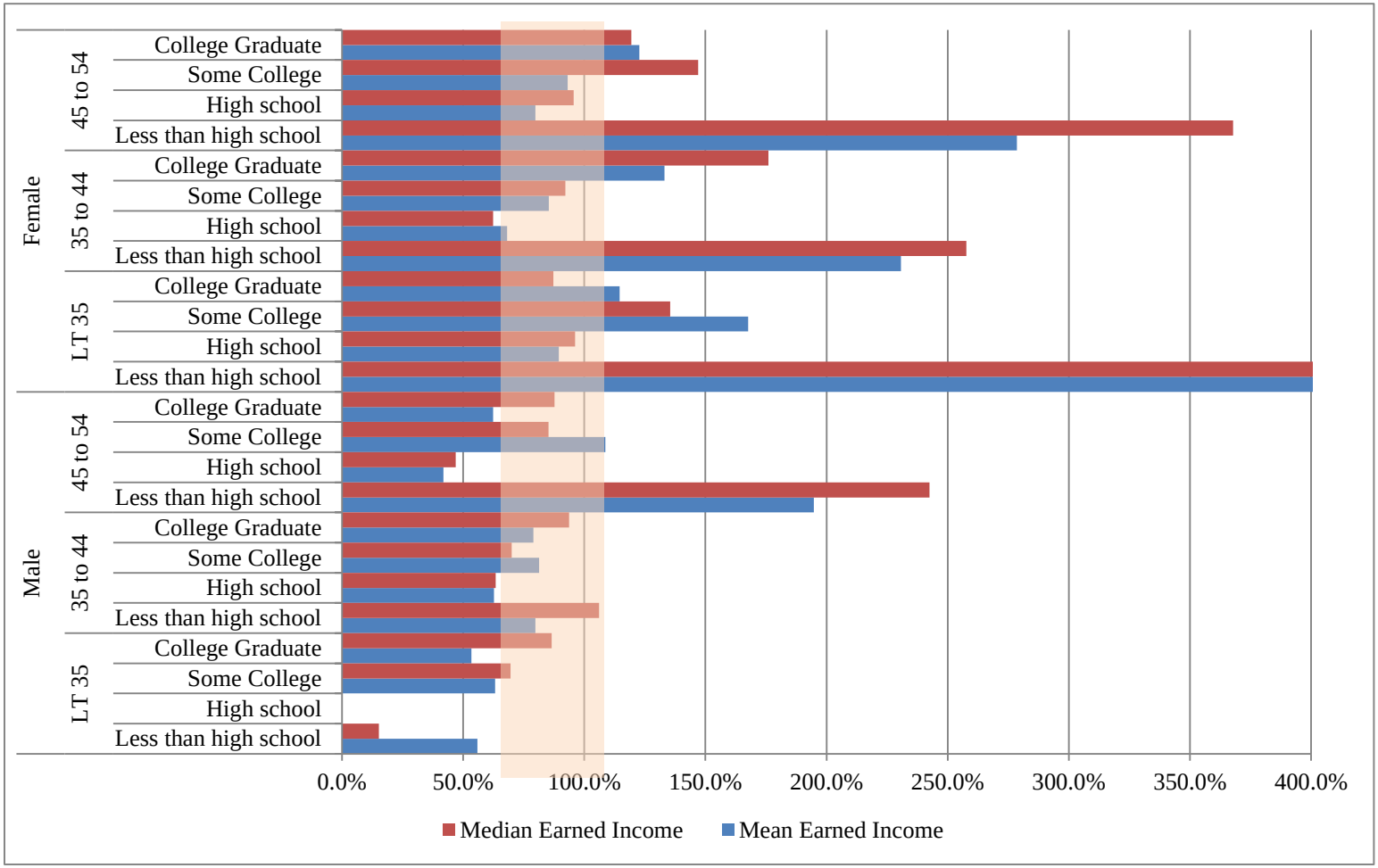


Figure A5 Ratios of Mean and Median Usual Hours of Work by Sex, Age and Education

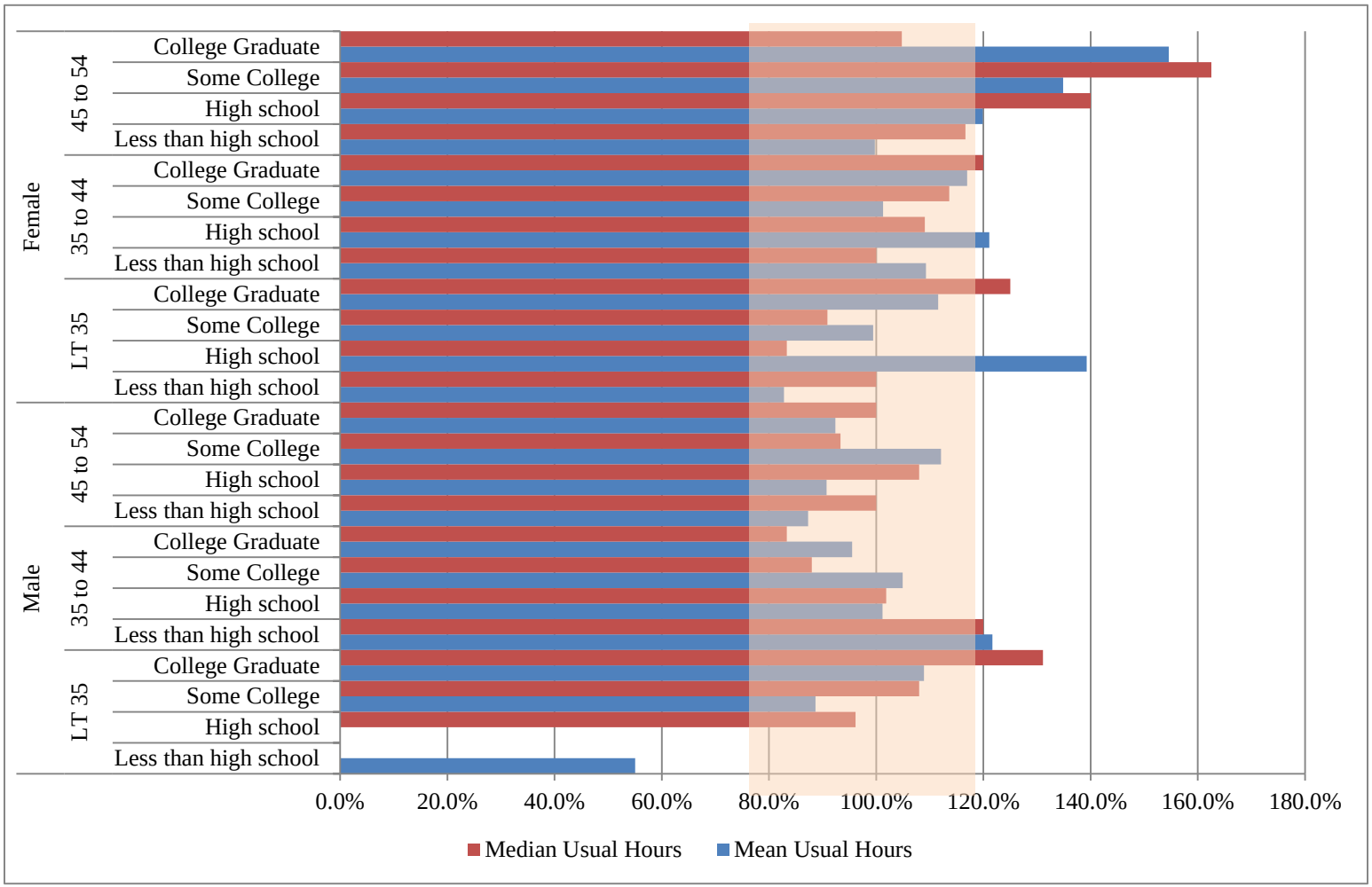


Figure A6 Donor and Recipient Pools for Time Use Simulation by Sex, Age and Education

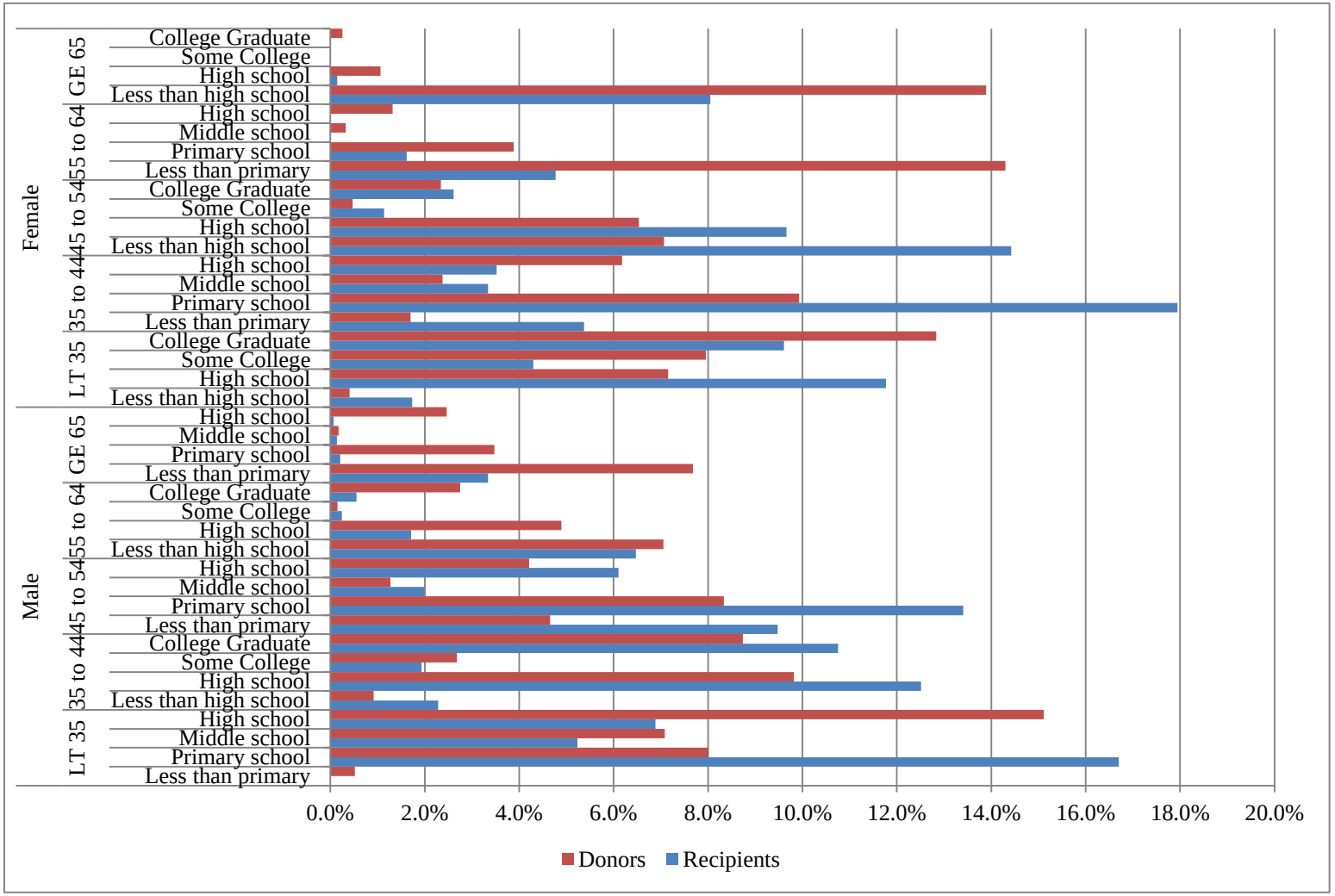


Figure A7 Donor and Recipient Pools for Time Use Simulation by Sex, Number of Adults and Number of Children

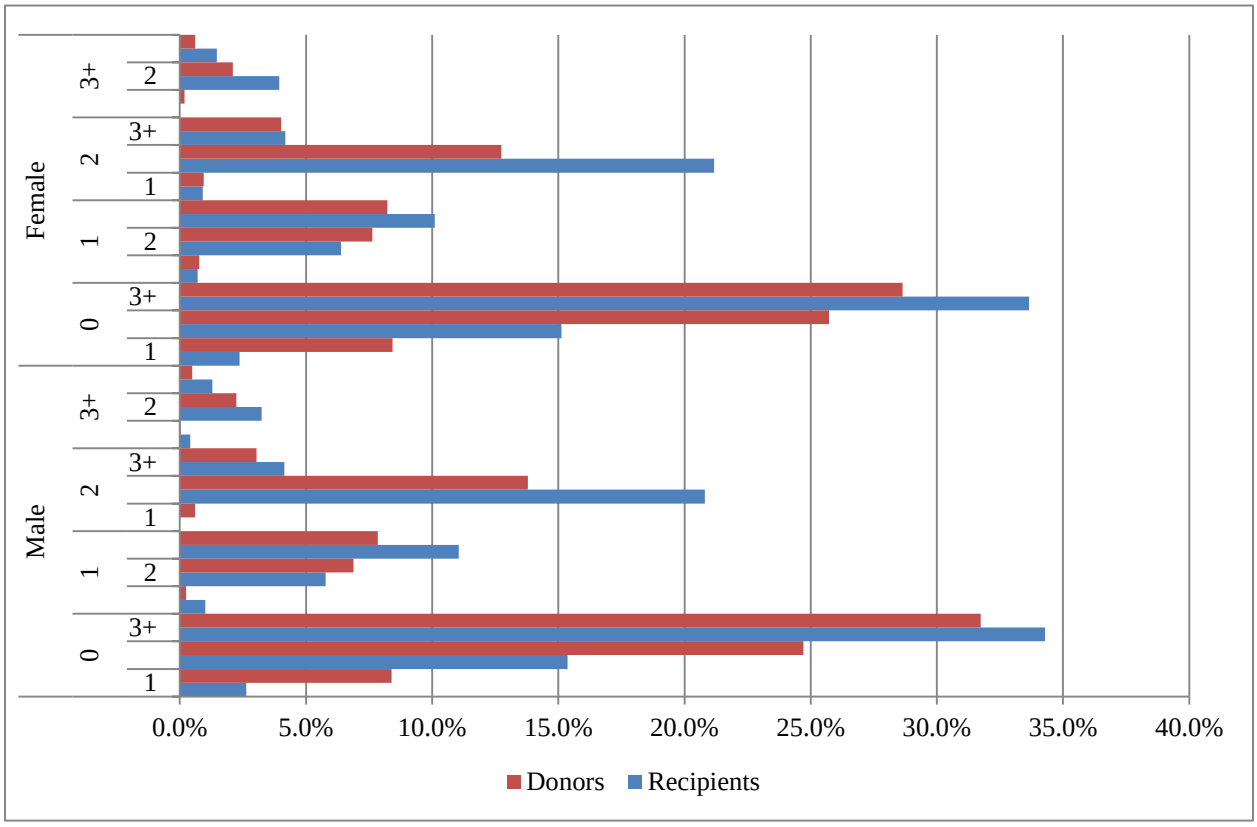


Figure A8 Ratios of Mean and Median Weekly Hours of Household Production by Sex, Age and Education

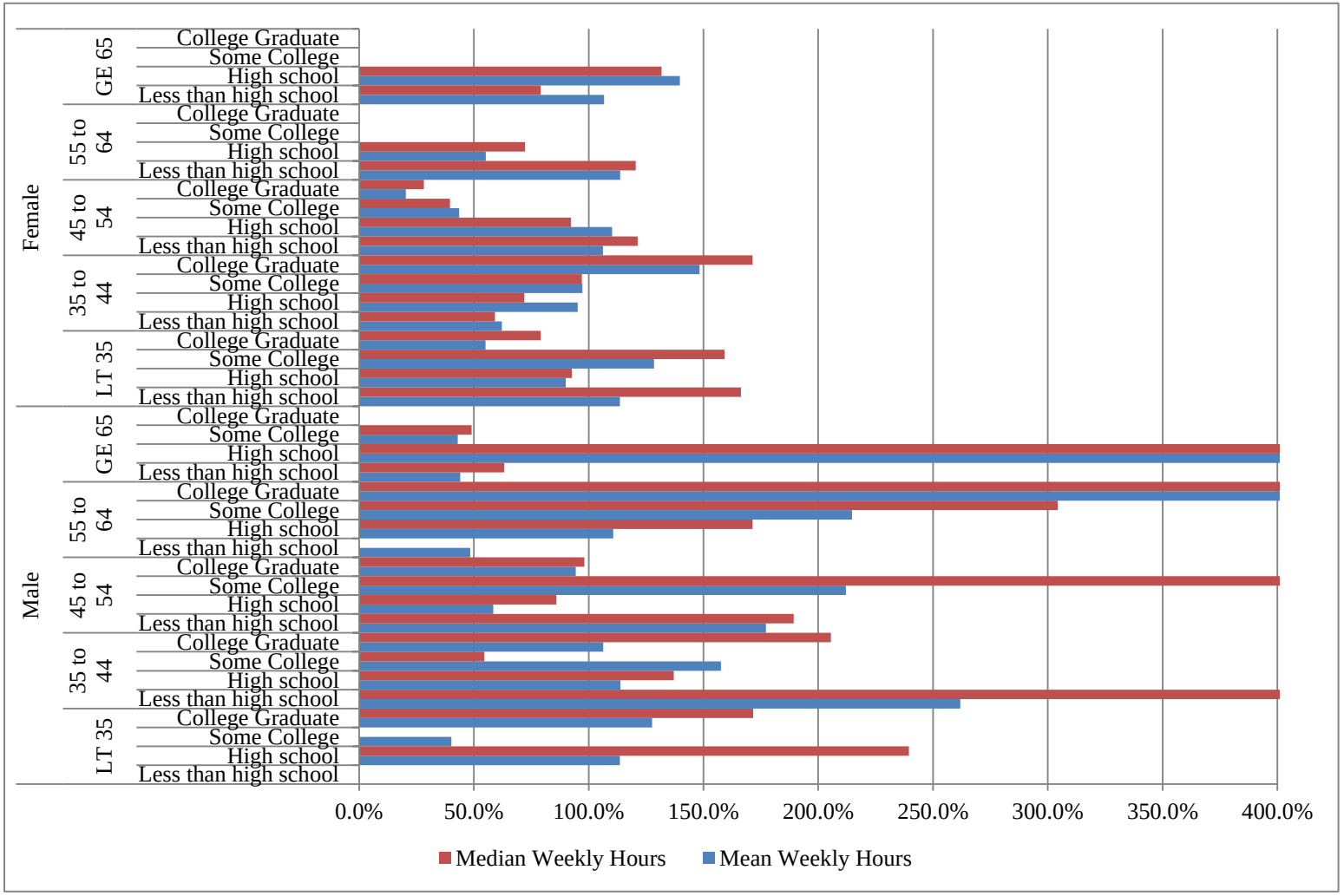


Figure A9 Ratios of Mean and Median Weekly Hours of Household Production by Sex, Number of Adults and Number of Children

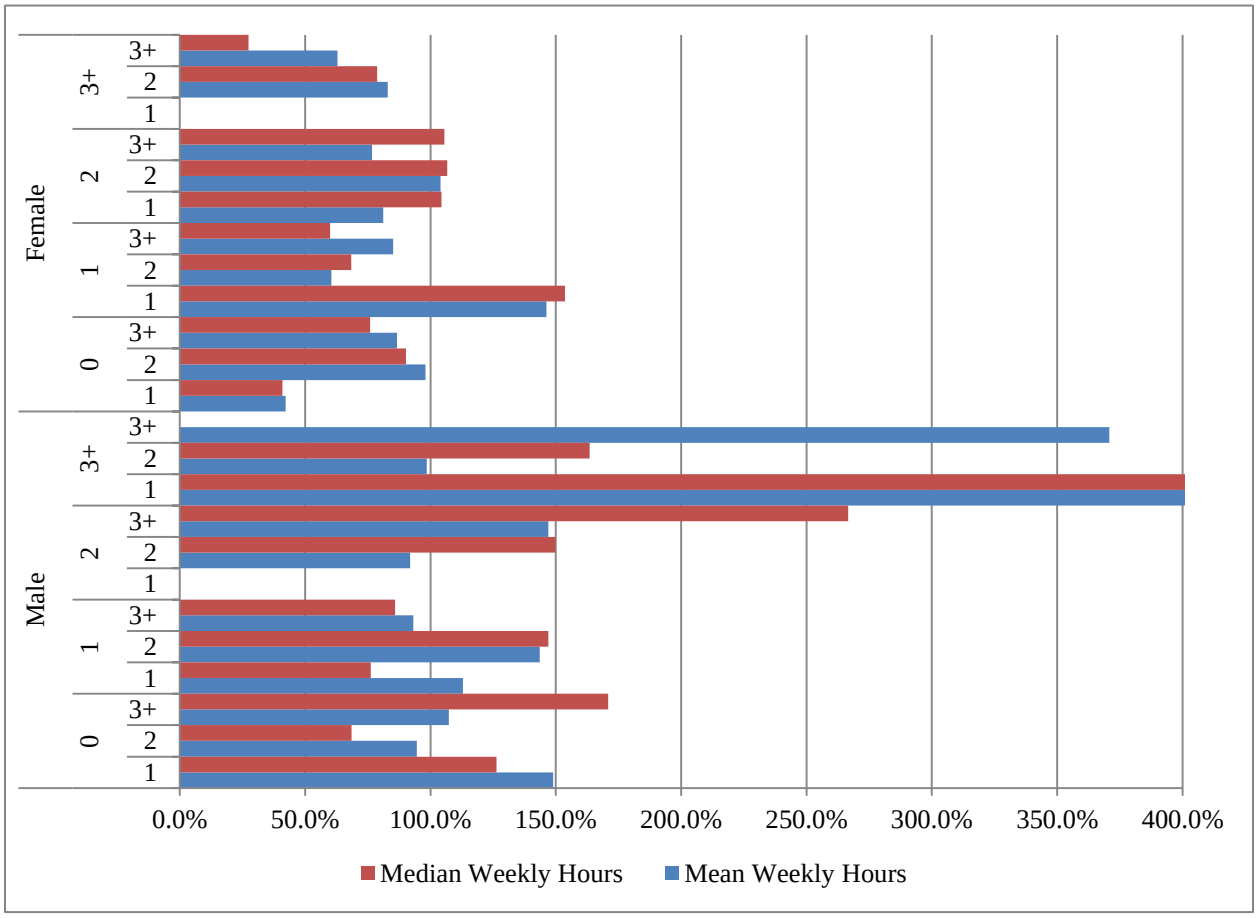


Figure A10 Donor and Recipient Pools for Childcare Hours Simulation by Number of Adults and Number of Children

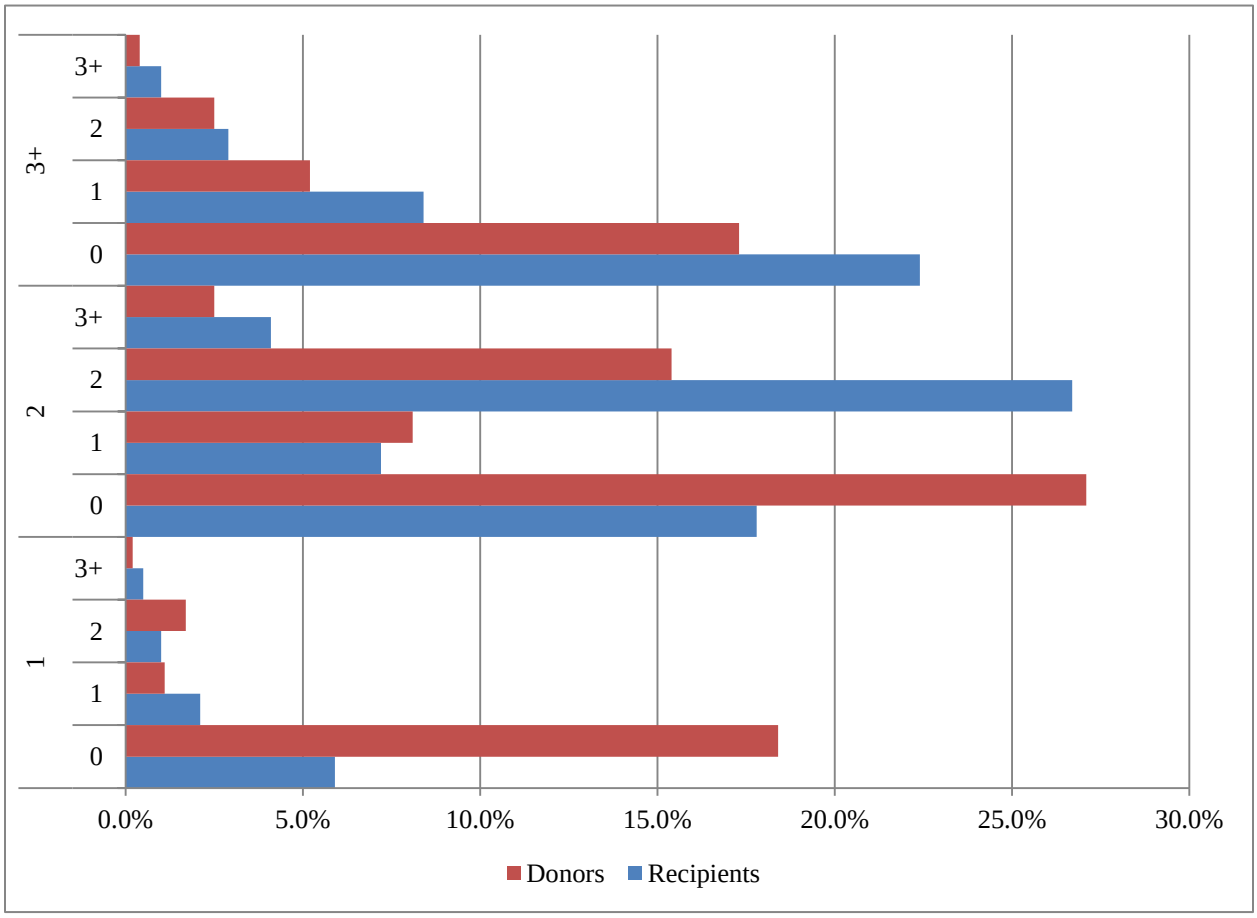
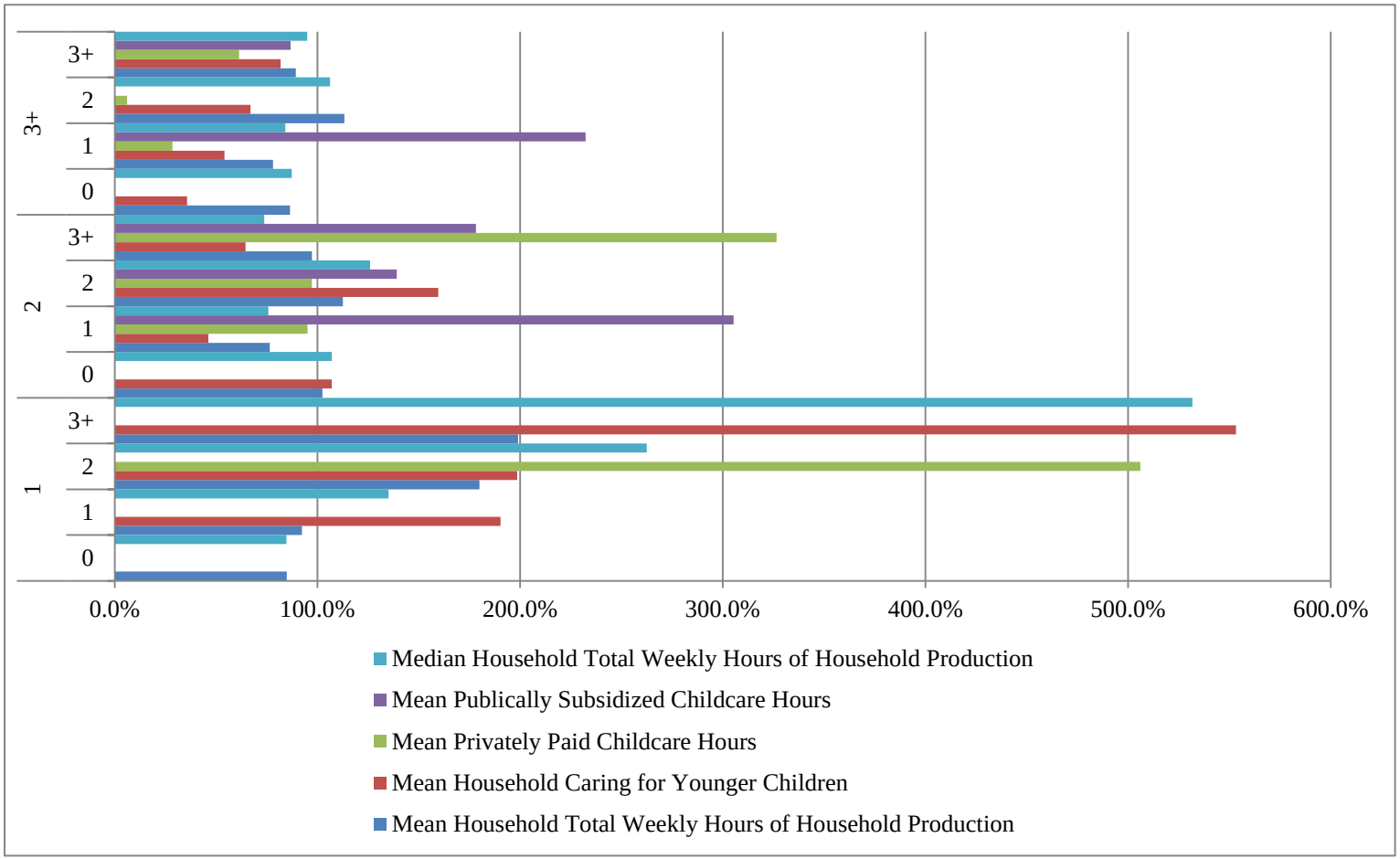


Figure A11 Ratios of Mean and Median Household Total Weekly Hours of Household Production, Privately Purchased and Publically Subsidized Childcare by Number of Children and Number of Adults

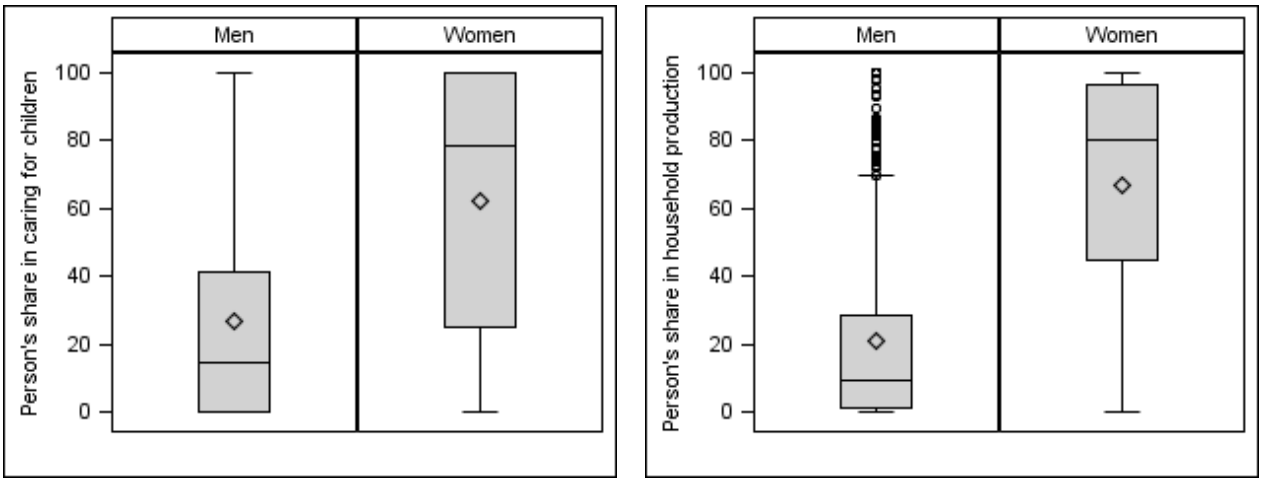


APPENDIX B: IMPUTATION OF OUTSOURCED HOURS OF CHILDCARE

This appendix describes the imputation of purchased and subsidized hours of childcare obtained by households with young children. As described in Section 2, we require for the imputation the individual's share in the household of total outsourced hours. To this end, we used the observed share of the individual in the combined total of the hours that all their household members spent on caring for children.[38] This is similar to the assumption that we made regarding the share of the individual in the household-level requirements of household production. The observed shares were obtained directly from the matched file. A comparison of the shares of men and women in the total hours spent by their household in caring for children against the shares in household production as a whole is shown in Figure B1. Compared to the gender disparity in the share of household production as a whole, the disparity in the share of caring for young children appears to be less.

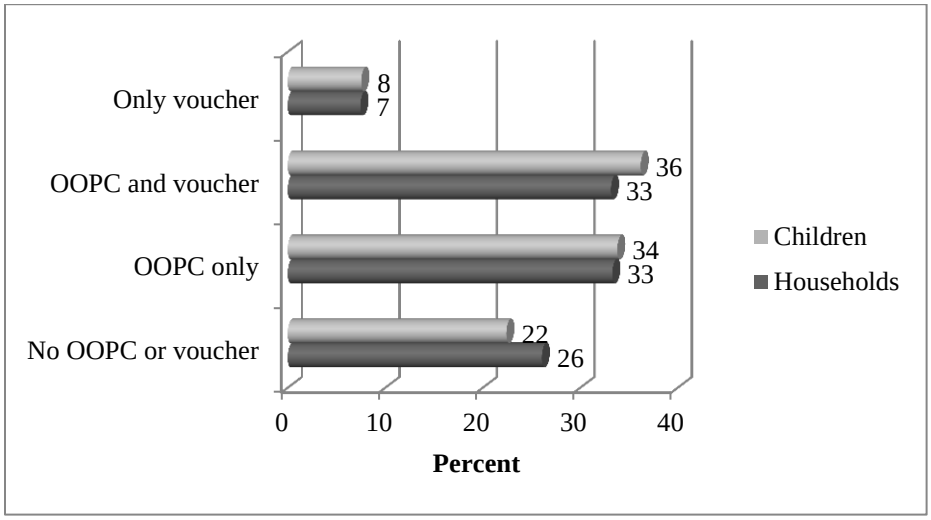
[38] A small proportion (10 percent) of households that outsourced childcare reported zero hours of in-home care of children by individuals in the household. To overcome the problem posed by this for the assignment of the time relief from outsourcing childcare to individuals, we imputed hours of in-home childcare to each individual in the household, added up the hours across all individuals in the household and then obtained the share of each individual in the household total. The imputed shares were used in assigning the time relief from outsourcing to each individual in the household. In order to impute hours of in-home childcare, we first estimated separate Tobit models of childcare hours for males and females in households that outsourced childcare and reported positive hours of in-home childcare. The independent variables used in the models were dummies for being under the age of 18, not employed, living in a household with two adults, living in a household with three or more adults, living in a household with two children, and living in a household with three or more children. Then, the estimated models were used to predict the hours of in-home childcare of individuals in households that outsourced childcare, but reported zero hours of in-home care of children by individuals in the household.

Figure B1 Person's Share in the Total Hours of Time Spent by their Household on Caring for Young Children (Left Panel) and All Household Production Activities (Right Panel) (Persons 18 to 70 Years Old in Households with at Least One Child Six Years or Younger)



Hours of government-paid care and purchased care were derived via process of imputation from the reported information on the value of vouchers received and out-of-pocket expenditures on childcare (OOPC). Among households with young children, 33 percent had only OOPC, 33 percent used a combination of vouchers and OOPC, 26 percent used neither, and 7 percent used only vouchers (Figure B2).

Figure B2 Percentage of Households with Young Children and Young Children (Households Incurring Out-of-pocket Expenditures on Children (OOPC) and/or Receiving Government Vouchers) by Type of Childcare Arrangement



In order to translate the OOPC into hours of purchased childcare, we estimated the hourly cost of privately-paid-for childcare. The latter was estimated from a reference group of households. Specifically, a household had to meet the following conditions to belong to the reference group:

- The household incurred only OOPC and received no vouchers
- The household had only one young child
- The only adults in the household were either the head or spouse of the head; or, a single female head that was the mother of the children in the household. In both types of households, the adult(s) had to be employed full time.

We imposed the restriction of households with no adults other than the head or spouse to minimize the possibility that childcare needs would be met by others in the household (e.g., an older sibling or grandparent). The restriction of full-time employment was placed so that we could be relatively certain that the parent(s) would have to rely on others to provide care to their young children on a regular basis. We believe that the two conditions, along with the restriction that the household had only a single young child, allows us to assume that the household would require full-time childcare. Full-time care was assumed to be 40 hours per week. On the basis of these assumptions, we calculated the average hourly cost of private childcare by the age of the

child in the reference group as OOPC per week divided by 40 hours.[39] The resulting estimates are shown in Table B1.

Table B1 Average Hourly Cost of Privately-paid-for Childcare Per Child by Age Group

Age group	Cost
Less than 3 years	2256
3 to 4 years	2036
5 to 6 years	1715

The OOPC reported in the data pertained to the total expenditures on all children in the household; that is, childcare expenditures are not broken down by each child in the household. Indeed, this was our motivation for restricting the reference group to consist only of households with a single young child. We obtained the hours of privately-paid-for childcare for households with a single child using their reported OOPC and the appropriate hourly cost from Table 1. For households with more than one young child, we calculated an hourly cost for all children in the household by averaging the hourly costs from Table 1. Clearly, the resulting hourly cost would vary among households depending on the number and ages of young children. The hourly cost was used to translate the OOPC into hours of privately-paid-for hours of childcare, with the provision that such hours would not exceed the maximum hours of full-time care required by the young children in the household.[40]

As noted above, the survey did not provide any information on the hours of childcare financed by government vouchers but only the value of the vouchers received by the household. Imputation of hours of care obtained via government vouchers were imputed separately for (a) households that used a combination of vouchers and OOPC to meet their childcare needs; and, (b) households that only used vouchers. To obtain the estimates for the first group, we began by

[39] We used three age groups in the calculation: less than 3 years, 3–4 years, and 5–6 years.
[40] The maximum weekly hours of full-time care required by the young children in the household was assumed to be equal to the number of young kids multiplied by 40. Without such a cap on hours, it would appear that some households leave their children with care providers for unrealistically large number of hours.

constructing a reference group. A household had to meet the following conditions to belong to the reference group:

- The household incurred OOPC and received vouchers
- The only adults in the household were either the head or spouse of the head; or, a single female head that was the mother of the children in the household. In both types of households, the adult(s) had to be employed full-time.

We assumed that, for the reference group, the total hours of childcare met via OOPC and vouchers was equal to the maximum hours of full-time care required by the young children in the household. Our rationale for this assumption is two-fold. First, the very fact that the households incur OOPC indicates that the hours of care obtained via vouchers were not sufficient to meet their needs. Second, households in the reference group require full-time care because the adult(s) in the household are in full-time employment. On the basis of this assumption, we calculated the hours of care provided for young children in the reference group via vouchers by subtracting the hours of privately-paid-for hours from the maximum hours of full-time care.

For the remaining households that incurred OOPC and used vouchers (i.e., households not in the reference group), we imputed hours of care provided by vouchers on the basis of the summary statistics for the reference group. Specifically, we calculated, by the value of vouchers and number of children,[41] the mean value and standard error of the hours of care provided via vouchers in the reference group. Next, we assigned hours to households that were not in the reference group on the basis of a formula that added together the mean value and a random "noise" term that was derived from the standard error of the mean, with the provision that the resulting value would not exceed its maximum possible value. The latter was set by subtracting the hours of privately-paid-for hours from the maximum hours of full-time care.

[41] We categorized the number of young children in the household into two groups: one child and two or more children (there were only very few households with three young children). Households with one young child were divided into three groups based on the monthly value of vouchers they received: less than ₩100,000, ₩100,000–₩150,000, and above ₩150,000. Households with two or more young children were grouped into two groups (because of the small number of observations in the reference group): less than ₩250,000, and above ₩250,000.

The final group of households in the imputation process was households that received only vouchers and incurred no OOPC. We implemented an imputation that was identical to the imputation for households that were not in the reference group among households that incurred OOPC and used vouchers. Of course, the reference group in this instance was different. To belong to the reference group, a household has to satisfy the following conditions:

- The household incurred OOPC and received vouchers
- The amount of its OOPC did not exceed the 25th percentile value of OOPC of households with the same number of young children[42]

We imposed the second restriction to ensure that we would impute hours that resembled as much as possible the hours of subsidized care obtained by households that spent very little of their own money on childcare.

To summarize: The hours of childcare obtained by households with young children via OOPC or government vouchers cannot be observed directly in the data. We imputed the hours in successive stages by utilizing the information on OOPC and value of vouchers. First, we derived an estimate of the average hourly cost per child (of a given age) of unsubsidized care. This hourly cost was used to construct an hourly cost for all children in the household because OOPC is not reported separately for individual children in the household. Using the latter, we calculated the hours of care obtained by OOPC. In the next stage, we derived the hours of care financed by vouchers as a residual from the maximum hours of full-time care for households that incurred OOPC and received vouchers. Finally, the hours of care financed by vouchers for households that received only vouchers were imputed on the basis of the hours of such care obtained by households that, in addition to receiving the vouchers, spent very little of their own money on childcare.

[42] Households were grouped into those with one young child and those with two or more young children.