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Counting Women's Labour:

A Reanalysis of Children's Net Production Using Cain's Data from a Bangladeshi Village

Rachel Sullivan Robinson,
School of International Service, American University

Ronald D. Lee, and
Departments of Demography and Economics, University of California, Berkeley

Karen L. Kramer
Department of Anthropology, Harvard University

Abstract

The economic contribution of children to their parents' households has long interested demographers because of its potential to influence fertility levels. Valuing children's labour in pre-industrial economies, however, is inherently difficult. The same is true of women's labour, a crucial component to any analysis of net production. Here we use Mead Cain's seminal (1977) study of children's economic contributions in a Bangladeshi village to illustrate these points. We combine Cain's data on landless women's and men's hours of work with data on the efficiency per hour of work from other pre-industrial settings (Mueller 1976; Kramer 1998). When women's labour is incorporated, we find that the Bangladeshi children begin to produce as much as they consume by ages ten (girls) or eleven (boys). Despite these productive contributions, neither women nor men "pay" for their cumulative consumption until their early twenties. We believe these methods could be usefully applied in other contexts.

Keywords

Child worth; female role; Bangladesh; Mead Cain; Maya

Introduction

One of the persistent goals of demography has been to understand why fertility is frequently high in poor, pre-industrial societies. Questions surrounding this theme particularly occupied academic as well as development circles in the 1970s, as demographers and policymakers alike turned their attention towards the rapid population growth of the Third World. During this period, John Caldwell and Mead Cain both made key contributions to the perspective that high fertility in such situations was economically rational for individuals. Caldwell (1976) argued that prior to the demographic transition, the direction of wealth flows was from children to parents. Cain (1977) added empirical flesh to Caldwell's argument by measuring the economic productivity of boys in rural Bangladesh and comparing it to their consumption. He concluded that boys' production first exceeded their consumption on a daily basis at age twelve (crossover age), on a cumulative life time basis at age 15 (breakeven age), and made up for a non-productive sister's cumulative consumption by age 22. Cain did not, however, take into account the labour of girls and women in his calculations. In the analysis presented below, we return

Address correspondence to: Rachel Sullivan Robinson, School of International Service, American University, 4400 Massachusetts Avenue, NW, Washington, DC 20016, USA, robinson@american.edu.

to Cain's data, this time including females' labour. In so doing, we address the same set of measurement challenges as Cain, Caldwell, and all other researchers who have explored this topic, along with larger questions about the relationship between high fertility and the economic role of children in pre-industrial settings.

Assigning value to the economic contributions of women and children in pre-industrial economies is difficult because much of their labour takes place outside of labour markets and does not produce a readily quantified output. Conversely, the labour of men, even when it is outside the market, often generates observable output that can be measured, for example by its caloric content. Thus anthropologists may measure age- and sex-specific production by "calorie counting." This technique, however, understates the contributions of women through food processing, meal preparation, chopping firewood, fetching water, and other important domestic tasks, such as child care. Furthermore, because we often we seek to estimate net production, we must somehow value consumption as well as production. If women's work preparing a meal is a valuable activity, then this value must be included as part of the value of the meal when it is consumed. Taking account of women's economic production means raising the estimated value of men's consumption while leaving their production largely unchanged, thereby reducing men's measured net economic contributions. To evaluate the magnitude of the effect of inclusion of women's economic contributions on household production and consumption, we choose the familiar Bangladeshi example from Cain (1977), both because it is frequently cited as evidence of the positive impact of wealth flows on fertility in traditional societies, and because Cain collected the appropriate data. However, our approach is more general and could easily be applied to other contexts.

Mead Cain's (1977) seminal study of the economic value of children in the Bangladeshi village of Char Gopalpur illustrates the traditional calorie counting approach. He drew on his time-use data to calculate the caloric contributions of males by age, which he then balanced against their imputed caloric consumption to derive his main results. He excluded the labour of women, which occurred mainly in the home, such that females entered the calculation only as consumers. Cain's conclusion that children in this Bangladeshi village were economically valuable to their parents provided empirical support for Caldwell's wealth flows theory, and his pioneering study established a method for studying economic production in a non-market economy.

Other work, however (Mueller 1976; Kaplan 1994; Kramer 1998, 2005; Stecklov 1999; Lee 2000; Lee and Kramer 2002), has found that in pre-industrial settings children are *expensive* to their parents. Asking similar questions, these studies have extended Cain's original work, but reach alternate conclusions by using differing estimates of production or consumption by age. Although children may make substantial economic contributions, these only partially offset their cumulative consumption costs. Indeed, in work on other Asian countries, Cain (1982) himself found that children are costly.

In this paper we take a different tack, and question the conceptual basis for Cain's accounting. Our purpose is not to criticise Cain's seminal contribution, but rather to build on it in new ways. Specifically, we ask what happens if the economic contributions of females are taken into account using Cain's own time-use data, both as production and as a component of consumption: were the children of Char Gopalpur really as economically beneficial to their parents as Cain suggested?

Although Cain only calculated the productive value of men's work, he presented age-specific time-use data for both males and females by economic class (landless, small landowners, and large landowners). We employ these time-use data for individuals in landless households and then make further adjustments for the differences in the productive efficiency of men's versus women's time, as well as children's versus adults' time. Because Cain did not provide the data to make these necessary additional adjustments, in this paper we draw on estimates by Kramer (1998,2005) and Mueller (1976) for men's and women's relative efficiency per hour of labour at different ages. We use these efficiency estimates to assign value to the work time of landless females and males at different ages in Char Gopalpur. These new estimates of total production, including women's household production, allow us to form related estimates of consumption and therefore of net production by age for individuals whose families' only source of income was from labour. Of particular interest are the ages at which children first produce more than they consume (crossover age) and at which their cumulative production first exceeds their cumulative consumption (breakeven age). These results give us a fresh look at the contributions of women and children in the Bangladeshi setting, and provide a different estimate of wealth flows based on this classic study. The methods we describe should be more generally applicable.

The analysis we present below is conducted at the individual level in order to maintain the closest comparison to Cain's (1977) calculations, also carried out at the individual level. Given that the overarching question in such research is about the economic rationality of fertility, a household-level analysis looking at the contributions and costs of all family members would also be informative. Cain's data do not readily lend themselves to such an analysis, however, so we focus on adding the value of women's and girl's labour to the calculations as he performed them.[i]

Data

To assess the balance of production and consumption in any setting, researchers must first measure their respective values. This measurement task is complicated by the fact that often neither production nor consumption can be directly observed, and even simply tallying the hours spent by each individual in productive work neglects differences in the rate of return to work by age and sex. In order to account for these differences, we use productivity "weights" that indicate how productive per hour an individual of a given age and sex is relative to an adult. Multiplying the hours worked by each age-sex group by the appropriate weight expresses output by males and females of different ages in equivalent units. Similarly, because consumption is difficult to observe (e.g., individuals in traditional societies often eat from a common pot and people in all societies snack), we rely on standard tables to estimate how consumption is distributed across the different age-sex groups in the population. To assess the sensitivity of our results to these assumptions, we present results based on a range of assumptions. The following section describes these measures of production and consumption as well as other factors (population age structure, mortality) that we use in our analysis.

Cain (1977) followed the standard economic approach of using wages to measure productivity. He multiplied observed market wages by the hours worked by males in agricultural tasks to estimate their production by age. Because women and girls rarely, if ever, engaged in market work, Cain could not assess their efficiency per hour of labour via this method. As a result, women's economic contributions, largely in household production, were excluded from the analysis and Cain's count of total production was limited to the food production activities of males. This strategy underestimated the amount produced by villagers, especially by females and younger children, and also the amount they consumed, since the time costs of meal preparation, child care, and other home production tasks were ignored. Cain's overall approach thereby favoured his conclusion that boys cumulatively covered their consumption costs by age 15.

[i]For discussion of the implications of household versus individual level analyses of the economic costs of children, see Lee and Kramer (2002).

In the analysis presented below, we rely on Cain's (1977, p. 218) age-sex specific daily time-use measurements. He presented hours worked by economic class, which he based on land ownership. In order to simplify our calculations, we focus specifically on landless individuals, approximately one third of the village population. In order to include women fully, we use their hours of total work in our calculations, not just those that Cain labelled "productive." Instead of using wages to infer the relative efficiency of individuals per hour of work, however, we use direct observation data on output per unit time from a different pre-industrial setting and gathered by Kramer (1998). These data describe the observed productivity by age of Maya males and females in various tasks in a village in Yucatan, Mexico. As an alternative to the Maya data we also use Mueller's (1976) estimates of the relative efficiency of males and females by age, based on a time period and location closer to that of Cain's Bangladesh. Each set of efficiency weights, called a production profile, is described in detail below and presented in Table 1.

Despite the temporal and spatial distance between the Maya and the villagers of Char Gopalpur, the application of Kramer's productivity weights to the Bangladeshi time-use data is justified on a number of grounds. In both populations, villagers practice subsistence agriculture, individuals perform similar tasks, children begin productive work by age four, daily hours worked increase sharply during the early- to mid-teens, teens are as productive as adults (by age 13-15 in Bangladesh and by age 16 among the Maya), and there is a strong sexual division of labour. Relative efficiency cannot, of course, be perfectly consistent across economic and cultural settings. Indeed, the Maya practice extensive agriculture rather than intensive, the Maya village is isolated from markets, and clearly the Maya culture is distinct from that of Bangladesh. Culturally-based discrimination against women and girls may also influence the calories available to them. We account for the direct effect of discrimination on caloric-intake in the consumption profiles below, but cannot determine the degree to which it might have influenced their efficiency. For this reason, as well as any other unobserved reasons why relative efficiency may vary across social setting, we employ a range of productivity profiles with different efficiencies of women relative to men, and of children relative to adults. There are also, however, several reasons why we would not expect relative efficiency to differ much by economic and cultural setting.

Economic and cultural differences will most frequently affect individual time budgets, and only in extreme circumstances alter relative efficiency per unit time, which is primarily determined by biology. Specifically, for people living close to subsistence levels, poor nutrition will most likely affect adults and children equally. It is only in dire economic conditions that parents would downwardly adjust their children's consumption such that it would differentially affect children's activity levels or relative efficiency to a great enough degree to affect the types of calculations we perform. Similarly, cultural setting mainly leads to different amounts of time spent performing particular activities by age and sex, but is largely unrelated to the relative efficiency per hour doing hard physical labour. Furthermore, relative efficiency at skilled household tasks depends more on proficiency than physical strength, and in both the Maya and Bangladeshi settings, males spend little time in home production.

For the above reasons, we believe that Kramer's (1998,2005) careful studies of productivity per unit time in the Maya setting are highly relevant for the Bangladeshi villagers. Women's productivity was not measured in Cain's original (1977) study, so our strategy is to use Cain's measures of the time spent in various activities by males and females at different ages, but to weight these using the relative efficiency measures from the Kramer and Mueller studies. Although these relative efficiency profiles are approximations for the true experience of the people of Char Gopalpur, based on the above discussion we believe that they are good ones, and by using a variety of profiles we can assess the dependence of our results on our assumptions.

In our analysis, we use three production profiles (P_{High}, P_{Medium}, and P_{Low}) that vary in the relative productivity per hour of work performed by an adult female versus an adult male. P_{High}, based on the Maya data, weights women as 84 per cent as efficient as men at heavy, physical tasks. Because women perform a combination of strenuous and less-strenuous tasks, overall this profile weights women as 95 per cent as productive as men. As a sensitivity check, we use a variant of the Maya data, called P_{Medium}, which weights women as 75 per cent as productive as men at heavy physical tasks, following Mueller (1976). This results in adult women overall being 88 per cent as productive as adult men. Finally, we employ Mueller's (1976) relative efficiency by age and sex as a third variant (P_{Low}) for calculating our outcome measures. This profile is based on survey data from India and Egypt, which Mueller adjusted to account for the labour of women and children (employed mainly during peak seasons). In this profile, children do not work until the age of ten, and adult women are 75 per cent as efficient as men overall. These three profiles provide us with a set of efficiency estimates to use with our calculations that bracket a reasonable range of values and so make up for our lack of a direct measure of relative efficiency in Char Gopalpur as well as any differences between the Bangaladeshi setting and that of Kramer and Mueller's data.

As in almost all studies, we infer the relative levels of consumption by age and sex from standard age-sex specific caloric-need tables. We use two such profiles, C_{Low} and C_{High}, which are described in Table 1. Relative to adult male consumption, under C_{Low} a woman consumes much less per day than under C_{High}. C_{Low} refers specifically to Bangladeshi caloric needs in the 1970s (Chen 1975) and is the same source Cain (1977) used. In this profile, adult females consume only 65 per cent as many calories as adult males. Even accounting for the extreme sex discrimination in Bangladesh, this figure is quite low. Indeed, for Matlab, Bangladesh at the same time, Chen et al. (1981) found that women consumed 72 per cent as much as men. To see how much Cain's relatively low caloric intake for women influences our results, we employ a second consumption profile, taken from Mueller (1976). In this profile, called C_{High} and based on a compilation of surveys by Mueller, adult females consume 80 per cent as much as adult males.[ii]

These three production profiles and two consumption profiles leave us with a total of six combinations of profiles to use in calculating our outcome measures. This range of combinations allows us to better assess the likely impact of including women's labour when measuring net cumulative production.

We assume that total household production is allocated to household members for consumption in proportion to caloric needs, and that total production equals total consumption. For the landless total production is derived exclusively from their labour so we can simply allocate total labour income, computed as described above, to consumption in proportion to caloric needs. (For landowners, we would need an additional assumption about the relative amount of income accruing to their land.) Consequently, the average age profiles of production and consumption should yield equal totals when multiplied by the population age distribution of the landless and summed. Because Cain did not report the full age-sex structure of the landless or of the full population of Char Gopalpur, we use the national age distribution reported in the 1974 Bangladeshi census (US Census Bureau 2005). Our fragmentary information about the age distribution in Char Gopalpur is sufficiently consistent with the national population age distribution that we feel justified in doing so. In particular, Cain (1977, p. 201) reported that almost 50 per cent of the villagers were less than age 15, which agrees well with the 48 per cent reported in the national census.[iii]

[ii]Conveniently, C_{High} and C_{Low} bracket the estimates of daily caloric intake from the 1981-82 Nutrition Survey of Rural Bangladesh employed by Pitt et al. (1990) in their examination of the determinants of calorie consumption in Bangladesh. The data from this survey indicate that adult women consume 73 percent as much as adult men.

Because Cain only provided data on individuals younger than 60, we are forced to limit our analysis to this age range as well. Almost 95 per cent of the 1974 national population of Bangladesh was younger than 60, suggesting that excluding those 60 and older from our analyses should have at most a small effect on our results. (Indeed, if production and consumption of those 60 and over were equal on average, omitting them would have no effect at all.) Sensitivity tests show that including adults over age 60 and making reasonable assumptions about decreased productivity among elderly individuals would not qualitatively alter our conclusions about individual-level net production.

Because we seek to estimate the expected economic value of children to their parents at their time of birth, we need to take into account their likelihood of survival to each age. We assume mortality follows the Coale Demeny model west female life table with $e_0 = 50$ (Coale and Demeny 1966), which is approximately the national level reported for Bangladesh in the 1970s by the United Nations (2003) and is consistent with the evidence from Cain (1977, 1978) on the demographic characteristics of Char Gopalpur. We multiply net production in each age interval times life table person-years lived and then sum this to calculate the cumulative net value up to each age in order to find the age at which as much has been produced as has been consumed. Incorporating survival in the estimates reflects the net contributions of siblings who die before reaching each age. Cain did not include mortality in his analysis, and although its inclusion is justified on theoretical grounds, it does not have a large affect on the results. Specifically, as expected, taking survival into account means that it takes longer for children to break even because they must compensate for the consumption of deceased siblings. In the case of males, we find that, on average, including mortality increases breakeven age by one to four years (between seven and eleven percent). Giving a substantive interpretation to the result of this sensitivity calculation, we can also conclude that mortality decline tends to raise the economic value of children or to make them less costly, other things equal.

Overall, including population age structure and mortality makes the calculations more realistic without excessively complicating Cain’s elegantly simple accounting procedures.

Methods

We convert time spent on agriculture and home production into calories so that all production and consumption can be compared in the same units (calories). Although we make our comparisons in units of calories, we refer to our method as a “time-use” approach because it is based fundamentally on the hours worked per day, rather than on the calories produced per day. We then compare production and consumption in calculating our main outcome measures: crossover age, breakeven age, cost at age of home-leaving (analogous to age at marriage for women), and proportion of cost at age of home-leaving paid for by the child by that age. Crossover age is the age at which an individual begins to produce as much as she consumes in a day, while breakeven age is the age at which an individual’s lifetime production equals her lifetime consumption. We measure the cost of children at the age of home-leaving in two ways described below.

Our calculation of production and consumption involves the following steps, as illustrated in Figure 1 and Tables 2 and 3. Tables 2 and 3 show the calculations for just women using P_{High} and C_{Low} as the production and consumption profiles, respectively. Table 2 presents the calculations carried out at the aggregate level in order to determine the conversion factor between hours of adult work and calories, while Table 3 shows our calculation of individual

[iii]Similarly, a Coale Demeny female, model west life table ($e_0 = 50$) with total fertility of 7.3 (the same total fertility that Cain noted (1978, p. 423) in the village) indicates that 45 per cent of the males and 44 per cent of the females should be under 15.

crossover and breakeven ages. In this example, the average adult produces 308 calories in one hour of work, girls cross over just before age eight, and break even between 21 and 22.

Of course, even poor people consume more than food, but so long as consumption and production at each age are proportional to consumption and production of food, the measures in which we are interested—crossover and breakeven ages—will not be affected.

We are also interested in where the parent-child balance of accounts stood at the time of home-leaving, essentially the age at marriage in Char Gopalpur. Although a child could still contribute to his or her parents after leaving home, the age at home-leaving is a convenient point at which to assess cumulative net production. The average age at home-leaving in Char Gopalpur was 16 for females and 26 for males (Cain 1978, p. 423). This was the average age at marriage for women, but two years after the average age at marriage for men.[iv] The "cost" to age at home-leaving is the individual's cumulative production minus cumulative consumption up to that age, expressed in terms of years of average annual adult consumption, divided by the probability of surviving to that age if the value is positive, and multiplied by the probability of surviving to that age if the value is negative. (Thus this cost is assessed at age of home-leaving rather than as an expectation at time of birth.) In the case of the C_{Low} consumption profile, average annual adult consumption equals [(2476 + 1598) / 2] * 365.25 = 743,832 calories. In this example, net cumulative production for females calculated at the individual level at age 16 is -1,304,912 calories, or 1.8 years of adult consumption (1,304,912 / 743,832 = 1.8). We adjust this number to account for the probability of surviving to this age by multiplying it by $1 / l_{\text{age at home-leaving}}$, which leaves us with a "cost" of 2.2 years. We also show this cost as the proportion of total consumption "paid" for via cumulative production by individuals by the time they leave home.

Finally, the analyses presented below do not include a discount factor to measure the difference in value between present and future consumption because we expect that opportunities for earning interest in rural Bangladesh in the 1970s were limited to non-existent, particularly for the landless. However, we did conduct sensitivity tests for discount rates from two to five percent and found that, although applying these does increase the breakeven ages as would be expected, it does so only marginally (by no more than three years for men and by no more than one year for women).

Analysis

We begin by reviewing Cain's (1977) analysis and find that he misinterpreted his data, which actually imply a younger crossover age using his own methods than he reported. We then replicate the analysis in Cain (1977), using his production and consumption profiles, looking only at men's production but using our method as described above. We then incorporate women's production, and estimate crossover and breakeven ages for our six combinations of production and consumption profiles. The breakeven results we report for everything except our direct replication of Cain's men-only analysis include both men's and women's production as well as mortality.

Overall, we find that the interaction of changes in production and consumption resulting from valuing women's production indicates that although children produce more than they consume, they begin do so at later ages than Cain (1977) found. Furthermore, on average, children don't repay their cumulative consumption until their early- to mid-twenties.

[iv]If dowry, common among many Muslim societies, were prevalent in Char Gopalpur, we would want to include its amount in our calculations. Cain (1979, p. 407) reports, however, that the value of any dowries given was "small."

Comparison to Cain's men-only results

Cain (1977) reported that boys achieved crossover by age twelve. However, he appears to have used the top-end of the age interval for daily production and consumption, rather than the midpoint, to calculate this value. If instead we interpolate across his net cumulative production estimates from the same table (Table 7, p. 222), for which the data refer unambiguously to the endpoint of each age interval, we find that the low point of the interpolated curve (as shown in Figure 2) corresponds to a crossover age at 9.1 rather than 12. Breakeven is still at age 15, where the curve crosses the x-axis and net production equals zero. Thus it appears that Cain's data and methods actually imply that boys produced as much as they consumed starting three years earlier than he thought.

When we use our methods as described earlier along with the productivity weights and time-use data that Cain (1977) reported in Table 7, but still without including women's work, we find that crossover for males occurred at age 9.0 years and breakeven took place at 14.6 years. These figures are extremely close to the 9.1 years and 15 years yielded by Cain's method, indicating that our technique for calculating crossover and breakeven ages generates results very similar to Cain's. The small differences arise because our assumption that aggregate production must equal aggregate consumption raises the age profile of production somewhat relative to consumption. To illustrate this difference, consider that an adult male in Cain's (1977) analysis produced 4,951 calories in a day's 9.6 hours of productive work, which means that he produced 516 calories an hour. In our analysis of the same data, an adult male produces slightly more calories (540) an hour, leading to slightly younger crossover and breakeven ages.

Results incorporating both men's and women's production

We now turn to our estimates that include both men's and women's production. In order to assess the range of feasible outcome values and as a form of sensitivity testing, we calculate our outcome measures using all combinations of the three production and two consumption profiles described in Table 1. We start by comparing production profiles using Cain's consumption profile (C_{Low}), and then repeat the exercise using C_{High}. We present these results both in graphical (Figures 3-5) and tabular (Table 4) form, starting with a discussion of crossover and breakeven ages, then moving on to the cost of raising a child to the age of home-leaving. Overall, based on this range of profiles, our general conclusion is that adding women's production to net production estimations raises the apparent cost of children. That said, the amount of the increase depends on assumptions about the relative efficiency and consumption of men and women.

In order to illustrate the meaning of crossover age, Figure 3 plots the C_{Low} and P_{High} profiles for both males and females. Crossover age is the point at which the production and consumption curves cross, 11.0 for males and 7.8 for females in this particular example. The crossover value for males is about 20 per cent higher than the 9.0 obtained from our revision of Cain's own analysis, indicating that including women's production alters the results in a meaningful way. Other combinations of profiles (presented in Table 4) confirm this result. When varying the production profile and holding consumption constant at C_{Low}, we obtain similar estimates of the crossover point (about 10.8 for males and 8.9 for females). When varying the production profile and holding consumption constant at C_{High}, the crossover age for males increases slightly to about 11.5 and girls, who consume more under this profile, cross over later, around age 10.5. Overall, however, regardless of the combination of profiles used, both boys and girls begin making positive contributions to their families at relatively young ages (in the pre-teen to early-teen years).

Figures 4 and 5 show cumulative net production for males and females, respectively, for all the combinations of our three production and two consumption profiles. Recall that cumulative net production is the sum from birth up to a given age of production minus consumption, weighted for survival. In these figures, breakeven occurs at the age where the curve crosses the x-axis.[v] (Crossover age is also visible at the local minimum of each curve.) In both figures, solid lines refer to the low consumption profile while dashed lines refer to the high consumption profile. Across all combinations of profiles, males break even between ages 20 and 25, later than Cain's (1977) estimate of 15, and females between 22 and 29.

Variation of production and consumption profiles results in predictable effects: the more efficient per hour women are relative to men, the longer it takes men to break even (Figure 4), and the younger women are themselves at breakeven (Figure 5). Averaging across consumption profiles, men break even at 21 (P_{Low}), 22 (P_{Medium}), and 24 (P_{High}), while women break even at 28 (P_{Low}) and 22 (P_{Medium} and P_{High}). Increasing women's consumption relative to men's (i.e., going from C_{Low} to C_{High}) predictably pushes breakeven ages down for men (Figure 4), and up for women (Figure 5). Averaging across production profiles, when consumption is raised from C_{Low} to C_{High}, men's breakeven age decreases by two years while women's breakeven age increases by one and a half years.

To understand why including women's labour increases men's breakeven ages, consider that women's work makes up 50 per cent of total production in the example using our C_{Low} and P_{High} profiles as outlined in Tables 2 and 3. This 50 per cent produced by females includes activities such as the processing and preparation of food, sewing, child care, and domestic maintenance. In Cain's analysis, males consumed roughly half of what they produced, with the balance consumed by females. In our analysis, males still consume roughly half of the food they produce, but in addition they consume approximately half of women's production. In other words, relative to Cain's analysis, males produce the same amount but consume about twice as much. This causes their breakeven and crossover ages to occur later than Cain found.

From this analysis it is clear that the addition of women's labour to the calculation of cumulative net production raises the cost of children. The exact amount, however, varies depending on assumptions about relative efficiency and consumption. Under our most conservative estimate of women's efficiency (P_{Low}), men break even in their early twenties while women do so in their late twenties. This is long after the age of leaving home for women, but before the comparable age for men.

Because of the structural shifts to households associated with children leaving home, we also evaluate cumulative net production up to the average age of leaving home, conveniently expressed relative to the total consumption costs up to that age. (See Table 4.) Sensitivity testing on our various profiles leads us to conclude that males completely repay their consumption costs before leaving home at age 26, approximately two years after marriage. Girls, who marry much younger, repay only about 80 per cent before they leave home at age 16. We can also compare these amounts to the average annual consumption of an adult. Across all production and consumption profiles, this measure indicates that at the age at leaving home, a surviving son has already paid his parents back approximately two years of adult consumption. Daughters, on the other hand, owe their parents about three years of consumption (roughly 2 million calories) when they marry and move away at age 16.

Clearly, the specific ages of crossover and breakeven as well as the cost of children at the time of marriage vary depending on the particular production and consumption profiles used in computing these measures. The outcomes also vary by economic class. The results of an

[v]No significance should be attached to the levels of the cumulated totals, since our total daily production is somewhat arbitrary and these could be calculated either per birth (as we have done) or per child surviving to leave home, for example. It is the shape and crossover point that are of interest, and these are not affected by such issues of scaling.

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analysis of Cain's (1977) data on landowners (not shown, but assuming that two thirds of output is attributable to labour inputs and one third to land and other property, and that all output is consumed) indicate that the increased consumption made possible by non-labour sources of income implies that boys never produce as much as they consume in a day, and girls do so only under low consumption assumptions. In no combination of profiles do the children of landowners ever pay back their net consumption.

Conclusion

Valuing the labour of females in the agricultural setting of Char Gopalpur alters our picture of the net economic costs and contributions of both males and females over their life cycles. The consequences of valuing women's labour follow not only from acknowledging the worth of their work, but also from raising the estimates of men's and women's consumption to reflect the value of women's labour embodied in it. When this is done, we find that although the children of landless families in Char Gopalpur were economically productive from a young age, they were still expensive to their parents.

Cain's estimated crossover age for boys should have been nine rather than twelve, whereas his estimated breakeven age of 15 was correct, on his assumptions. The benchmark comparison ages for an analysis based on men are thus 9 and 15. Our specific findings when women's labour is valued are as follows:

1. The crossover age for males is 11.2, slightly more than two years older than the men-only benchmark.
2. Males have not produced enough until at least their early twenties to cover their consumption costs and those of deceased siblings. By the time they leave home, surviving sons have, on net, produced two years worth of adult consumption.
3. The crossover age for females is one and a half years earlier than for males, slightly before age 10.
4. The breakeven age for females is slightly older than that of males, between 22 and 29, depending on choice of production and consumption profiles. Unlike males, it costs almost three years of adult consumption to raise a surviving daughter to marriage age. Because women marry and leave home at a younger age than men, at home-leaving they have paid for only 80 per cent of their net consumption.

Were children the economic asset to their parents that Cain suggested? We find that generally they were not when only their direct economic contributions are considered. However, both boys and girls worked, and this work reduced their cost to their parents, suggesting that although Cain's conclusions were overstated, children's labour was valuable to the families of Char Gopalpur. We have not attempted to assess their potential contributions to risk sharing, physical security, political power or old age support, and neither did Cain. Without such an assessment we cannot reject the claim that children are economically beneficial to their parents in a broader sense, but we also believe that it is relevant and important to establish that children did not attain positive asset value in this narrower sense until well into adulthood.

A number of studies of agricultural and pre-agricultural populations seek to estimate the economic contributions of individuals across their life cycles. We hope to have shown the importance of accounting for women's labour in any such enterprise, both in production and in consumption. We believe that the results of omitting women's production would be similar in most settings, and that the methods we have developed and applied here could be usefully applied in other contexts.

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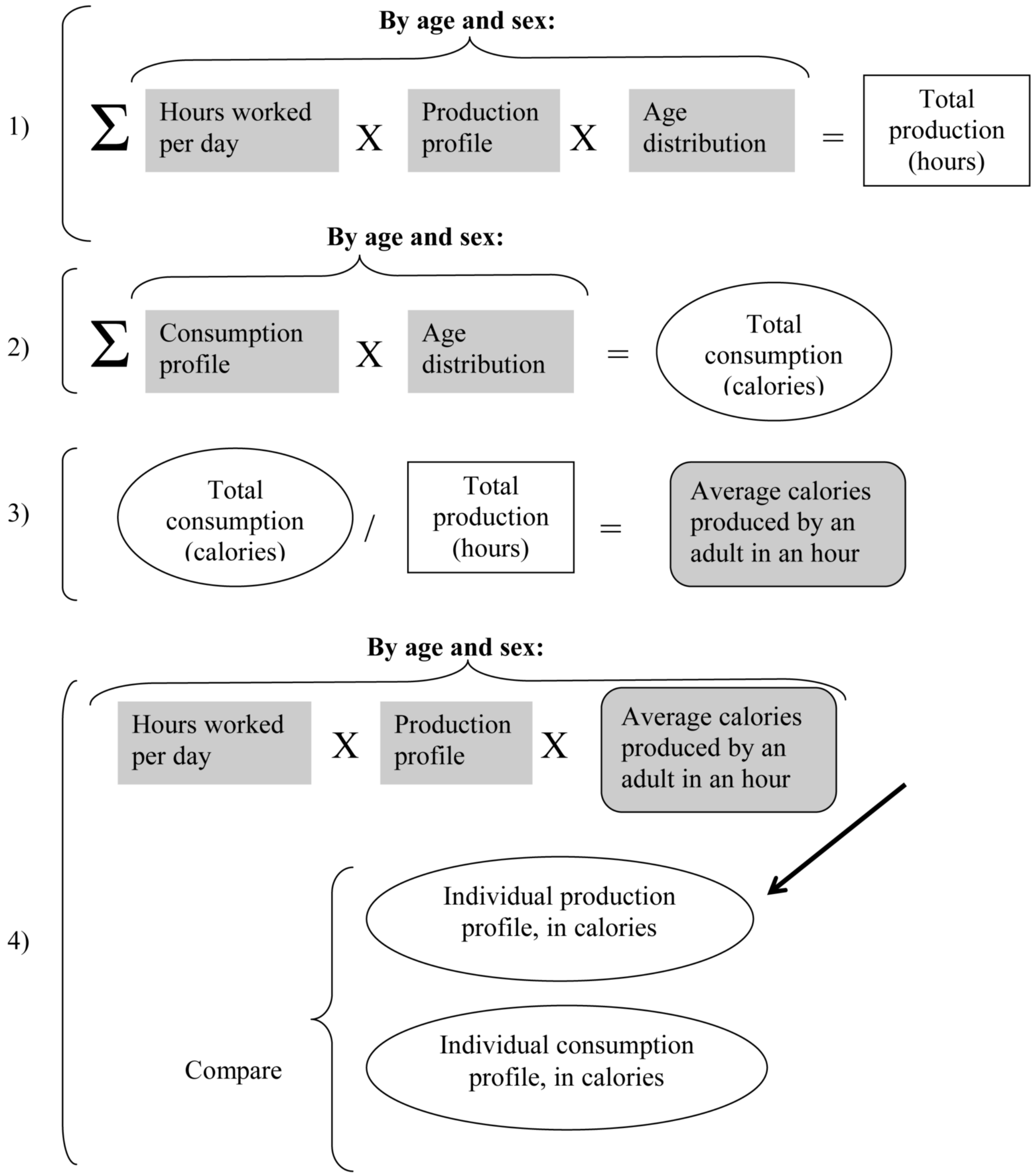

Figure 1.
Time-use approach to calculating net production

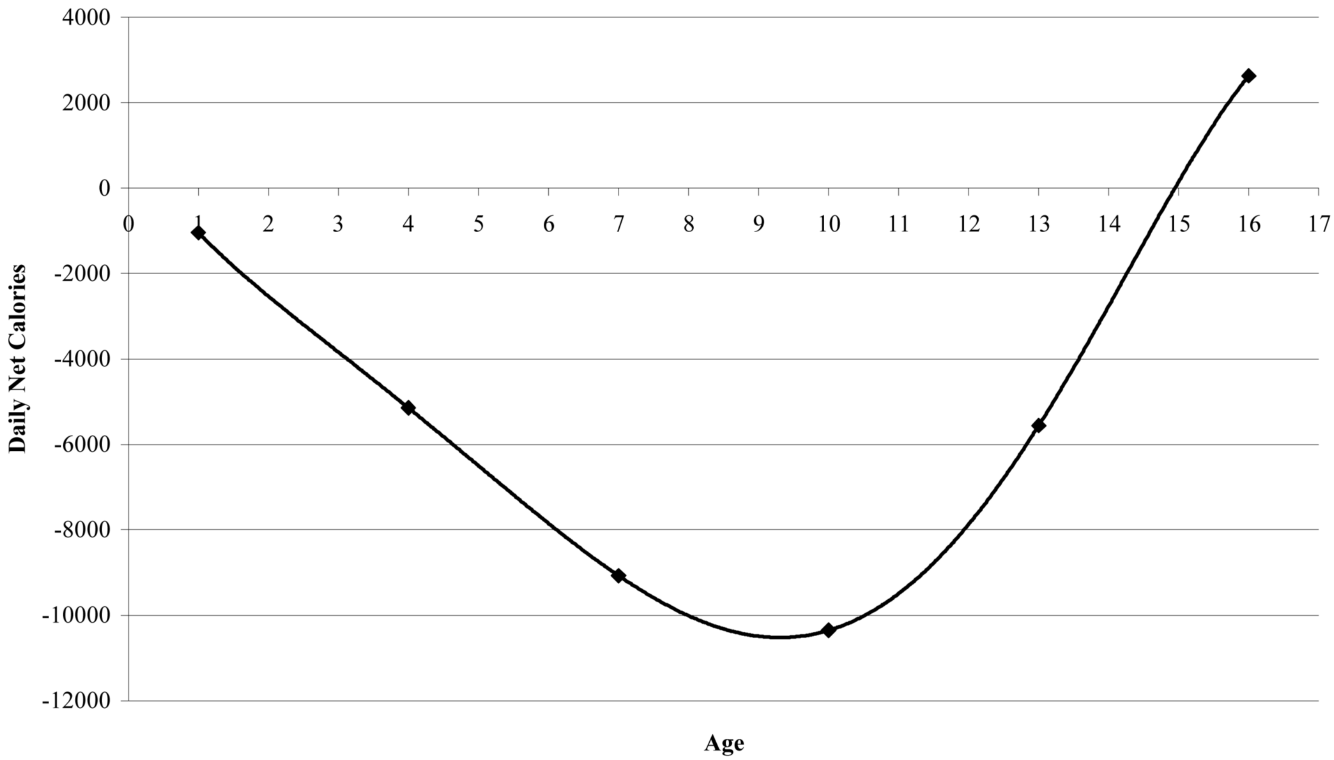

Figure 2.
Cumulative net production for landless boys from Cain (1977)
Source: Interpolated from data in Cain (1977: 222, Table 7, Column (8)) and smoothed using a fifth order polynomial;markers indicate values at exact age x from Table 7

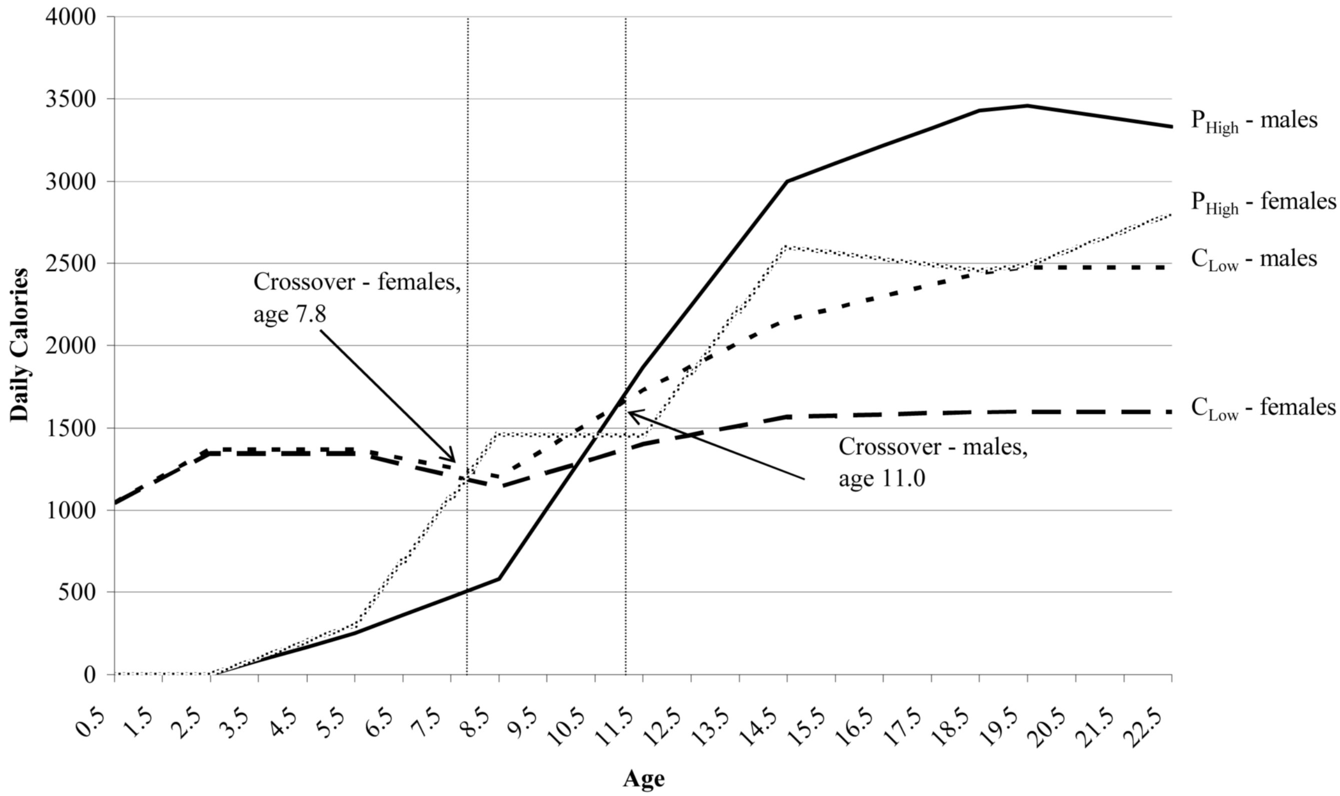

Figure 3.
Example of landless men's and women's production and consumption profiles by age
Source: Authors' calculations based on data from Cain (1977) and Kramer (2005)

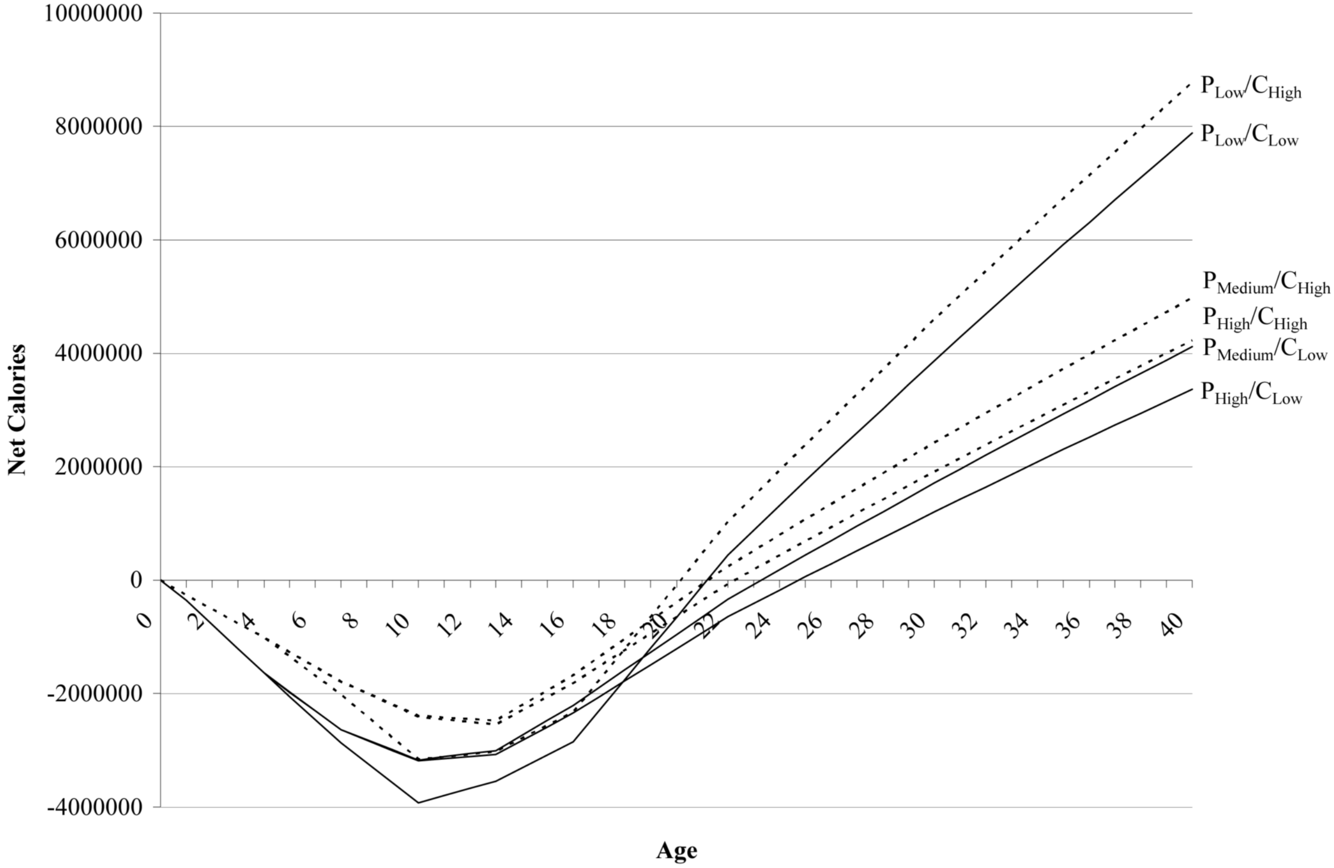

Figure 4.
Landless men’s net cumulative production: six different combinations of consumption and production profiles
Source: As for Figure 3

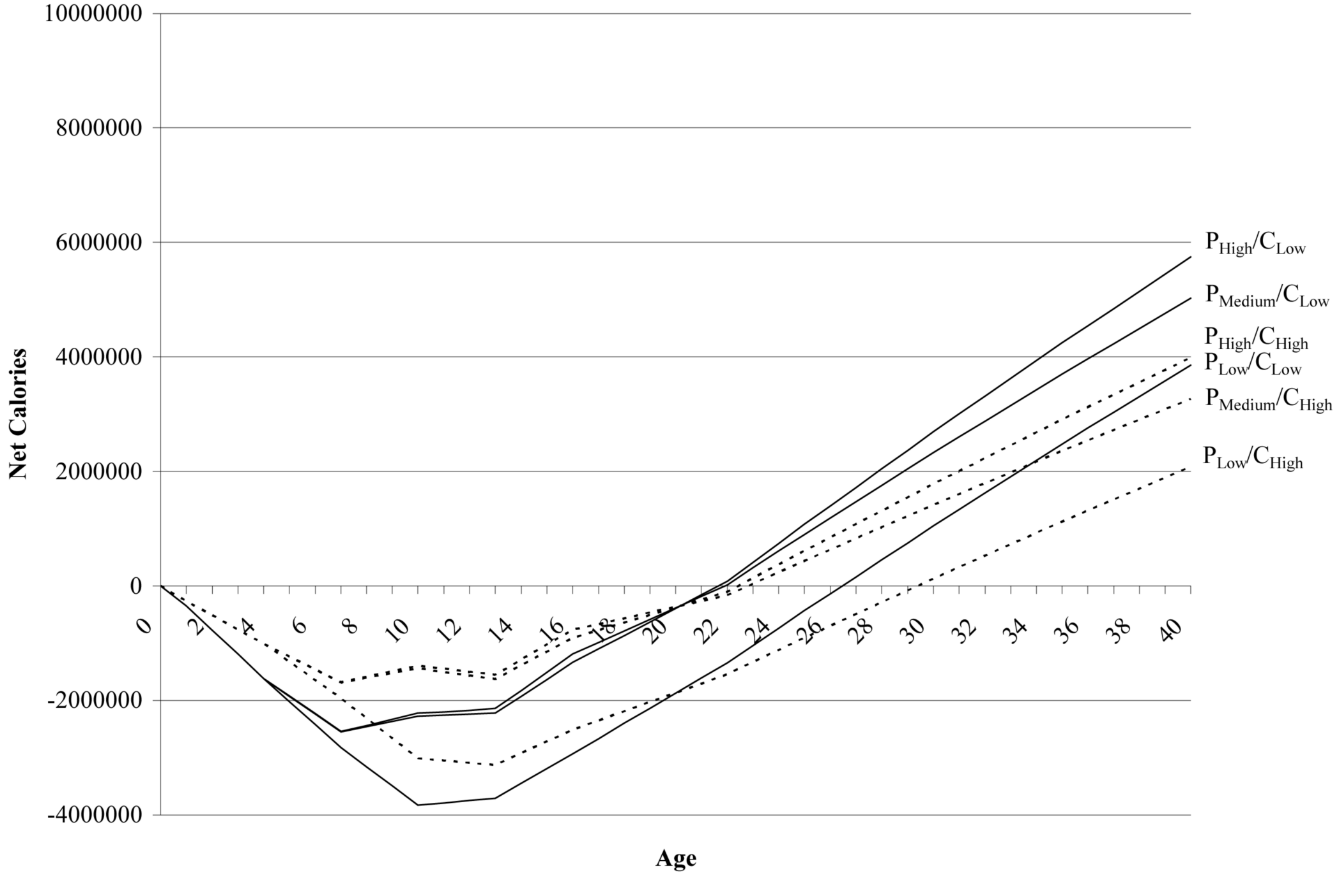

Figure 5.
Landless women’s net cumulative production: six different combinations of consumption and production profiles
Source: As for Figure 3

Table 1

Production and consumption profiles used in analysis of net production

Profile name	Description
Production	
Profile name	**Description**
P_{High}	Until age twelve boys and girls are roughly equally efficient per hour of work. Adult females (ages 16+) are weighted at 84 per cent (from Kramer 2005) of adult males for heavy/physical tasks (chopping wood, harvesting maize, and hauling water). Overall women are 95 per cent as efficient as men.
P_{Medium}	Same as P_{High}, except adult females (ages 16+) are weighted at 75 per cent (from Mueller 1976) of adult males for heavy/physical tasks (chopping wood, harvesting maize, and hauling water). Overall, women are 88 per cent as efficient as men.
P_{Low}	Children are not productive until age ten because labour force participation rates serve as the basis for this profile. Adult women are 75 per cent as efficient as adult men, and productivity declines from age 55 onwards. Based on Mueller (1976), Table 4-8, Column 2 (p. 118).
Consumption	
Profile name	**Description**
C_{Low}	From Chen (1975), used in Cain (1977). Girls and boys consume roughly the same amount until age 9, there is a decrease in consumption among 7-9 year-olds relative to younger and older age groups*, and adult women consume 65 per cent less than adult men.
C_{High}	Uses Mueller's (1976) medium-consumption profile from Table 4-2 (p. 107) and sets adult male consumption at C_{Low} (2476 calories per day). Adult women consume 80 per cent less than adult men.

Notes:

*The dip in consumption at ages 7-9 is, to the best of our knowledge, an artefact of the sample from which the data come (authors' personal communication with Lincoln Chen, December 2006). It is not so large as to produce any major effect on the results (see Figure 3).

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Table 2

Example of calculation of average calories produced in one hour, showing only landless women's production and consumption

	(A)	(B)	(C)	(A)*(B) = (D)	(E)	(D)*(E) = (F)	(C)*(E) = (G)
Age group	**Daily work hours**	**Production profile**	**Consumption profile (calories)***	**Weighted daily work hours**	**Age distribution**	**Total daily production**	**Total daily consumption (calories)**
<1	0.0	0.00	1043	0.00	0.01	0.00	15
1-3	0.0	0.00	1344	0.00	0.06	0.00	76
4-6	2.1	0.47	1344	0.98	0.06	0.06	77
7-9	8.1	0.58	1140	4.74	0.06	0.27	66
10-12	6.6	0.71	1399	4.72	0.04	0.18	52
13-15	9.8	0.86	1567	8.43	0.03	0.28	52
16-21	8.7	0.91	1598	7.91	0.05	0.38	76
22-59	9.6	0.95	1598	9.09	0.18	1.63	287
					Sub-total (women)	2.79	702
					Daily total (both sexes)	5.55	1712
					Average calories produced by an adult in one hour	1712 / 5.55 = 308	

Notes:

- Production profile is P_{High} and consumption profile is C_{Low}
- Daily work hours (column (A)) and the consumption profile (column (C)) are for individuals
- Total daily production (column (F)) and total daily consumption (column (G)) are per population age group

* See note for Table 1

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Table 3

Example of calculation of crossover and breakeven ages for landless women

	(A)	(B)	(A)*(B)*308 = (C)	(D)	(E)	Σ(C)*(E)*365.25 = (F)	Σ(D)*(E)*365.25 = (G)
Age group end-point	**Daily work hours**	**Production profile**	**Daily production (calories)**	**Daily consumption (calories)**	$_nL_x$	**Cumulative production (calories)**	**Cumulative consumption (calories)**
1	0.0	0.00	0	1043	0.92	0	351542
4	0.0	0.00	0	1344	2.57	0	1613766
7	2.1	0.47	302	1344	2.47	271875	2823863
10	8.1	0.58	**1459**	**1140**	2.42	1559110	3829655
13	6.6	0.71	1453	1399	2.39	2826168	5049755
16	9.8	0.86	2597	1567	2.36	5067057	6401801
22	8.7	0.91	2436	1598	4.63	**9185630**	**9102208**
25	9.6	0.95	2800	1598	2.26	11391141	10420435
30	9.6	0.95	2800	1598	3.67	14977218	12563821
35	9.6	0.95	2800	1598	3.55	18438240	14632463
40	9.6	0.95	2800	1598	3.41	21763226	16619796
45	9.6	0.95	2800	1598	3.26	24941943	18519705
50	9.6	0.95	2800	1598	3.09	27961604	20324547
55	9.6	0.95	2800	1598	2.90	30793127	22016939
60	9.6	0.95	2800	1598	2.66	33390189	23569195

Notes:

- Production profile is P_{High} and consumption profile is C_{Low}
- Daily production and consumption values apply to the *middle* of the age range for the row
- Bolded values in columns (C) and (D) indicate the age by which crossover has occurred: 7.8
- We multiply production by 308, which comes from Tables 2, because it is the average number of calories produced by an adult in one hour
- Cumulative production and consumption values are achieved at the *end* of the age range for the row
- Bolded values in columns (F) and (G) indicate the age by which breakeven has occurred: 21.6

Table 4

Results from sensitivity tests using different consumption and production profiles

Landless Males				
Profile	**Age at crossover**	**Age at breakeven**	**Cost (years of adult consumption)**	**Net consumption paid (per cent)**
C_{Low}				
P_{High}	11.0	24.7	-0.9	104.8
P_{Medium}	10.8	23.3	-1.4	107.8
P_{Low}	10.7	21.2	-3.6	119.2
Average	10.8	23.1	-2.0	110.6
C_{High}				
P_{High}	11.9	22.3	-1.5	109.2
P_{Medium}	11.8	21.2	-2.0	112.3
P_{Low}	11.2	20.2	-4.0	124.2
Average	11.6	21.2	-2.5	115.3
Average across all profiles	11.2	22.1	-2.2	112.9
Landless Females				
Profile	**Age at crossover**	**Age at breakeven**	**Cost (years of adult consumption)**	**Net consumption paid (per cent)**
C_{Low}				
P_{High}	7.8	21.6	2.2	83.9
P_{Medium}	7.7	21.9	2.0	85.9
P_{Low}	11.2	26.5	5.6	59.8
Average	8.9	23.3	3.3	76.5
C_{High}				
P_{High}	7.7	22.4	1.5	88.3
P_{Medium}	12.0	22.8	1.2	90.4
P_{Low}	12.0	29.4	4.8	63.0
Average	10.5	24.9	2.5	80.6
Average across all profiles	9.7	24.1	2.8	78.6

Note: Cost is the amount of his or her cumulative consumption that a surviving child has (negative value) or has *not* (positive value) produced by the age of leaving home (26 for males and 16 for females), expressed in terms of years of average adult consumption. Net consumption paid is the percentage of his or her total consumption that a child has produced up to the age of leaving home