

# Parental Altruism under Imperfect Information: Theory and Evidence.

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## Abstract

Can we reconcile the predictions of the altruism model of the family with the evidence on parental monetary transfers in the US? This paper provides a new assessment of this question. I expand the altruism model by introducing effort of the child and by relaxing the assumption of perfect information of the parent about the labor market opportunities of the child. First, I solve and simulate a model of altruism and labor supply under imperfect information. Second, I use cross-sectional data to test the following prediction of the model: Are parental transfers especially responsive to the income variations of children who are very attached to the labor market? The results of the analysis suggest that imperfect information accounts for many of the patterns of intergenerational transfers in the US.

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## 1. Introduction

The altruism model of the family posits that the utility of an individual (for example, a parent) depends on the utility of other family members (for example, an adult child), and that this interdependence shapes intergenerational transfers of money and services. Richer parents, if altruistic towards their adult children, will be more likely to give transfers to poorer children. In fact, Becker (1974) and Barro's (1974) altruism models imply that an exogenous redistribution of the income of a dynasty linked by altruism and providing monetary help will be neutralized by private intergenerational transfers. Assessing empirically if altruism is the force behind economic links is then crucial for understanding the effectiveness of any public program that redistributes income between generations. This paper assesses if the altruism model of the family can be reconciled with the empirical evidence on intergenerational transfers in the US.

Several papers have tested Becker's hypothesis with data from the US. Their results generally confirm that, while the response of transfers to the income of the parent and the child have the predicted sign, the responses are almost an order of magnitude less than what is needed to support the hypothesis that transfers neutralize redistributions of income between generations. While the altruism model of family links predicts that, among parents giving transfers, a dollar increase in the income of the parent coupled with a dollar decrease of the income of the child results in a rise of the intergenerational transfer of one dollar, empirical estimates show that transfers increase by less than 15 cents.<sup>1</sup>

Alternative explanations have been given for this finding. Pollak (1988) argues that transfers from altruistic parents are tied to specific assets, and do not respond to the income variations of the child. Andreoni (1989) suggests that parents are not altruistic, but derive utility from the mere action of giving transfers. Kotlikoff et al. (1990) find that children may benefit from acting strategically to exact higher parental transfers from their altruistic parents. Cox (1987) argues that parents use transfers to buy services from their children. McGarry (2000) assumes that parents are uncertain about the future earnings of their children and use current earnings as a signal of permanent earnings. All these explanations overturn Becker's prediction.

This paper assesses whether adding two key modifications to the basic altruism

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<sup>1</sup>See for instance, Altonji et al. (1997) and McGarry and Schoeni (1995) who use matched data on parents and children and find that redistributing a dollar of income from the child to the parent rises transfers by less than 15 cents. Cox (1987) and Cox and Jakubson (1995) use datasets on receivers of help only, and find that parental transfers respond positively to the income of the child. Their results imply that redistributing a dollar of income from the child to the parent rises parental transfers only by 1 cent.

model improves the concordance between the model and the data. I endogenize effort of children and relax the assumption that the parent has perfect information about the labor-market opportunities of the child. I consider that incorporating children's labor supply decisions in the altruism model is very important, given the fact that several researchers have documented that children modify their labor market decisions because of parental help.<sup>2</sup>

In my model parents observe the income of their (egoistic) children, but observe neither the labor market opportunities nor the effort of their children. For example, parents visit their children, and can infer their income from their consumption habits. Nevertheless, it is hard for them to observe whether children have the option of working in a lucrative job that requires extended hours. In this setting, parents face a trade-off when deciding about the optimal amount of help to give to their descendents. On one hand, they would like to compensate the income variations of their children. On the other, the monetary help may distort the effort decisions of their children. I show that parents solve this trade-off by providing transfers that do not respond much to income.

I also show that, under some circumstances, the strategic considerations just mentioned are important for children who have a weak attachment to the labor market, but not for those who are very attached to the labor market. In particular, I show that if altruistic parents act according to my model, parental transfers are more responsive to the earnings of children with lower labor supply elasticities. I then develop an empirically testable hypothesis by referring to the well-documented fact that labor supply elasticities differ across the various members of a married child's household. I test whether or not parental transfers are more responsive to a fall in the labor earnings of the member of the child's household with a lower labor supply elasticity - the primary earner.<sup>3</sup>

While previous researchers have modeled the effects of imperfect information about labor market opportunities on the size of parental transfers,<sup>4</sup> I am not aware of work that attempts to match the empirical facts about transfers or to make an empirical test of the theory. This paper makes two contributions to this literature. The first contribution is to assess the quantitative impact of imperfect information on the response of parental transfers of money to income to the

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<sup>2</sup>Card and Lemieux (2000) document that younger generations in US and Canada have reacted to adverse labor market conditions by staying longer at their parent's house. Holtz-Eakin et al. (1993) also present evidence that the receipt of an inheritance disincentivates labor market participation.

<sup>3</sup>This result is very close in spirit to previous results in the literature of optimal taxation. For example, Boskin and Sheshinski (1983) argue that marginal taxes should be higher for the income earned by primary earners than for the income earned by secondary earners.

<sup>4</sup>See, for example, Kotlikoff and Razin (1988) and Chami (1998).

parent and child. I do this assessment by simulating a computable version of the altruistic model under imperfect information. My simulation results suggest that imperfect information greatly reduces the optimal responses of parental transfers to earnings of the child and to earnings of the parent.

The second contribution is to extend the model so that it yields testable empirical predictions. I present empirical evidence from the Panel Study of Income Dynamics (wave 1988). While not all the predictions of the theory are accepted, I find evidence that the probability of receiving a transfer responds more to permanent earnings of the primary earner than to those of the secondary earner in the household of a married child.

The paper is organized as follows. Section 2 describes the model. Section 3 provides a benchmark case in which the parent has perfect information about the labor market opportunities of the child. Section 4 solves the model with imperfect information. Section 5 provides simulation results. Section 6 discusses the empirical strategy and the data used. Section 7 presents the results of the empirical test and the paper concludes with Section 8.

## 2. The model

This section describes the households of the parent and child and provides the modeling assumptions.

Two households interact in this model. The first one is the household of a single parent who cares about the utility of the child. The second household is that of the child, and is composed of two members: a primary and a secondary earner. Assumptions 1, 2 and 3 describe the preferences of the members of these two households. Assumptions 4 and 5 describe the information of the parent about the labor market opportunities and effort of the child.

The household of the child maximizes the joint utility function of the two members. Their utility depends on the consumption of a common good ( $c^c$ ), the hours of leisure of the primary earner ( $l_p^c$ ) and the hours of leisure of the secondary earner ( $l_s^c$ ). For each member of the household of the child, leisure is defined as the difference between time available ( $\bar{l}_s^c$  for the secondary earner,  $\bar{l}_p^c$  for the primary earner) and hours of work ( $h_p^c$  for the primary earner,  $h_s^c$  for the secondary earner).<sup>5</sup>

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<sup>5</sup>The following notation is used. The superscript  $p$  ( $c$ ) over a variable denotes that it corresponds to the parent (child). Subscripts will only be used for the household of the child. The subscript  $p$  denotes primary earner, and the subscript  $s$  denotes secondary earner (in the household of the child).

*Assumption 1 (preferences in the household of the child):* The joint utility of the household of the child is:

$$U^c(c^c, h_p^c, h_s^c) = v(c^c) + \gamma_s(\bar{l}_s^c - h_s^c) + \gamma_p(\bar{l}_p^c - h_p^c) \quad (2.1)$$

where  $v()$ ,  $\gamma_s()$ , and  $\gamma_p()$  are increasing, strictly concave and differentiable functions. Furthermore,  $\gamma_s'''()$  is assumed to be positive.

*Assumption 2 (labor supply elasticities):* The labor supply of the primary earner is perfectly inelastic with respect to own wage. The (uncompensated) elasticity of the labor supply of the secondary earner with respect to own wage is positive.

There is abundant evidence that the elasticity of hours worked with respect to own wage is higher for married females (secondary earners) than for married males (primary earners).<sup>6</sup> The assumption of a zero elasticity of labor supply for the primary earner simplifies considerably the theoretical setup of the problem. It has been used in previous empirical studies of incentives-see Attanasio and Davis (1996).<sup>7</sup>

The budget constraint of the household of the child is the following:

$$c^c \leq w_p^c \bar{h}_p^c + w_s^c h_s^c + t$$

Income of the primary earner is the product of the wage  $w_p^c$ , and the (fixed) number of hours worked by the primary earner ( $\bar{h}_p^c$ ). Income of the secondary earner is the product of the wage  $w_s^c$  and the number of hours worked ( $h_s^c$ ). Consumption is less than or equal to the sum of the income earned by the two earners, parental transfers ( $t$ ). The following notation will be used:

$$y_s^c = w_s^c h_s^c \quad y_{exo}^c = w_p^c \bar{h}_p^c$$

$$y^c = y_s^c + y_{exo}^c$$

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<sup>6</sup>See, for example, Johnson and Pencavel (1984). Characterizing husbands as primary earners, as opposed to wives may seem anachronistic. Nevertheless, almost all husbands in my sample have higher permanent incomes than their wives. Also, while there is an important literature showing that the uncompensated labor supply elasticity to own wage is larger for married females than for married males, I have not found evidence about the labor supply of primary and secondary earners (regardless of their gender).

<sup>7</sup>An alternative interpretation is that the household makes a choice between the number of hours that each member of the household of the child spends working in the market sector and the number of hours devoted to home production. Assumption 2 then can be restated as: "only the secondary earner is productive at home."

That is, total earned income of the household is the sum of income earned by the secondary and primary earners. The rationale for this division is the following: the first component will be affected by effort decisions, and is sensitive to the wage of the secondary earner, in the sense that a change in the labor market opportunities of that earner also changes the optimal level of hours of market work. The second component is assumed to be strictly exogenous. There is no labor supply response of the primary earner to a wage change.

*Assumption 3 (altruistic parent):* The preferences of the parent are defined over own consumption and the utility of the household of the child. They can be represented by the function:

$$U^p = c^p + \eta U^c = c^p + \eta \{v(c^c) + \gamma_p(\bar{l}_p^c - h_p^c) + \gamma_s(\bar{l}_s^c - h_s^c)\} \quad (2.2)$$

where  $c^p$  stands for consumption of the parent. Namely,  $c^p$  is the difference between income of the parent ( $y^p$ ) and the money given to the child through monetary transfers  $t$ .  $\eta$  is a parameter measuring the degree of altruism of the parent.<sup>8</sup>

*Assumption 4 (variables that the parent does not observe):* The parent does not have information about the wage realizations nor about the effort decisions of any of the members of the household.

Ex ante, the parent knows that the wage of each earner is drawn from a discrete distribution with  $n$  wage values ( $0 < w_{p,1}^c < \dots < w_{p,n}^c$ ) for the primary earner and another distribution of  $n$  wage values ( $0 < w_{s,1}^c < \dots < w_{s,n}^c$ ) for the secondary earner. Each wage  $w_{p,i}^c$  and  $w_{s,i}^c$  (wages of the primary and secondary earner respectively) is drawn with probability  $\pi_{p,i}^c$  (for the primary earner) and  $\pi_{s,i}^c$  for the secondary earner.<sup>9</sup>

*Assumption 5 (variables that the parent does observe):* The parent observes the income earned by each member of the household: namely, the product of the wage and the number of hours worked. The parent is able to distinguish between the income earned by the primary and secondary earner.

Assumption 4 formalizes the notion that it is difficult for parents to observe the marginal rate of pay of an extra hour of work of their children. Parents, in general, may not know whether or not their children search for overtime work. It is also difficult to observe whether or not the child has the opportunity of working in less pleasant but more lucrative occupations.

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<sup>8</sup>The assumption of risk neutrality imposes that parental transfers are not affected by income of the parent. In the simulations, I relax this assumption.

<sup>9</sup>Modelling the wage distribution as continuous is arguably more elegant. Nevertheless, I could not get clean results for the preferences posed in this paper.

On the other hand, it is possible to observe the earnings of the persons within a family. Parents visit their children, observe the home they live in, whether they have a car, and their consumption habits. Hence, they can form an assessment of what is the total income earned in the household of the child. Assumption 5 goes further, and states that the parent can observe the earnings of each member. The idea is that parents know the education and occupation of each of the members of the household of the child. Up to some observational error, parents can infer the earnings of each of the members.<sup>10</sup>

An additional note about the consequences of assumptions 3 and 5 is in order. I assumed that the primary earner always desires to work the same number of hours. I also assume that the parent knows the preferences of the household of the child. The parent is not aware of the wage of the primary earner, but observes the income earned (assumption 5), and knows what are the preferences of the primary earner for work. Hence, the parent is able to infer the origin of any income variation of the primary earner. Thus, this component can be treated as observable.

Finally, I briefly describe the allocation of consumption and leisure consumed by the child in the absence of parental transfers. The child solves:

$$\max_{\{c^c, y_s^c\}} v(c^c) + \gamma_p(\bar{l}_p^c - \frac{y_{exo}^c}{w_p^c}) + \gamma_s(\bar{l}_s^c - \frac{y_s^c}{w_s^c}) \quad (2.3)$$

The allocation that solves this problem will be denoted as  $\{\hat{c}^c(w_s^c, y_{exo}^c), \hat{y}_s^c(w_s^c, y_{exo}^c)\}_{i=1}^{i=n}$ . For the preferences assumed in the simulations, both consumption and labor income earned by the secondary earner are increasing with respect the wage  $w_s^c$ , which is consistent with the empirical evidence. This completes the description of the model.

### 3. The case with perfect information

This section solves the problem for the case in which the parent has perfect information about the wages and choices of each one of the two members of the household of the child. This will establish a benchmark to compare the effects of private information on the shape of parental transfers.

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<sup>10</sup>One may argue that parents can observe the wage of the child, as well as the number of hours worked, but not the preferences for leisure of the children. The model can be reinterpreted to accommodate this information setup. Consider the utility of the child  $U^c = U^c(c^c, \frac{y^c}{w^c})$ . One can reinterpret  $w^c$  as the preference of the child for leisure. Children with higher  $w^c$  find it less costly in terms of utility to achieve an earnings level  $y^c$ . If the parent is not able to observe  $w^c$ , but do observe earnings, the results of my model would still hold.

The parent decides over own consumption and over the consumption and labor choices of the two members of the household of the child. This plan is made before the child is born. The parent does not need to worry about the disincentives created by parental help, as the wage of each member is perfectly observed. Nevertheless, the parent cannot enforce a plan that involves negative transfers from the household of the child.

The parent maximizes the expected utility function over all the possible wages of the secondary earner. The utility of the altruistic parent depends on the level of own consumption and on the utility of the child:

$$\max_{\{(t_i, y_{s,i}^c)_{i=1}^{i=n}\}} U^p = \sum_{i=1}^{i=n} \pi_{s,i}^c [y^p - t_i + \eta U_i^c(c_i^c, \frac{y_{s,i}^c}{w_{s,i}^c}, y_{exo}^c)] \quad (3.1)$$

$$s.t. \quad t_i > 0 \quad \forall i = 1, \dots, n$$

$$s.t. \quad c_i^c = y_{s,i}^c + y_{exo}^c + t_i \quad \forall i = 1, \dots, n$$

where

$$U_i^c = v(y_{exo}^c + y_{s,i}^c + t_i) + \gamma_s (\bar{l}_s^c - \frac{y_{s,i}^c}{w_{s,i}^c})$$

In (3.1),  $\pi_{s,i}^c$  is the probability of occurrence of the wage  $w_{s,i}^c$ ,  $y^p$  denotes parental resources,  $t_i$  the amount of parental monetary transfers,  $U^c$  is the level of utility of the child,  $\eta$  is the altruism parameter,  $c_i^c$  denotes the consumption of the child,  $w_{s,i}^c$  is a particular realization of the wage of the secondary earner,  $y_{s,i}^c$  is the earnings of the secondary earner in the household of the child, and  $y_{exo}^c$  is the earnings of the primary earner in the household of the child. The parent solves (3.1) for each level of  $y_{exo}^c$ .

The subscript  $i$  indexes the different wages that the child could earn. In this expression, for convenience, the number of hours worked by the secondary earner is replaced by the ratio of the labor earnings and wage of the secondary earner. Also, the wage of the primary earner is normalized to one. The solution of this problem assigns a different transfer (or combination of consumption and income in the household of the child) for each possible wage and level of income of the primary earner.

The first order conditions of this problem are:

$$\frac{\partial U_p}{\partial t_i} = -1 + \eta v'[y_{s,i}^c + y_{exo}^c + t_i] \leq 0 \quad \forall i = 1, \dots, n \quad (3.2)$$



$$\frac{\partial U_p}{\partial y_{s,i}^c} = v'(y_{s,i}^c + y_{exo}^c + t_i) - \gamma'_s(\bar{l}_s^c - \frac{y_{s,i}^c}{w_{s,i}^c}) \frac{1}{w_{s,i}^c} = 0 \quad \forall i = 1, \dots, n \quad (3.3)$$

Equation (3.3) equates the marginal disutility of an additional hour of work of the secondary earner in the household of the child, weighted by the wage, to the marginal utility that the child derives from an additional unit of consumption. For an isoelastic utility of the child, equation (3.3) implies that the income earned by the secondary earner is increasing with the wage.

Equation (3.2) states that the parent equates the (constant) marginal utility of own consumption with the marginal utility that the parent derives from one unit of extra consumption of the child. Given the shape of the utility function of the child, equation (3.2) implies that for all wages of the secondary earner that cause a positive transfer, the consumption in the household of the child is a constant. That is, the parent guarantees a constant consumption level to the child. Also, given that income is increasing with the wage, the marginal utility of consumption of the child decreases with the wage of the secondary earner. Hence, given  $y_{exo}^c$ , there is a wage  $w_{s,v_0}^c$  for which the marginal utility of the parent is greater than that of the child, and the parent stops providing transfers.

The prediction of constant consumption for children who receive transfers is an extreme case of the offsetting of exogenous redistribution of income predicted by the altruism model by Becker (1974). The assumption of risk neutrality of the altruistic parent changes the prediction of offsetting of exogenous redistribution to a perfect compensation of income variations of any of the members of the household of the child.<sup>11</sup>

Figure 1 illustrates the perfect information allocation of child's household consumption and income of the secondary earner with a full solid line (for a given level of income of the primary earner  $y_{exo}^c$ ). For all wages that prompt a parental transfer, the parent provides the household of the child with a constant level of consumption. This level exceeds the sum of the earnings of the primary

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<sup>11</sup>The prediction of Becker's model is that

$$\frac{\partial t}{\partial y^p} - \frac{\partial t}{\partial y^c} = 1$$

With linear utility in consumption of the parent, this equality still holds, but in a more restrictive form. The response of transfers to income of the parent to be zero. Hence, under my assumptions:

$$\frac{\partial t}{\partial y^c} = -1; \quad \frac{\partial t}{\partial y^p} = 0$$

and secondary earner (the dotted line in Figure 1) by the amount of parental monetary transfers. For higher wages, there is no transfer, and the child lives on own resources. Given that the child has the same level of consumption for the range of wages that prompt a transfer, and that the income of the secondary earner increases with the wage, parental transfers decrease with income on a dollar for dollar basis.<sup>12</sup>

### 3.1. The transfer decision.

So far, I have only discussed the determinants of the transfer amount. In this subsection, I discuss the determinants of providing a transfer under perfect information.

Define the latent variable  $L(w_s^c, y_{exo}^c, \eta)$

$$L(w_s^c, y_{exo}^c, \eta) = -\frac{\partial U^p}{\partial c^p} + \frac{\partial U^p}{\partial c^c} = -1 + \eta v'[y_s^c(w_s, y_{exo}^c, \eta) + y_{exo}^c] \quad (3.4)$$

Where  $y_s^c(w_s, y_{exo}^c, \eta)$  is the level of earnings of the secondary earner that solves equations (3.1) and (3.2). In the equilibrium under full information, for each wage of the secondary earner  $w_s^c$  the parent provides a transfer if and only if  $L(w_s^c, y_{exo}^c, \eta)$  is positive. In that case, the marginal utility that the parent derives from an additional unit of own consumption is smaller than the utility that the parent derives from an additional unit of consumption of the child, when transfers equal zero.

Regarding the effects on the latent variable of a change in the earnings of the primary and secondary earner, a dollar increase in the earnings of the primary earner has two effects on the latent variable. First, it diminishes the marginal utility that the parent derives from the consumption of the child, and makes the transfer less likely. There is a second order effect, because the earnings of the primary earner also affects negatively the earnings of the primary earner, and tends to increase the marginal utility that the parent derives from the consumption of the child. The overall effect is likely to be negative if the second order effect is small. On the other hand, an increase in the earnings of the secondary earner will have a negative effect on the likelihood of a transfer, as the marginal utility that the parent gets from the consumption of the child.

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<sup>12</sup>In this model, both the earnings of the secondary earner and the transfers level are decisions of the parent. This section and the next subsection describe the optimal relationship between transfers and earnings of the secondary earner, where the different levels of earnings of the secondary earner in the household of the child correspond to different wages  $w_{s,i}^c$ .

Summarizing, the expanded model of altruism under perfect information has sharp empirical predictions regarding the response of the transfer amount to the earnings of both members of the household of the child. It predicts a dollar for dollar substitution of income of the child with parental transfers, no matter whether these variations occur because of an increase in the income of the primary or the secondary earner. Also, if we ignore the second order effect, this model predicts similar responses to the probability of receiving a transfer to earnings variation of the primary and secondary earner.

#### 4. Second best solution: the case with imperfect information

The purpose of this section is to provide a full characterization of intergenerational transfers under imperfect information. Specifically, the main objectives are first, to determine the optimal response of parental transfers to earnings of both members of the household of the child and, second, to assess whether or not the parental transfers compensate more for variations in the earnings of the primary earner in the household of the child than for variations in the earnings of the secondary earner.

The section has three subsections. In the first one, the nature of the solution of the problem is discussed and it is proven why the perfect information allocation is not feasible under imperfect information. In the second, the solution to the problem with imperfect information is characterized. In the third subsection, I examine the response of parental transfers to income variations. I am able to prove that parental transfers are more sensitive to the earnings of the primary earner in a special case. For all other cases, evidence based on simulations is presented.<sup>13</sup>

##### 4.1. Overview

With imperfect information, the parent makes a monetary transfer conditional on every possible income realization of each of the earners. The child chooses a point of transfers and income in the schedule given by the parent. A parent who observes that the secondary earner has a low income level cannot distinguish whether the reason for this is that this secondary earner had a poor draw of  $w_s^c$  or if the secondary earner had a high wage draw but decided to exert low effort. Hence, a parent who is unable to observe the true wage of the secondary

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<sup>13</sup>I am aware that simulations do not provide me with a formal proof of the result. Nevertheless, the theory of optimal contracts and insurance provides scant closed-form results. A notable exception to this literature is Ligon (1998).

earner must take into account that the child may act strategically. The parent must provide the correct incentives so that, in the event that the child has a high wage, it is not optimal for him or her to choose a point in the transfer schedule in which the secondary earner exerts low effort and the household lives off parental transfers. I give a graphical explanation of why a transfer schedule with the features of the perfect information case does not provide the child with the correct incentives.

Figure 1 depicts the preferences of the child between consumption and income. These depend on the wage observed by the child. Consumption is a “good” for the household of the child, and income is a “bad” (earning more income implies enjoying less leisure). Figure 1 reports two indifference curves. The steeper one corresponds to the case in which the secondary earner has a low wage. The less steeper corresponds to the case in which the secondary earner has a high wage. The slope of the indifference curve is steeper if the child has a low wage because of the following reason. Earning an extra dollar is costlier in terms of effort for a child with a low wage. If the child is to earn an additional unit of income, it takes more consumption to maintain a child with a low wage in the same utility level than to keep indifferent a child with a high wage.

If the parent presented the child with a “flat” budget constraint -the first best allocation- there would be a range of wages for which the optimal choice for the child is to have the secondary earner in the household work zero hours, and live off parental transfers (Figure 1). This allocation is not optimal for the parent. Under imperfect information, the first-best plan incentives the child to lie about the wage of the secondary earner. It turns out that the optimal shape of the program is that presented in Figure 2, where income and consumption are weakly increasing in the wage, and parental transfers are less responsive to the earnings of the secondary earner than in the solution of the case with perfect information.<sup>14</sup>

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<sup>14</sup>The setup of this problem presupposes that the parent is able to precommit to maintain the transfer in the schedule once income is realized. The imperfect information solution is a second best solution, so both the parent and the child can benefit by modifying the transfer, once the parent observes the earnings of the child. One alternative to this model is that the child “moves first” and chooses the favorite earnings level. In such a case, the parent would optimally choose to compensate all income variations, and the spouse would choose not to work. Even if the parent is risk averse, Ricardian equivalence would hold among households giving transfers in this case. As I discussed in the introduction, this result is not supported by the data on US transfers.

## 4.2. The setup.

Under imperfect information, the interaction of the parent and the child can be modelled as a Bayesian game. The action of the parent is the amount of the monetary transfer. The action of the child is an effort level, and the type of the child is the wage of the secondary earner, that the parent cannot observe. I assume that the parent knows the distribution from which the wage of the secondary earner is drawn. As stated in assumption 4, the parent observes neither the effort choices nor the wage of the secondary earner. Hence, the parent has to provide the child with a transfer plan that does not provide work disincentives. The transfer plan will be a budget constraint linking the consumption and income of the secondary earner, from which the child chooses a point.

The Revelation Principle (Myerson, 1991) suggests that this class of games can be reinterpreted as another game with the following timing and strategies. In the first stage, the child privately observes the wage, and reports it to the parent. In a second stage, the parent gives the child a recommended labor supply and consumption decision -these two variables determine the transfer that the child will receive. Third, the child exerts the effort, and attains the income. Finally, in the fourth stage, the parent observes the income realization, and transfers occur. The parent has to establish a plan so that the child finds it optimal to report the true wage, instead of pretending that another wage occurred.

The next step is to characterize the solution of this game. It belongs to the class of principal-agent models (P-A), where the parent acts as an altruistic principal making a contract with a selfish agent. I assume that the parent solves the problem for every possible realization of  $y_{exo}^c$ . The parent has now the same preferences as in the case with perfect information. Nevertheless, the parent faces constraints on the amount of consumption granted to the child. The parent cannot offer the child schemes that induce the child to lie about the wage of the secondary earner. The problem solved by the parent is the following:

$$\max_{\{t_i, y_i\}} \sum_{i=1}^{i=n} \pi_{s,i}^c \{y^p - t_i + \eta U_i^c(c^c, \frac{y_{s,i}^c}{w_{s,i}^c}, y_{exo}^c)\} \quad (4.1)$$

$$\begin{aligned} s.t. \quad v(y_{exo}^c + y_{s,i}^c + t_i) + \gamma_s(\bar{l}_s^c - \frac{y_{s,i}^c}{w_{s,i}^c}) &\geq v(y_{exo}^c + y_{s,j}^c + t_j) + \gamma_s(\bar{l}_s^c - \frac{y_{s,j}^c}{w_{s,i}^c}) \\ \forall i &= 1 \dots n \quad \forall j = 1 \dots n, i \neq j \end{aligned} \quad (IC)$$

$$s.t. \quad t_i \geq 0 \quad \forall i = 1 \dots n$$

where

$$U_i^c = v(y_{exo}^c + y_{s,i}^c + t_i) + \gamma_s \left( \bar{l}_s^c - \frac{y_{s,i}^c}{w_{s,i}^c} \right)$$

(IC) stands for incentive compatibility constraints. They embody the restriction that the child must be prevented from lying about the observed wage. The solution of this problem assigns to each wage a consumption and an income level, just as in the benchmark case with perfect information. Transfers can be recovered from this bundle, as the difference between consumption and the sum of income of the primary and secondary earners.

I characterize the solution of the problem in the next proposition.

**Proposition 1.** *The solution of to the problem  $\{(c_i^{c,*}, y_{s,i}^{c,*})_{i=1}^{i=n}\}$  of the parent is characterized as follows. The transfer schedule presents the following characteristics:*

[1] *consumption and earnings of the secondary earner are increasing in the wage, up to a finite number of bunching points.*

*The consumption-earnings schedule contains three regimes.*

[2] *For low wages,  $c_i^{c,*} = \bar{c}$ ,  $y_{s,i}^{c,*} = 0$*

[3] *There is an intermediary range of wages for which the child receives zero transfers and is indifferent between the chosen bundle and the one associated to the lower wage.*

[4] *If there exists a wage for which  $c_i^{c,*} = y_{s,i}^{c,*} + y_{exo}^c$ , for wages higher than this, transfers are also zero.*

The proof of the proposition is detailed in Appendix 1.

Hence, the optimal transfer schedule has the following characteristics. If the wage of the secondary earner is low enough, the parent will provide transfers and have the secondary earner producing only in the nonmarket sector. There is an intermediary range of wages for which consumption in the household of the child rises. Finally, for a given level of  $y_{exo}^c$  if the wage of the secondary earner is high enough, the child will not receive any transfer at all. For a more precise characterization of the schedule, I need to analyze the response to transfers to income of the child. This is done in the next subsection.

### 4.3. The response of the transfer amount to variations in income

In this section, I present three propositions, which characterize how parents respond to variations in the two components of the total income in the household of the child.

First, I characterize the response of transfers to income of the secondary earner. Because the grid of wages is discrete, a derivative of transfers with respect to income earned by the secondary earner is not well defined. The problem will be addressed using a concept from the literature on optimal taxation: the “implicit marginal tax.”<sup>15</sup>

This implicit marginal tax (IMT) is defined as follows:

$$IMT(y_{s,i}^c) = 1 - \frac{\partial U^c / \partial y_{s,i}^c}{\partial U^c / \partial c_i^c} = 1 - \frac{\frac{1}{w_s^c} \gamma'(\bar{l}_s^c - \frac{y_{s,i}^c}{w_{s,i}^c})}{v'(c_i^c)}$$

which is, one minus the marginal rate of substitution between consumption and earnings evaluated at each point of the solution (see previous footnote). The slope of the transfer schedule is the IMT multiplied by minus one.<sup>16</sup>

**Proposition 2.** *The implicit marginal tax on effort income (income of the secondary earner) is a (positive) number strictly smaller than one.*

<sup>15</sup>This magnitude reflects the trade-off between consuming an additional unit and exerting the effort necessary to earn an additional unit of income. This trade-off depends on the wage privately observed by the child. See, for example, Besley and Coate (1995).

<sup>16</sup>The rationale of the definition is the following. Assume for a moment that the distribution of wages is continuous. Assume also that a differentiable scheme  $t(y^c)$  exists, and that this scheme maximizes the utility of the parent. The child facing this schedule solves:

$$\max_{\{y_s^c\}} v[y_s^c + t(y_s^c)] + \gamma_s[\bar{l}^c - \frac{y_s^c}{w_s^c}]$$

The first order condition of this problem yields:

$$v'[y_s^c + t(y_s^c)](1 + t'(y_s^c)) = \gamma_s'[\bar{l}^c - \frac{y_s^c}{w_s^c}] \frac{1}{w_s^c}$$

Rearranging:

$$t'(y_s^c) = \frac{\gamma_s'[\bar{l}^c - \frac{y_s^c}{w_s^c}] \frac{1}{w_s^c}}{v'[y_s^c + t(y_s^c)]} - 1 = -IMT(y_s^c)$$

In the simulations in the next section I confirm that as the wage distribution is populated with more wages and becomes closer to a continuum, the “implicit marginal tax” converges to the actual slope of the transfer function, measured as the ratio of increment in transfers divided by the increment in income.

$$0 < IMT(y_{s,i}^c) < 1 \quad \forall i = 1, \dots, n$$

This proposition formalizes the intuition in Figure 2. That is, despite the fact that consumption and income are increasing in the wage, parental transfers will decrease with the wage of the child. Parental transfers will be weakly redistributive, in the sense that parents will give more to the child if the income of the child is lower.

This is an important result, as it shows that it is possible to have an altruism model in which risk neutral parents do not compensate children for income variations, if the assumption of perfect information is relaxed.

**Proposition 3.** *If the transfer scheme is such that, in equilibrium, the child receives a transfer for every wage, a variation in income that does not involve an effort response is perfectly compensated by the parent.*

$$\frac{\partial t_i^*}{\partial y_{exo}^c} = -1 \quad \text{if } t_i^* > 0 \quad \forall w_{s,i}^c$$

**Proposition 4.** *If the transfer scheme is such that, in equilibrium, there is a range of wages for which the child receives transfers and another for which the child does not, a variation in income that does not involve an effort response will not be perfectly compensated by the parent.*

$$-1 < \frac{\partial t_i^*}{\partial y_{exo}^c} < 0 \quad \text{if } t_i^* = 0 \quad \text{for some } w_{s,i}^c$$

Hence, the last two results suggest that, if in equilibrium transfers are positive for all wages, the reaction of transfers to observable shocks is greater in absolute value than the response to effort income (where the latter is driven by unobservable wage differences that prompt an effort response). This is not necessarily the case if in equilibrium there are wages for which transfers are zero.

In order to get an intuition for the first proposition, consider Figure 3. This figure depicts an equilibrium in which the child receives a positive parental transfer for every possible wage. Imagine also that the income of the primary earner in the household of the child falls by a dollar. This amounts to a parallel shift of the budget constraint in the absence of transfers to the southeast. The parent will choose to keep the same consumption-income schedule for the child as before the fall in the income of the primary earner. The reason is that this schedule satisfies the incentive compatibility constraints. In the new equilibrium, parental



transfers (the vertical distance between the budget constraint in the absence of transfers and the consumption level) compensate the fall in income of the primary earner on a dollar for dollar basis.

Consider now the equilibrium in which there is some level of income  $y_v^c$  for which parental transfers are zero, and the consumption in the household of the child is the sum of earnings of the primary and secondary earners. This allocation is depicted as A in Figure 4. Consider the income level  $y_v^c$ . For this income level  $y_v^c$ , the child is indifferent between reporting the true wage of the secondary earner ( $w_v^c$ ) and pretending that the secondary earner received a wage  $w_{v-1}^c$  and receiving positive transfers. Assume now that the income of the primary earner falls by a dollar. The budget constraint of the child, in the absence of transfers (the dotted line in Figure 4) has a parallel shift to the southeast. The allocation that the child with wage  $w_v^c$  can afford moves now to a point like B. Assume that the parent kept the same consumption-income schedule. That would imply that the parent replaces the fall in earnings of the primary earner with transfers at a dollar for dollar basis for all wages below  $w_v^c$ . In that case, the child with wage  $w_v^c$  has an incentive to pretend that the wage of the secondary earner is  $w_{v-1}^c$  and receive positive parental transfers, in a point like C. The child has no incentive to report the true wage  $w_v^c$ . Hence, in this case, it is not feasible for the parent to substitute earnings of the primary earner with transfers on a dollar for dollar basis without creating an incentive for the child to lie.

In order to give support to the hypothesis that transfers react more to variations in the income of the primary earner, section 5 presents evidence from simulations, confirming the intuition.

#### 4.4. The transfer decision

Finally, I discuss the determinants of providing a transfer under imperfect information. Due to incentive problems, the parent will not provide a transfer comparing the marginal utility of own consumption with the marginal utility of consumption of the child. In the next section, I compute the reaction of the probability of receiving a transfer to both earnings components solving the model numerically.

Before going to the simulations, I summarize the main differences between the patterns of the transfer schedule under perfect and imperfect information. There are two main differences. The first is that, in the imperfect information case, transfers do not diminish with earnings on a dollar for dollar basis. Second, under imperfect information, parental transfers treat differently the earnings of different members of the household.

How would one apply this model to the data? Consider a sample of households with information on parental transfers and earnings of the household of the child. For each household, one can observe the combination of transfers and income selected by the child from the budget constraint set by the parent. Hence, one can then use the variation in wages across households to estimate the reaction of parental transfers to the income of the recipient child.

## 5. Simulations

This section solves the altruism model of the family numerically to obtain further insights about the effects of imperfect information on the schedule of transfers and earnings.

### 5.1. Transfer amount

In the section above, it was proven that, if in the solution, the child receives a monetary transfer no matter what the wage realization is, the response of parental transfers to exogenous income components is bigger than the response to labor income components. The result was not proven for the important case in which there is a range of wages that do not qualify for a transfer. Furthermore, the qualitative results do not provide information about the magnitudes of the transfers responses to the various components of income. This section provides evidence about the response of transfers to earnings of children from simulations based on plausible parameters for the utility function.

Following much of the literature on labor supply and consumption, the following utility function is posed for the child:

$$U^c(c^c, \frac{y_s^c}{w_s^c}) = \frac{(c^c)^{1-\phi_c}}{1-\phi_c} + \frac{(\bar{l}_s - \frac{y_s^c}{w_s^c})^{1-\rho_s}}{1-\rho_s} \quad (5.1)$$

and, for the parent:

$$U^p = \varepsilon c^p + \eta U^c$$

Simulations of the model require estimates of the parameters of the utility function, the shape of the wage distribution that the child faces ex-ante, and some estimate of the earnings of the primary earner. Parameters of the utility function are chosen in the following manner.  $\phi_c$  is the degree of risk aversion of the child. A higher value of  $\phi_c$  is associated to a more concave utility function (with respect to consumption). An estimate of 2 is used, following Rangazas (1999).  $\rho_s$  is taken to generate an uncompensated labor supply elasticity of married women that falls

within the range of empirical estimates of Mroz (1987). Namely, a baseline value of 2.4 is chosen, for  $\rho_s$ . This value generates a static labor supply elasticity of 0.13 evaluated at the mean wage in his sample, 11 dollars (1993 dollars).

The parameter  $\eta$  and the marginal utility that the parent derives from own consumption ( $\varepsilon$ ) are not separately identified in the model, due to the fact that the parent is risk neutral with respect to own consumption.  $\varepsilon$  is normalized to 1, and  $\eta$  picked so that the simulated average transfer matches the unconditional mean of transfers in the PSID 1988 transfer file, 378 dollars per household (including values of zero).

The wage distribution was obtained from the Panel Study of Income Dynamics. The wage of a wife is defined as the ratio of labor earnings over hours of work reported. The mean wage of a white married secondary earner with 30 years of age and no kids is predicted by means of a log regression of wages on demographics and year dummies. The mean residual for each individual over the years that the individual contributed an observation is then added to the mean predicted value. The 10th percentile, mean and 90th percentile of the resulting distribution of the wages are 4.97, 10.8, and 17.9 (1993 dollars). In order to get estimates of the probability of a given wage, the density of the distribution is estimated using a kernel.

To obtain  $y_{exo}^c$  I regressed labor earnings of primary earners on a set of demographics and year dummies. This regression yields the prediction of mean earnings of a white primary earner at age 30 without children. The mean value of the prediction is 27,000 dollars (valued in 1993 dollars).

Specific details of the simulation procedure can be found in Appendix 2. The baseline specification takes  $\phi_c$  as 2 and  $\rho_s$  as 2.4 (which implies an uncompensated labor supply elasticity of the secondary earner of 0.44, 0.11 and 0 at the 10th percentile, mean and 90th percentile of the wage distribution).

Table 1 reports the simulated mean response of parental transfers to variations in income of the secondary earner for the two information regimes: perfect and imperfect information. In both information regimes, the response of parental transfers to income variations is negative, but the magnitude of the response is very different in each case. While under perfect information a dollar increase in the income of the primary earner is associated to a dollar decrease in parental transfers (rows 4 and 5), the same dollar increase under imperfect information decreases parental transfers by only 12 cents (row 9, specification I). The mean response of parental transfers to income of the primary earner is 20 cents in absolute value (row 10, specification I).

The second result to note is that the average response of parental transfers to income variations of the secondary earner is smaller in absolute value than the

response of parental transfers to the income of the primary earner.<sup>17</sup> Finally, it is worth noting that, compared to actual data, the simulated model under imperfect information overpredicts the proportion of households receiving transfers, (54 percent vs 23 percent) and underpredicts the mean of parental transfers for those who receive ( these results are not reported in the Table 1).

Table 1 presents a second specification where  $\rho_s$  is 3, which corresponds to an uncompensated static labor supply elasticity of 0.11 at the 10th percentile of the wage, 0 at the median wage and -0.05 at the 90th percentile of the wage distribution. This value of the coefficient  $\rho_s$  implies that the disutility of leisure is now less closer to linear than in the former specification. Drawing an analogy from the results of the optimal taxation theory, parental transfers should be especially responsive to income of a secondary earner with a low static labor supply elasticity, because this secondary earner is very attached to the labor market. The simulations in Table 1 confirm this intuition. The average response of parental transfer to income of the secondary earner is slightly higher in absolute terms than in the baseline case: a dollar increase in the permanent income of the wife decreases parental transfers by 13 cents (row 9, specification II). The response of parental transfers to variations in the income of the primary earner are now smaller in absolute value: an increase in the income of the primary earner diminishes parental transfers by 18 cents (row 10, specification II).

The simulations above assume that the parent is assumed to be risk neutral in own consumption. To assess if this assumption is driving the results in Table 1, a third set of simulations is ran (specification 3). Parental preferences are now assumed to take the following form:

$$U^p = \frac{(c^p)^{1-\phi_p}}{1-\phi_p} + \eta U^c \quad (5.2)$$

A value of 2 is chosen for  $\phi_p$ , consistent with the choice for  $\phi_c$ . The third panel in Table 1 presents the results of these simulations. Again, imperfect information about the wage of the children reduces the magnitude of the responses of transfers to earnings of the primary and secondary earner in the household of the child. The numerical results are similar to the case in which parental utility is linear on own consumption, and I do not comment them in detail.

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<sup>17</sup>The response of parental transfers to variations in income of the primary earner is pointwise higher in absolute value than the response of transfers to income of the secondary earner.

## 5.2. The transfer decision

The previous analysis has focused on the response of the transfer amount to the earnings of the husband and wife among households that receive transfers. This subsection investigates numerically the relationship between the probability of receiving a transfer and the earnings of both members of the household of the child.

The strategy I use is the following: I generate a random sample of 530 households of children from the Panel Study of Income Dynamics, each with a different realization of the wage of the secondary earner,  $w_s^c$ , earnings of the primary earner,  $y_{exo}^c$ . The mean (standard deviation) of  $y_{exo}^c$  is 27,000 dollars (10,222). The corresponding numbers for the wages of the secondary earner  $w_s^c$  are 9.95 (4.16). I assigned to each household a random parameter of parental altruism  $\eta$ , drawn from a Normal distribution with an average of 14.<sup>18</sup> Given that I could not find in the literature an estimate for the variance of  $\eta$ , I use several parameter values.

Each household is assumed to have the same preferences used in the previous subsection, and faces the same ex-ante distribution of the wage of the secondary earner (the distribution of wages described in the previous subsection). To evaluate the impact of imperfect information, I first assume that the parent can observe the wage of the secondary earner, and then relax the assumption. The output of these computations is a sample of children in which the  $i$ -th observation is a transfer amount  $t_i(w_i, y_{i,exo}^c, \eta_i)$ , and the earnings choice of the secondary earner  $y_{i,s}^c(w_i, y_{i,exo}^c, \eta_i)$ . I examine the response of the probability of receiving a transfer to the earnings of the husband and wife using the following Probit.

$$P(t_i > 0 | y_{i,exo}^c, y_{i,s}^c) = \Phi(\gamma_0 + \gamma_1 y_{i,exo}^c + \gamma_2 y_{i,s}^c)$$

where  $\Phi$  is the cumulative normal distribution,  $t_i$  is the amount of parental transfers received by the child, and  $y_{i,exo}^c$  and  $y_{i,s}^c$  reflect the earnings of the husband and wife in the household of the child. The results of the simulations are shown in Table 2.

In the first and second rows of Table 2, I report the coefficient on the Probit of earnings of the primary and secondary earner in a sample generated under the assumption that the parent has perfect information about  $w_s$ . For all specifications, the coefficients of both earnings components are almost identical, consistent with the discussion in Section 3.1.

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<sup>18</sup>Variation in  $\eta$  is needed in order to identify the effects of earnings on the probability of receiving a transfer. As shown in Section 5, the probability of receiving a transfer is zero if earnings fall below the cutoff value of earnings. Hence, without variation in the altruism parameter  $\eta$ , the earnings of the secondary earner would be a perfect predictor of receiving a transfer.

The third and fourth rows in Table 2 present the coefficients of the same Probit specification on a sample generated assuming that the parent does not have full information on the wage of the secondary earner. In this case, the probability of receiving a transfer does depend on which member of the household loses the dollar. An increase in the earnings of the primary earner has a bigger impact on the probability of transfer receipt than the same increase in the earnings of the secondary earner. These results are on line with those found in the previous subsection: under imperfect information parental transfers are more responsive to the earnings of children who are more attached to the labor market.

The second panel in Table 2 presents the predicted probability of receiving a transfer at various income levels. At the sample means, the probability of receiving a transfer is 0.26. A household in which the secondary earner earns \$4,000 less than the average has a probability of receiving of 0.38. Conversely, if the primary earner earns \$4,000 less than the average, the probability that the household receives a transfer is 0.54.

### 5.3. Results from the simulations

Overall, I draw three conclusions from the simulations. The first conclusion is that imperfect information reduces substantially the sensitivity of the amount of parental transfers to the income of the parent and child, and helps reconciling the predictions of the altruism model of the family with the data. The second conclusion is that, according to the altruism model of the family under imperfect information, the *amount* of parental transfers is more responsive to the income of the primary earner than to the income of the secondary earner. Finally, the third conclusion is that the *probability* of receiving a transfer is more responsive to the income of the primary earner than to the income of the secondary earner.

I test the last two hypothesis in the next Section, using data from the Panel Study of Income Dynamics.

## 6. The empirical strategy and the sample

This section motivates the econometric specification of the model and discusses the data. In the empirical implementation, I examine whether data drawn from the PSID supports the pattern of simulation results described in section 5. First, I examine whether a dollar increase in the earnings of the primary earner has a bigger impact on the probability of receiving a transfer than the a dollar increase in the earnings of the secondary earner. Second, I test whether a dollar increase in the income of the primary earner in the household of the child leads to a larger

reduction in the parental transfer *amount* than a dollar increase in the income of the secondary earner in the same household.

I use a limited dependent variable model to compare the slopes of the transfer function with respect to income of the primary and secondary earners in the household of the child. In the data, the primary earner is identified with the husband in a married household, and the secondary earner with the wife.

The model estimated is the following:

$$T_i = \max\{\beta_0 - \beta_h Y_{h,i}^c - \beta_f Y_{f,i}^c + \beta_p Y_i^p + \delta X_i + U_i, 0\} \quad (6.1)$$

The dependent variable ( $T_i$ ) is the amount of transfers received by the household of the child, indexed by  $i$ .  $Y_{h,i}^c$  are a measure of permanent labor earnings of the husband in the household of the child, and  $Y_{f,i}^c$  labor earnings of the wife in the household of the child.  $\beta_h$  and  $\beta_f$  are the degree to which the transfer from the parent decreases with income of each of the earners.  $Y_i^p$  stands for permanent income of the parent. The results from Section 5 imply that parental income affects positively the amount of the transfer. The income measure to include in the equation deserves discussion. The model described in section 4 is static. In this framework, both parental transfers and income of the child are lifetime decisions. Following Altonji et al. (1997), I construct lifetime earnings variables.

$X_i$  includes variables that control for the determinants of the needs of the members of the household of the child such as the total number of children in the household of the child -grandsons and granddaughters of the parent- and the specific number of children in age brackets.  $X_i$  also includes variables that affect the willingness of the parent to provide a transfer, including whether parents are divorced or widow/er, and interactions with marital status. Finally,  $X_i$  includes determinants of the earning ability of the child, such as education. It is quite likely that parents use all available information to form an assessment of the wage distribution faced by their children. Education is a variable that parents can easily observe, and it is also a strong predictor of earnings. Hence, parents are likely to use that information to make a better assessment of the wage distribution faced by the members of the household of the child.

The transfer function can only take positive values, because the parent cannot enforce negative transfers. Also, the sample of children receiving transfers is a selected one, as households composed of children with high incomes who receive transfers will tend to have parents who are very altruistic. This implies that a limited dependent variable model should be used. The empirical test that I make is whether or not  $|\beta_h| \geq |\beta_f|$ .

A standard specification, like the Tobit, presents the following problem. Unobservable variables summarized by  $U_i$  are constrained to enter the transfer equation

in a separable fashion. Nevertheless, it is easy to show than, even in the most simple perfect information case, the reaction of transfers to income of the child depends on household-specific parameters such as parental altruism. That is, transfers depend on income and unobservable taste parameters in a non separable way. Hence, the coefficients of the Tobit specification may be biased, and nothing can be said a priori on the direction of the bias.

This problem motivates the second estimation strategy, which is based on a semiparametric estimator developed by Altonji and Ichimura (1997). I refer to this estimator as the A-I estimator. Unlike the Tobit specification, this estimator reports the mean slope of the transfer schedule, but allows for heterogeneity in these slopes. It provides an estimate of  $E\{\frac{\partial T_i(Y_i, U_i)}{\partial Y_i} | Y_i, T(Y_i, U_i) > 0\}$ , which is the expected value of the response of transfers to an extra dollar of income when income is  $Y_i$  evaluated over the distribution of unobserved heterogeneity  $U_i$  conditional on a positive transfer. In the special case in which the Tobit model is correctly specified, this is the coefficient in the Tobit model.<sup>19</sup> Finally, I report estimates using a two step approach to correct for sample selection

### 6.0.1. Endogeneity of Child's Income

The estimators I use take  $Y_{f,i}^c$  as fixed when the parent chooses  $T_i$ . In the model solved above, parents choose both earnings of children and transfers. In other words, both variables are chosen simultaneously. Nevertheless, I have chosen to run regression models to match the moment computed in the simulations in Section 5. In that section, I report the slope of the locus of transfers and earnings of the secondary earner -the equivalent to a regression function.

There is a further issue, not taken into consideration in the previous literature on transfers. Comparing the transfer-income selection of different households can be problematic, as there is heterogeneity in the degree of parental altruism. Holding education constant, more generous parents are likely to give higher transfers and allow the secondary earner to earn less income, hence biasing downward

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<sup>19</sup>The A-I estimator is an analog estimator and is based on the following relationship.

$$E\left\{\frac{\partial T_i(Y_i, U_i)}{\partial Y_i} \mid Y_i, T(Y_i, U_i) > 0\right\} = \frac{\partial E\{T_i \mid Y_i, T(Y_i, U_i) > 0\}}{\partial Y_i} + E\{T_i \mid Y_i, T(Y_i, U_i) > 0\} \frac{\partial P\{T_i > 0 \mid Y_i\}}{\partial Y_i} / P\{T_i > 0 \mid Y_i\}$$

I implement it by replacing the expressions on the right hand side with estimates obtained using a global polynomial approximation to the regression function  $E\{T(Y_i, U_i) \mid Y_i, T(Y_i, U_i) > 0\}$  and the conditional probability  $P\{T(Y_i, U_i) > 0 \mid Y_i\}$ . Standard errors are calculated using the delta method -see Altonji et al (1997).



the coefficient on income of the secondary earner in a censored regression model. While this problem may be addressed instrumenting labor earnings with the wage of the secondary earner, I do not do this in this paper. The reason is that the performance of the instrumental variables version of the A-I estimator may be poor with a sample size like the one at hand. At any rate, the presence of heterogeneity in parental altruism will bias the coefficient on the income of the secondary earner against the predictions of the altruistic model of the family under imperfect information.

## **6.1. Data**

This subsection presents the data on transfers and the construction of the permanent income measures.

### **6.1.1. The sample**

The data is taken from the 1988 wave of the Panel Study of Income Dynamics, which includes a supplement of transfers between relatives. This survey contains reliable data on lifetime resources of the recipient of transfers and detailed information on transfers. The sample consists of married respondents to the 1988 survey who were between 21 and 55 years of age in this year. In 1988, in addition to the transfer supplement respondents were asked questions about their parents and their spouse's. Questions include education, age, marital status, and current income. This sample has been used by other researchers. Among their findings, it is worth mentioning that transfers do not seem to be related to the purchase of a house by the child -see Altonji et al (1997). They also report that very few children are students, so transfers are not likely to be associated to payments like college tuition.

### **6.1.2. Data on transfers.**

The Transfer supplement contains information on the amount received and on the person who gave the transfer. The question asked is: "During 1987, did (you/your family living there) receive any loans, gifts or support worth \$100 or more from your parents? About how much were those loans, gifts or support worth altogether in 1987?"

Separate questions are asked about transfers from the father and transfers from the mother if the parents are divorced. The question is asked first about the husband's parents and then about the wife's parents. I aggregate transfers

from both sets of parents. That specification implicitly assumes that both sets of parents coordinate when deciding about giving transfers to their children.

### 6.1.3. Data on the permanent income of the child

The measure of permanent income of the child is a time-average of past, current, and future income adjusted for demographic variables and time. I used the panel data on all individuals from the PSID who were either a head or a wife in a particular year. The following income generating process is assumed:

$$\log Y_{it} = \gamma_0 + Z_{it}\gamma_1 + e_{it} + v_i \quad (6.2)$$

$Y_{it}$  are labor earnings of the member in the household of the child in a given year.  $Z_{it}$  contains a set of demographic variables.  $v_i$  is a permanent individual effect, uncorrelated with the demographic variables, and  $e_{it}$  denotes transitory variation in income.

The parameters  $\gamma_1$  are estimated by (gender specific) OLS regressions, using all the individuals in the PSID who were ever heads or wives between the ages of 18 and 60 (and only years in which they were heads or wives).<sup>20</sup> Also, only years in which labor earnings were above 400 dollars are included. The individual specific component  $v_i$  is estimated as the mean of the residuals for each person. This component is added to the predicted income for a person of age 40, married, and without children, and the variables are normed so that  $Z_{it}\gamma_1$  is 0 for such a person. Consequently,

$$\hat{Y}_i^c = \exp(\gamma_0 + v_i)$$

A caveat with this measure of lifetime resources is that secondary earners tend to participate in the labor market less frequently than primary earners do. Hence, including only the years in which wives earn more than 400 dollars is likely to overestimate their true lifetime resources. To correct for this, lifetime resources of the individuals are weighted by the proportion of years that they contributed to the regression, i.e.:

$$Y_i^c = \frac{\#(\text{years } Y_{it} > 400)}{\#(\text{years observed})} \hat{Y}_i^c$$

The 10th percentile, median and 90th percentile of the resulting distribution of permanent earnings of the husband are 14,926, 33,271 and 57,147, respectively

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<sup>20</sup>The  $Z_{it}$  contains a fourth order polynomial in age centered at the age of 40, a dummy for non married, number of children and year specific dummies. For females, dummies indicating head of household and head of household with children are also added.

(dollars of 1993). For wives, the corresponding numbers are 6,264, 16,225 and 34,187.

Finally, these income measures are pre-tax. Nevertheless, parents decide on transfers based on their income and the income of their children after taxes. Even in the presence of perfect information, this will bias the test against altruism. I do not correct income to make it net of taxes. I suspect that it will not affect the prediction of different reaction of transfers to income of the primary and secondary earners if they file jointly their income taxes.<sup>21</sup>

The sample consists of observations on 2,022 household with information on earnings and transfers received. Table 3 shows the (unweighted) summary statistics of the sample. 23% of all married households report transfers from at least one set of parents. The mean transfer (among those who receive) is 2,986 dollars (in 1993). The mean age of the children is 35 years (for husbands) and 33 (for wives). Nonwhites are overrepresented in the sample, as they contribute a 22% of the observations.<sup>22</sup>

## 7. Results

This section analyzes the effects of permanent income of each member in the household of the child on both the amount of the transfer received and on the probability of receiving a transfer. I provide evidence based on Probit, Tobit, Heckman two step and A-I estimators.

### 7.1. The response of parental transfers amount to earnings of husband and wife

In what follows, I censor transfers above 10,000 dollars and give them a value of 10,000. The main reason that I censor the data is to reduce the influence of outliers on the estimates. However, transfers above 10,000 dollars can be subject

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<sup>21</sup>This sample has no direct information on parental permanent income. I create a measure of this variable by exploiting the special structure of the PSID. A subsample of respondents in the 1988 survey were born inside PSID households. I match the records of persons who were sons/daughters in the 1968 PSID sample to the records of their parents. I then construct measures of the lifetime resources of the parents of these respondents following Altonji et al (1997). For the rest of respondents in the 1988 survey, I impute parental income by means of predicted values of regressions of parental lifetime resources on the set of parental variables available in the 1988 survey.

<sup>22</sup>Given the choice of households of children, the sample includes cases coming from the same family. That is, there are 23 observations of individuals whose children are also included in the sample. I reran the analysis excluding these cases, without much effect on the results.

to taxes, and the prediction of Becker (1974) will not hold for them.<sup>23</sup>

### 7.1.1. Probit analysis

In this section, I use a Probit specification to test if the probability of receiving a transfers reacts more to a dollar decrease in the earnings of the primary earner than to a dollar decrease in the earnings of the secondary earner.

The Probit models I and II in Table 4 include the receipt of a transfer as the dependent variable. All models include a polynomial in the age of the head and wife and variables that reflect the composition of the household, in order to capture the needs of the child that affect the marginal utility of consumption of the household.<sup>24</sup> As discussed in Section 6, the education of the husband and the wife are also included in some specifications. Standard errors are corrected for the fact that regressors are generated, along the lines of Cox and Jakubson (1995). They also correct for the fact that respondents may come from the same 1968 household.

In all specifications, the sign of the earnings of the husband is negative. The coefficient of the earnings of the wife is also negative, and the magnitude is significantly lower than that of the husband. The coefficients in the Probit model I imply that an increase of 10,000 dollars of the income of the husband increases the probability of receiving a transfer by 0.025. An increase of 10,000 dollars of the income of the wife increases the probability of receiving a transfer by 0.014. These results accord with the predictions of the altruistic model of the family under imperfect information. Including education of the child and quadratic terms in earnings rises the absolute value of impact of earnings on the probability, for both members of the household of the child. This change in coefficients can be interpreted as an indication that parents use education to assess the wage distri-

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<sup>23</sup>Individual transfers of less than 10,000 dollars to a given individual are not subject to taxes in the US, while these above \$10,000 are included in the donor's gift tax base. Once the donor accumulates \$600,000 dollars of taxable gifts (above \$10,000), gifts are taxed. Married couples can give 20,000 a year up to a 1.2 million limit, assuming a careful estate management. More details in Poterba (2001).

<sup>24</sup>The set of demographics includes contains the following variables: a polynomial of second order in the age of the husband and wife in the household of the child, dummies indicating whether the parents of the husband and wife are widow or a widower, and interactions with marital status, dummies for divorced parents, and interactions with the marital status and a dummy for nonwhite child. I also include the total number of children (grandchildren of the parent) living in the household of the child. Finally, the number of children of the child between 1 and 2 and the number of children of the child between 3 and 5 years of age are included.

bution faced by the members of the household of the child

### 7.1.2. Tobit specification

This subsection presents the results of the Tobit specification. The Tobit model I in Table 4 shows that parental transfers rise by 2.2 cents in response to a dollar reduction in the earnings of the head. Transfers rise by 1 cent in response to a dollar decrease in the income of the secondary earner.<sup>25</sup> This result accords with the results from the simulations in section 5. The difference in slopes is robust to the inclusion of education of the parent and child (Tobit model II in Table 4). As in the Probit analysis, both income coefficients become larger in absolute value when the education of both members is included.

The predicted sign of education is ambiguous. On one hand, schooling is an observable component of income, and the parent should “tax” it. In this case, the sign of the coefficient should be negative. On the other hand, as mentioned above, education of the child can be correlated with parental altruism. Parents with a higher degree of altruism are likely to give more gifts to their children than less altruistic parents. The estimated coefficient is positive and significantly different from zero for both members of the household. Finally, the rest of the coefficients are in line with the Probit results.

The evidence from the Tobit specification is consistent with the hypothesis under consideration: a dollar decrease in the permanent earnings of the head results in an increase in transfers that ranges from 2.2 to 3.6 cents. Conversely, a dollar decrease of the permanent earnings of the wife results in an increase of transfers between 1 and 2.4 cents. Nevertheless, the Tobit model constrains the slope of the transfer amount to be the same as the determinants of the probability of reporting a transfer. Hence, the coefficients of the Probit part may be driving the results concerning the slope of the transfer schedule. In the previous subsection, it was seen that a dollar decrease in the income of the head is more likely to be associated with the reporting of a parental transfer. To evaluate to what extent is the Probit part of the likelihood function affecting the results, I use three estimators that use the subsample of children receiving positive transfers.

### 7.1.3. Heckman two step estimator

To circumvent the specification problem in the Tobit model, a two step estimator is presented in table 5. That table shows the results for linear specifications in income that do not control for selection (OLS) and who do control for it (2 step

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<sup>25</sup>The reported standard errors in the Tobit specification do not account for correlation within the family nor for the fact that parental permanent earnings are generated.

Heckman). Only the subsample of 546 children households who receive transfers is used.

The OLS coefficients are most probably biased, as they do not take into account the truncation in the dependent variable. The income coefficients in the OLS model I are negative and not significantly different from zero: a dollar decrease in the income of the husband results in a decrease of 0.5 cents in transfers. The effect of income of the wife is slightly smaller in absolute terms (0.4 cents), and not statistically significant. The reported standard errors account for correlation within dynasties and heteroscedasticity between dynasties, as well as for generated regressors.

Including a term that takes sample selection into account results in higher standard errors.<sup>26</sup> OLS-corrected model I reports a specification without education measures, and the coefficients of income of the husband and wife are positive and nonsignificant, contrary to the prediction of the altruism model of the family. The results do not vary much once the education of the child and parent are included. Nevertheless, the standard errors are very high, and none of the coefficients is significantly different from zero. This experiment is not conclusive, due to the imprecision of the estimates. I turn next to the A-I estimator.

#### 7.1.4. A-I estimator

Table 6 presents the results from the estimator developed by Altonji and Ichimura (1997). As mentioned above, this estimator has the advantage of allowing for heterogeneity in the preferences of the parents and the child, as well as nonseparability between the error terms and the explanatory variables.

The parameter reported is the derivative of transfers with respect to permanent earnings of the husband and wife for the subsample of children who report transfers, evaluated at sample means. To estimate the form of the truncated regression, a global polynomial procedure was used. It contains the income of the parent, a third order polynomial in labor income earned by the wife in the household of the child, and third order polynomial in labor income earned by the head, and interactions between first order and second order terms of the polynomials. The same set of demographics as in the former specifications is included.

Evaluated at mean earnings, an extra dollar of permanent income of the husband results in a decrease of parental transfers of 2 cents. The average reaction of transfers to earnings of the wife varies more across specifications. In model I, that excludes education controls, it is 3 cents. Once the education of the members

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<sup>26</sup>In their analysis of inter vivos transfers, Cox and Jakubson (1995) report accuracy problems when using a generalized Tobit estimator.

of the household of the child is included (models II and III), the average slope of the income of the wife rises to 5 cents. These results contradict the prediction of the model of altruism under imperfect information regarding the response of the transfer amount to the earnings of the members of the household.

## 7.2. Discussion of findings

Overall, the conclusion of the analysis with permanent earnings of husband and wife supports one of the predictions of the altruism model under imperfect information: the probability of receiving is higher if the primary earner of the household of the child loses a dollar than if the secondary earner does. Another prediction of this model is that among households who receive transfers, an additional dollar of the primary earner diminish transfers more than an additional dollar of the secondary earner. Only the Tobit coefficients are consistent with that hypothesis, but the pattern can be explained by the specific functional form restrictions that this model embodies. Once nonseparabilities and measurement error issues are taken into consideration, the evidence does not support this second prediction.

A possible explanation for this failure of the theory is that parents care more about their own offspring than about their son or daughter-in-law. This fact could create heterogeneous responses to earnings components if, in addition, children households are not unitary. I explored this possibility examining the response of the transfer amount to the earnings of the donor, controlling by the sum of earnings of both members of the household. If parents are only altruistic toward their own offspring, their transfers should be very responsive to the earnings of the offspring. The results of the A-I estimator in Table 7 show that, controlling for the resources of the household of the child, a loss of a dollar in the income of the offspring of the donor does not increase the transfer amount significantly.

A model with exchange-motivated parental transfers could be consistent with the failure of the prediction of informationally constrained altruism regarding the transfer amount. For example, imagine that parents provide transfers to their young children in exchange of care when the parents are older. Parents would then be more likely to compensate with transfers the income variations of their daughters as they are more likely to provide help when parents grow old.

Further evidence in support of the altruism model under imperfect information can be found in Villanueva (2001). In that paper, I present evidence based on food consumption data, following the same strategy as Altonji et al (1992), who use dynasty fixed effects models of consumption growth in a given year. They find that the differences in consumption growth among parents and siblings

are strongly related to differences in the growth of wages.<sup>27</sup> I examine whether the difference in consumption levels of members of the same dynasty is related to differences in observable shocks to income that lie outside of the control of the child. The shocks considered are identified with unemployment due to plant closings and medical conditions that limit the amount of work that can be done. My findings are that none of these shocks are related to the differences in consumption levels, nor do they explain the difference of growth rates between the members of a dynasty. Nevertheless, the differences among the related households in wage growth do lead to differences in consumption growth. These results indicate that the members of a dynasty are more willing to insure each other from observable income shocks, than from variations in the price of labor or hour fluctuations that are not related to involuntary unemployment or health problems. That interpretation is in line with the theoretical predictions of the present work.

## 8. Conclusions and policy implications

This paper asks whether the altruism model of the family can be modified to reconcile it with the empirical evidence on intergenerational transfers. I expand the altruism model of the family by including effort of the child on one hand, and by relaxing the assumption of parental perfect information about the labor market opportunities of the child on the other. This new model is simulated, with some parameters chosen to match estimates from the labor supply and consumption literatures and others chosen to match the incidence of money transfer in the U.S. The computations reported in the paper suggest that, among households of children who are receiving monetary help, the response of parental transfers to a dollar decrease in the income of the secondary earner in the household of a married child is below 14 cents. Conversely, the response of parental transfers to a dollar decrease of the income of the primary earner is around 22 cents. Previous researchers have reported empirical estimates of the response of transfers to a dollar decrease of the income of the child, and this magnitude is around 10 cents.

The paper also tests the following prediction of the model. Are parental transfers more responsive to a dollar decrease in the earnings of the primary earner in the household of the child than to a dollar decrease in the earnings of the secondary earner? I do not find that, among households receiving transfers, a dollar decrease in the earnings of the primary earner rises transfers more than a dollar decrease in the earnings of the secondary earner. Nevertheless, I find that the household of a married child is more likely to receive a transfer if the primary earner loses a dollar than if the secondary earner does.

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<sup>27</sup>See also the literature on risk sharing in the economy, particularly Cochrane (1991)



What does this model say about the effect of a program that taxes a dollar of the income of the child to give it to the parent? This tax would lie out of the control of the child, and would be observable to the parent. The model presented in this paper predicts then that while parental transfers will not necessarily neutralize this program, they will rise in response to it. The model presented here also suggests that the increase of parental transfers following this exogenous redistribution will be higher than the increase suggested by Altonji et al. (1997) or Cox (1987), who identify the effect on parental transfers of income variations of the child associated to endogenous effort choices. The effectiveness of public programs that redistribute income between generations remains then an open question for further empirical research.

## 9. Appendix 1: Proof of the propositions in the text.

This appendix presents the proofs of the propositions in the text. Proposition 1 is presented in a series of lemmas. The following notation is used. A hat ( $\hat{\cdot}$ ) over a variable denotes that it forms part of the solution to the problem that the child would solve without parental transfers.  $\hat{U}^c(w_j, y_{exo}^c)$  is the utility level of the household of child if the secondary earner has a wage  $w_j$  in the absence of parental transfers. An asterisk (\*) over a variable denotes that forms part of the solution to the problem with imperfect information. I drop the superscript  $c$  in the income and consumption variables of the child. The utility function is rescaled to make zero the utility from the leisure of the primary earner. The subscript  $s$  in the wage, probability and income is also dropped, once the primary earner is ignored. The problem of the parent is to maximize:

$$\max_{\{(c_i, y_i)_{i=1}^n\}} \sum_{i=1}^{i=n} \pi_i \{y^p - c_i + y_i + \eta U_i^c(c_i, \frac{y_i}{w_i}, y_{exo})\} \quad (9.1)$$

$$s.t. \quad v(c_i) + \gamma_s (\bar{l}_s^c - \frac{y_i}{w_i}) \geq v(c_j) + \gamma_s (\bar{l}_s^c - \frac{y_j}{w_i}) \quad i \neq j \quad \forall i = 1 \dots n \quad (\text{IC})$$

$$s.t. \quad U_i^c(c_i, \frac{y_i}{w_i}, y_{exo}) \geq \hat{U}_i^c(w_i, y_{exo}) \quad \forall i = 1 \dots n \quad (\text{PC})$$

$$s.t. \quad c_i - y_{exo} - y_j \geq 0 \quad \forall i = 1 \dots n$$

$$where \quad U_i^c = v(c_i) + \gamma_s (\bar{l}_s^c - \frac{y_i}{w_i})$$

Besley and Coate (1995) prove that, for the preferences posed, one needs only to worry about the informational constraints between adjacent wages. First I define these special informational constraints in detail.

**Definition 1.** The constraint  $v(c_i^*) + \gamma_s(\bar{l}_s^c - \frac{y_i^*}{w_i}) \geq v(c_{i-1}^*) + \gamma_s(\bar{l}_s^c - \frac{y_{i-1}^*}{w_i})$  will be defined as the downward adjacent incentive compatibility constraint (DAIC) associated to wage  $w_i$

**Definition 2.** The constraint  $v(c_i^*) + \gamma_s(\bar{l}_s^c - \frac{y_i^*}{w_i}) \geq v(c_{i+1}^*) + \gamma_s(\bar{l}_s^c - \frac{y_{i+1}^*}{w_i})$  will be defined as the upward adjacent incentive compatibility constraint (UAIC) associated to wage  $w_i$

Lemmas 1 through 7 characterize the solution described in Proposition 1.

**Lemma 1.** The participation constraint PC is never binding.

Assume that there exists some  $i$  for which

$$U_i^c(c_i, \frac{y_i}{w_i}, y_{exo}) < \hat{U}_i^c(w_i, y_{exo})$$

Then, replace  $(c_i^*, y_i^*)$  with  $(\hat{c}_i, \hat{y}_i)$  -the optimal consumption level if the child does not receive transfers. This change improves the utility of the child, if the wage of the secondary earner is  $w_i$ , and does not increase the cost to the parent, since the transfer was at least nonnegative in the former solution, and now is zero. Once this change has been made for all  $i$ 's, it cannot happen that

$$v(c_i^*) + \gamma_s(\bar{l}_s^c - \frac{y_i^*}{w_i}) < v(\hat{c}_j) + \gamma_s(\bar{l}_s^c - \frac{\hat{y}_j}{w_i})$$

The reason is that, by revealed preference,

$$\hat{U}^c(w_j, y_{exo}) \geq v(\hat{c}_j) + \gamma_s(\bar{l}_s^c - \frac{\hat{y}_j}{w_i})$$

**Lemma 2.** Any allocation  $\{(c_i, y_i)_{i=1}^n\}$  satisfying the informational constraints imposes that consumption and income are nondecreasing in the wage. Also, if  $y_i \neq y_{i+1}$  then  $y_i < y_{i+1}$

Proof. Let any pair of wages  $w_i$  and  $w_{i+1}$ :

$$v(c_i) + \gamma_s(\bar{l}_s^c - \frac{y_i}{w_i}) \geq v(c_{i+1}) + \gamma_s(\bar{l}_s^c - \frac{y_{i+1}}{w_i}) \quad (9.2)$$

and

$$v(c_{i+1}) + \gamma_s(\bar{l}_s^c - \frac{y_{i+1}}{w_{i+1}}) \geq v(c_i^*) + \gamma_s(\bar{l}_s^c - \frac{y_i}{w_{i+1}}) \quad (9.3)$$

Combining the two expressions, (9.2) and (9.3), one gets

$$\int_{y_i}^{y_{i+1}} \gamma'_s(\bar{l}_s^c - \frac{x}{w_i}) \frac{1}{w_i} dx \geq \int_{y_i}^{y_{i+1}} \gamma'_s(\bar{l}_s^c - \frac{x}{w_{i+1}}) \frac{1}{w_{i+1}} dx \quad (9.4)$$

Using the facts that the marginal utility of leisure is higher for a person with a lower wage, and that  $\frac{1}{w_i} > \frac{1}{w_{i+1}}$  one gets that  $y_{i+1} \geq y_i$ . Once income is nondecreasing in the wage in equilibrium, consumption must also be nondecreasing in the wage. The second part of the lemma follows from (9.4)

**Corollary 3.** *Let the solution of the problem,  $\{(c_i^*, y_i^*)_{i=1}^{i=n}\}$ . Let two bundles of consumption and income associated to wages  $w_i$  and  $w_{i+1}$  be  $(c_i^*, y_i^*)$  and  $(c_{i+1}^*, y_{i+1}^*)$ , where  $(c_i^*, y_i^*) \neq (c_{i+1}^*, y_{i+1}^*)$ . It cannot be the case that the UAIC associated to wage  $w_i$  and the DAIC associated to wage  $w_{i+1}$  bind at the same time.*

The proof of this corollary is straightforward replacing the weak inequalities in the proof of lemma 1 by equalities.

**Lemma 4.** *If there exists a wage  $w_r$  such that  $y_r = 0$  then, for every wage  $w_i$  such that  $w_i < w_r$ ,  $y_i^* = 0$  and  $c_i^* = c$*

Proof: from lemma 2.

**Lemma 5.** *Let  $\{(c_i^*, y_i^*)_{i=1}^{i=n}\}$  be the solution to the problem. For all  $j \in (1, \dots, n)$  such that  $c_j^* > y_j^* > 0$  (i.e. for all wages such that the child receives positive transfers), and  $(c_j^*, y_j^*) \neq (c_{j-1}^*, y_{j-1}^*)$  the UAIC associated to wage  $w_{j-1}$  does not bind.*

Proof: Assume that there is a range of  $(w_{n_0}, \dots, w_{n_1})$  such that the UAIC for each wage binds. Assume also that UAIC associated to  $w_{n_0-1}$  does not bind, nor does the one associated to  $w_{n_1+1}$  (maybe because  $n_0 = 1$  and  $n_1 = n$ ). By assumption, there exists at least two combinations of consumption and income that correspond to adjacent wages  $w_k$  and  $w_{k+1}$  and that are such that  $(c_k^*, y_k^*) \neq (c_{k+1}^*, y_{k+1}^*)$ . By corollary 3, the DAIC associated to wage  $w_{k+1}$  does not bind, and, by lemma 2:

$$v'(c_{n_1}^*) \leq v'(c_{n_1-1}^*) \leq \dots \leq v'(c_{n_0}^*) \quad (9.5)$$

The set of inequalities (9.5) follows from the following facts: that (1) the consumption level of any sequence that satisfies the adjacent incentive constraints is nondecreasing in

the wage, and (2) the utility level is strictly concave in consumption. Also, at least one of the inequalities holds with strict inequality.

Next, consider the following redistribution of consumption within the set of bundles  $\{(c_i^*, y_i^*)_{i=n_0}^{i=n_1}\}$ . Assume that there are  $m$  wages that share the same combination  $(c_{n_1}^*, y_{n_1}^*)$  ( $m$  can be one). Define  $\{(c_i^0, y_i^*)_{i=n_0}^{i=n_1}\}$  as follows:

$$c_j^0 = c_j^* - \sum_{i=n_1-m}^{n_1} (\pi_i) \varepsilon \quad j = n_1-m, \dots, n_1$$

$$c_j^0 = c_j^* + \frac{\sum_{i=n_1-m}^{n_1} (\pi_i)}{\sum_{i=n_0}^{n_1-m-1} \pi_i} \varepsilon = c_j^* + \varepsilon_1 \quad j = n_0, \dots, n_1-m-1 \quad (9.6)$$

This plan redistributes consumption from the wage types  $w_{n_1} \dots w_{n_1-m}$  to the wage types  $w_{n_0}, \dots, w_{n_1-m-1}$ , leaving the expected expenditure of the parent unaffected. It does not violate the AIC constraints, for an  $\varepsilon$  small enough. The DAIC of wage  $n_0$  is relaxed. The UAIC between  $n_1$  and  $n_1+1$  will not bind for small enough  $\varepsilon$ . Finally, due to strict concavity of  $v$ , increasing the consumption level of each wage type  $w_{n_0}, \dots, w_{n_1-m-1}$  by the same amount  $\varepsilon_1$  will not violate the UAIC between any two adjacent wages.<sup>28</sup> It also improves the utility of the parent. The change in the utility of the parent is:

$$\sum_{i=n_1-m}^{n_1} (\pi_i) [1 - v'(c_{n_1}^*)] \varepsilon - \left\{ \sum_{i=n_0}^{n_1-m-1} \pi_i [1 - v'(c_i^*)] \right\} \varepsilon_1 \geq$$

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<sup>28</sup>In equilibrium, before the modification, the UAIC between any pair of adjacent wages in the interval  $[w_{n_0}, w_{n_0+1}, \dots, w_{n_1}]$  was binding in equilibrium. i.e.:

$$v(c_i^*) + \gamma \left( \bar{l}_s^c - \frac{y_i^*}{w_i} \right) = v(c_{i+1}^*) + \gamma \left( \bar{l}_s^c - \frac{y_{i+1}^*}{w_i} \right)$$

I will show that increasing  $c_i^*$  and  $c_{i+1}^*$  by the same amount does not violate the UAIC. Trivially, if  $(c_i^*, y_i^*) = (c_{i+1}^*, y_{i+1}^*)$  the new plan will not violate the UAIC associated to  $w_i$ . Assume that two adjacent bundles are different and that the UAIC was violated after the change. Then:

$$v(c_i^* + \epsilon) + \gamma \left( \bar{l}_s^c - \frac{y_i^*}{w_i} \right) < v(c_{i+1}^* + \epsilon) + \gamma \left( \bar{l}_s^c - \frac{y_{i+1}^*}{w_i} \right)$$

Combining the two expressions, they imply that:

$$v(c_i^* + \epsilon) - v(c_i^*) < v(c_{i+1}^* + \epsilon) - v(c_{i+1}^*)$$

Dividing by  $\epsilon$  and taking limits, the last equality implies that the  $v'' \geq 0$ , which is not consistent with the strict concavity of  $v()$

$$\begin{aligned}
& \sum_{i=n_1-m}^{n_1} (\pi_i)[1 - v'(c_{n_1}^*)]\varepsilon - \left\{ \sum_{i=n_0}^{n_1-m-1} \pi_i \right\} [1 - v'(c_{n_1-m-1}^*)]\varepsilon_1 = \\
& \sum_{i=n_1-m}^{n_1} (\pi_i)[1 - v'(c_{n_1}^*)]\varepsilon - \sum_{i=n_1-m}^{n_1} (\pi_i)[1 - v'(c_{n_1-m-1}^*)]\varepsilon > 0 \quad (9.7)
\end{aligned}$$

The first inequality uses the fact that marginal utility of consumption is lower for higher wages. The second equality substitutes in the definition of  $\varepsilon_1$ . The increase is positive, and we get to a contradiction. Hence, the UAIC will not bind for any interval.

**Lemma 6.** *Let  $\{(c_i^*, y_i^*)_{i=1}^{i=n}\}$  be the solution of the problem. Then, if  $c_i^* > y_i^* + y_{exo}$ , and  $(c_i^*, y_i^*) \neq (c_{i-1}^*, y_{i-1}^*)$  then the DAIC associated to  $w_i$  must bind*

Proof. Assume not. From corollary 5, I know that the UAIC associated to wage  $w_{i-1}$  does not bind. If the DAIC is non binding, the marginal utilities associated with higher wages are strictly lower than those of the lower. One can then redistribute income in the same manner than in the proof of lemma 5.

**Lemma 7.** *Let the solution to the problem  $\{(c_i^*, y_i^*)_{i=1}^{i=n}\}$ . If there exists some  $v \in (1, \dots, n)$  such that  $c_v^* = y_v^* + y_{exo}$ , then, for all  $k > v$ ,*

$$c_k^* = y_k^* + y_{exo} \quad \text{and} \quad y_k^* = \hat{y}_k$$

Proof: Assume that  $c_v^* = y_v^* + y_{exo}$  and  $c_{v+1}^* > y_{v+1}^* + y_{exo}$ . Then, by the former lemma, the DAIC constraint associated to wage  $w_{v+1}$  must bind. Using the IC's, one can get the following chain of inequalities:

$$\begin{aligned}
\hat{U}^c(w_{v+1}, y_{exo}) & \leq v(c_{v+1}^*) + \gamma_s \left( \bar{l}_s^c - \frac{y_{v+1}^*}{w_{v+1}} \right) = v(\hat{c}_v) + \gamma_s \left( \bar{l}_s^c - \frac{\hat{y}_v}{w_{v+1}} \right) \quad (9.8) \\
& < v(\hat{c}_{v+1}) + \gamma_s \left( \bar{l}_s^c - \frac{\hat{y}_{v+1}}{w_{v+1}} \right) = \hat{U}^c(w_{v+1}, y_{exo})
\end{aligned}$$

The first inequality comes from the fact that the utility for a given wage is, at least, the level without transfers (lemma 1). The second equality makes use of the property that the DAIC must bind, if transfers are positive. The strict inequality comes from revealed preference. The chain of inequalities results in a contradiction, hence,  $c_{v+1}^* = y_{v+1}^* + y_{exo}$ . Utility maximization implies that  $y_v^* = \hat{y}_v$ .

Lemmas 1 through 7 complete the proof of proposition 1.

The next step is to prove propositions 2 through 4 in Section 4. For the next proofs, I use the result that, if the first hour worked brings zero disutility to the child, then for no wage is the child working zero hours in the solution.

I introduce the following notation.

$$U_i^c = v(c_i^c) + \gamma_s \left( \bar{l}_s^c - \frac{y_i}{w_i} \right) \quad \forall i = 1 \dots n \quad (9.9)$$

With this new notation, the DAIC can be rewritten as:

$$U_j^c = U_{j-1}^c - \gamma_s \left( \bar{l}_s^c - \frac{y_{j-1}}{w_{j-1}} \right) + \gamma_s \left( \bar{l}_s^c - \frac{y_{j-1}}{w_j} \right) \quad (9.10)$$

The problem is now the following:

$$\begin{aligned} & \max_{\{(U_i, y_i)_{i=1}^n\}} \sum_{i=1}^{i=v-1} \pi_i \{y^p - c_i^c(U_i, y_i) + y_i + \eta U_i^c\} \\ \text{s.t. } & U_i^c \geq U_{i-1}^c - \gamma_s \left( \bar{l}_s^c - \frac{y_{i-1}}{w_{i-1}} \right) + \gamma_s \left( \bar{l}_s^c - \frac{y_{i-1}}{w_i} \right) \quad \forall i = 2, \dots, v-1 \\ & \text{s.t. } c_i \geq y_i + y_{exo} \quad \forall i = 1, \dots, n \end{aligned}$$

Now, I make the change of variable:

$$c_i = f(U_i^c, y_i)$$

Using the equalities in (9.10) and the results in the previous proposition, the problem becomes:

$$\begin{aligned} & \max_{\{U_1^c, (y_j)_{j=1}^n\}} \sum_{i=1}^{i=v-1} \pi_i \{y^p - c(U_i^c, y_i) + y_i + \eta U_i^c\} \\ \text{s.t. } & \hat{U}_v^c \geq U_1^c + \sum_{i=1}^{i=v-1} \left\{ -\gamma_s \left( \bar{l}_s^c - \frac{y_i}{w_i} \right) + \gamma_s \left( \bar{l}_s^c - \frac{y_i}{w_{i+1}} \right) \right\} \end{aligned}$$

After rearranging, and dropping the income of the parent  $y^p$ , the Lagrangian of this problem ( $\ell$ ) is the following

$$\begin{aligned} \ell = & \eta U_1^c \sum_{i=1}^{i=v-1} \pi_i + \sum_{i=1}^{i=v-1} (\pi_i y_i) - \sum_{i=1}^{i=v-1} (\pi_i c(U_i^c, y_i)) + \\ & \eta \sum_{i=2}^{i=v-1} (\pi_i [ \sum_{i=1}^{i=v-1} (-\gamma_s (\bar{l}_s^c - \frac{y_i}{w_i}) + \gamma_s (\bar{l}_s^c - \frac{y_i}{w_{i+1}})) ]) - \\ & -\lambda [U_1^c + \sum_{i=1}^{i=v-1} (-\gamma_s (\bar{l}_s^c - \frac{y_i}{w_i}) + \gamma_s (\bar{l}_s^c - \frac{y_i}{w_{i+1}})) - \hat{U}_v^c] \end{aligned}$$

The first order conditions of the problem take the following form, after rearranging:

$$\frac{\partial \ell}{\partial U_1^c} = \sum_{i=1}^{i=v-1} \pi_i \left[ \eta - \frac{1}{v'(c_i)} \right] - \lambda = 0 \quad (9.11)$$

$$\begin{aligned} \frac{\partial \ell}{\partial y_i} &= \pi_i \left( 1 - \frac{\partial c}{\partial y_i} \right) - \left\{ \lambda + \sum_{j=i+1}^{j=v-1} \pi_j \left[ \frac{1}{v'(c_j)} - \eta \right] \right\} \left[ \gamma' \left( \bar{l}_s^c - \frac{y_i}{w_{i+1}} \right) \frac{1}{w_{i+1}} - \gamma' \left( \bar{l}_s^c - \frac{y_i}{w_i} \right) \frac{1}{w_i} \right] = 0 \\ \forall i &= 1, \dots, v-2 \end{aligned} \quad (9.12)$$

$$\pi_i \left( 1 - \frac{\partial c}{\partial y_i} \right) - \lambda \left[ \gamma' \left( \bar{l}_s^c - \frac{y_i}{w_{i+1}} \right) \frac{1}{w_{i+1}} - \gamma' \left( \bar{l}_s^c - \frac{y_i}{w_i} \right) \frac{1}{w_i} \right] = 0 \quad (9.13)$$

**Proposition 8.** *If the solution is such that, in equilibrium, the child receives a parental transfer regardless of the wage, an increase in  $y_{exo}$  of a dollar rises  $t_i$  by a dollar for every  $i=1, \dots, v-1$*

*Proof:* This can be seen from the first order conditions (9.11), (9.12) and (9.13). In such a case,  $v-1 = n$  the allocation of consumption is not affected by (local) movements in  $y_{exo}$ .

$$\pi_1 \left[ \eta - \frac{1}{v'(y_{exo} + y_1 + t_1)} \right] + \dots + \pi_n \left[ \eta - \frac{1}{v'(y_{exo} + y_n + t_n)} \right] = 0$$

and

$$\pi_i \left[ 1 - \frac{\gamma' \left( \frac{y_i}{w_i} \right) \frac{1}{w_i}}{v'(y_{exo} + y_i + t_i)} \right] - \left[ \sum_{j=i}^{j=n} \pi_j \left[ \eta - \frac{1}{v'(y_{exo} + y_j + t_j)} \right] \right] - \lambda \left[ \gamma' \left( \bar{l} - \frac{y_i}{w_{i+1}} \right) \frac{1}{w_{i+1}} - \gamma' \left( \bar{l} - \frac{y_i}{w_i} \right) \frac{1}{w_i} \right] = 0$$

The amount of transfers and  $y_{exo}$  appears together in all expressions. This implies that if  $y_{exo}$  goes down by a dollar, then the transfer goes up by one.

**Lemma 9.** *The implicit marginal tax on effort income is a number between zero and one.*

From the first order conditions (9.11), (9.12) and (9.13) and the fact that consumption is nondecreasing with the wage.

## 10. Appendix 2: Numerical solution

The optimal transfer scheme under perfect information is calculated from the first order conditions in Section 3, for the wage distribution and the parameter values of the utility function described in Section 5.

The transfer scheme under imperfect information is derived using the results in Section 4. First, the optimal allocation without transfers  $\{(\hat{y}_i)_{i=1}^{i=v}\}$  is computed. Using proposition 1, it is known that, for wages of the secondary earner above the cut-off value  $w_v$ , the optimal transfer is zero, and the optimal income level is that without transfers. Hence, the transfer scheme  $\{(c_i, y_i(w_i))_{i=v}^{i=n}\}$  for wages above a given  $w_v$  is set to  $\{(\hat{y}_i, \hat{y}_i)_{i=v}^{i=n}\}$

Next, the following problem is solved, for a given  $w_v$ :

$$\max_{\{U_1, (y_i)_{i=1}^{i=v}\}} \sum_{i=1}^{i=v-1} \pi_i \left\{ \frac{(-c(U_i, y_i) + y_i + y_{exo})^{1-\phi_p}}{1-\phi_p} + \eta U_i^c \right\}$$

$$s.t. \quad \hat{U}_v = U_{v-1} - \frac{(\bar{l}_s^c - \frac{y_{v-1}}{w_{v-1}})^{1-\rho_s}}{1-\rho_s} + \frac{(\bar{l}_s^c - \frac{y_{v-1}}{w_v})^{1-\rho_s}}{1-\rho_s}$$

$$s.t. \quad y_{i+1} \geq y_i \quad \forall i = 1 \dots v-1$$

$$s.t. \quad U_i \geq \hat{U}_i \quad \forall i = 1 \dots v-1$$

$$where \quad U_i = U_{i-1} - \frac{(\bar{l}_s^c - \frac{y_{i-1}}{w_{i-1}})^{1-\rho_s}}{1-\rho_s} + \frac{(\bar{l}_s^c - \frac{y_{i-1}}{w_i})^{1-\rho_s}}{1-\rho_s} \quad \forall i = 2, \dots, v-1$$

It can be shown that the objective function is concave in its arguments, and that the constraints form a convex set if  $\gamma'''()$  is positive. The problem is solved for several cut-off wages, starting with the wage cut-off under perfect information. The solution is the  $\{U_1, (y_i)_{i=1}^{i=v}\}$  combination that solves the former problem and the smallest wage cut-off  $w_v$  for which the Lagrange multiplier associated to the IC constraint is smaller than the derivative of the utility of the parent with respect to  $\hat{U}_v$

The derivative of transfers with respect to  $y_{exo}$  is obtained by solving the problem again substituting  $y_{exo}$  with  $y_{exo} + \epsilon$ . Denote the resulting schedule  $\{U_1^\epsilon, (y_i^\epsilon)_{i=1}^{i=v}\}$ . The derivative of parental transfers with respect to income of the primary earner are obtained as follows:  $\frac{t_i - t_i^\epsilon}{y - y^\epsilon}$ . The average derivative reported in Table 1 is  $\sum_{i=1}^{i=v-1} \pi_i(w_i) \left( \frac{t_i - t_i^\epsilon}{y_i - y_i^\epsilon} \right)$



For the case of a risk averse parent, we could not get analytical results regarding which IC constraints bind and which do not. The problem solved was slightly different:

$$\begin{aligned} & \max_{\{(U_j, y_i)_{i=1}^{j=v}\}} \sum_{i=1}^{i=v-1} \pi_i(w_i) \{-c(U_i, y_i) + y_i + y_{exo}\} + \eta U_i^c \\ \text{s.t. } & U_j \geq U_{j-1} - \frac{(\bar{l}_s^c - \frac{y_{j-1}}{w_{j-1}})^{1-\rho_s}}{1-\rho_s} + \frac{(\bar{l}_s^c - \frac{y_j}{w_j})^{1-\rho_s}}{1-\rho_s} \quad \forall j = 1, \dots, v \\ & \text{s.t. } y_{i+1} \geq y_i \quad \forall i = 1 \dots v - 1 \\ & \text{s.t. } U_i \geq \hat{U}_i \quad \forall i = 1 \dots v - 1 \end{aligned}$$

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**Table 1 Simulated effects of earnings on the amount of the transfer.**

|  | Specification I            | Specification II          | Specification III            |
|--|----------------------------|---------------------------|------------------------------|
|  | $\phi_p = 0$ $\phi_c = 2$  | $\phi_p = 0$ $\phi_c = 2$ | $\phi_c = \phi_p = 2$        |
|  | $\rho_s = 2.4$ $\eta = 14$ | $\rho_s = 3$ $\eta = 14$  | $\rho_s = 2.4$ $\eta = 0.35$ |
| Perfect information                            |                            |                           |                              |
| 1. Mean transfer                               | 1,148                      | 564                       | 732                          |
| 2. Income of wife                              | 15,090                     | 18,590                    | 6,248                        |
| 3. $\frac{\partial t}{\partial y_p}$           | 0                          | 0                         | 0.48                         |
| 4. Mean $\frac{\partial t}{\partial y_s}$      | -1.00                      | -1.00                     | -0.52                        |
| 5. Mean $\frac{\partial T}{\partial y_{exo}}$  | -1.00                      | -1.00                     | -0.49                        |
| Imperfect information                          |                            |                           |                              |
| 6. Mean transfer                               | 343                        | 186                       | 375                          |
| 7. Income of wife                              | 14,920                     | 18,490                    | 8,042                        |
| 8. $\frac{\partial t}{\partial y_p}$           | 0                          | 0                         | 0.17                         |
| 9. Mean $\frac{\partial t}{\partial y_s}$      | -0.12                      | -0.14                     | -0.14                        |
| 10. Mean $\frac{\partial t}{\partial y_{exo}}$ | -0.20                      | -0.18                     | -0.20                        |
| Actual data                                    |                            |                           |                              |
| 11. Mean transfer                              |                            | 353                       |                              |
| 12. $\frac{\partial t}{\partial y_p}$          |                            | (0.05,0.10)               |                              |
| 13. $\frac{\partial t}{\partial y_c}$          |                            | (-0.10,0.00)              |                              |

The utility function of the child used in the simulations is  $U_c = \frac{c^{1-\phi_c}}{1-\phi_c} + \frac{(\bar{l}_s - y_s/w)^{1-\rho_s}}{1-\rho_s}$ .

The utility of the parent is  $U_p = \frac{c^{1-\phi_p}}{1-\phi_p}$  For all specifications,  $\bar{l}_s^c$  is set at 6 (corresponding to a time endowment of 6,000 hours a year). The income of the primary earner is fixed at 2.7, corresponding to 27,000 dollars a year (the average earnings at age 30 of PSID married males). The average response  $\frac{\partial t}{\partial y_s}$  is obtained from the simulated solution using the discrete approximation  $\frac{t_i(w_i, y_{exo}^c) - t_{i-1}(w_i, y_{exo}^c)}{y_i(w_i, y_{exo}^c) - y_{i-1}(w_i, y_{exo}^c)}$ .

The mean transfer corresponds to the unconditional mean reported by Altonji et al (1997). Nevertheless, their sample also contains unmarried households. The empirical estimates of the response of transfers to earnings of parents and children are taken from Altonji et al. (1997), Cox and Jakubson (1995), and McGarry (1995).

**Table 2 Simulated effects of earnings on the probability of a transfer.**

| Parameters in all specifications: $E(\eta) = 14, \phi_c = 2, \rho_s = 2.4, \phi_p = 0$ |                 |                  |                   |
|--|-----------------|------------------|-------------------|
|  | Specification I | Specification II | Specification III |
|  | $V(\eta) = 1$   | $V(\eta) = 2$    | $V(\eta) = 3$     |
| (A) Probit coefficients,   |                 |                  |                   |
| Perfect information  |                 |                  |                   |
| 1. Income, primary earner  | -1.09<br>(0.23) | -0.56<br>(0.10)  | -0.31<br>(0.04)   |
| 2. Income, secondary earner  | -1.02<br>(0.26) | -0.56<br>(0.09)  | -0.30<br>(0.04)   |
| Imperfect information  |                 |                  |                   |
| 3. Income, primary earner  | -0.55<br>(0.06) | -0.25<br>(0.02)  | -0.19<br>(0.02)   |
| 4. Income, secondary earner  | -0.33<br>(0.04) | -0.15<br>(0.01)  | -0.12<br>(0.01)   |
| (B) Probability of transfer, imperfect information                                     |                 |                  |                   |
| 5. $Y_h = \bar{Y}_h, Y_f = \bar{Y}_f - 4$  | 0.57            | 0.54             | 0.55              |
| 6. $Y_h = \bar{Y}_h, Y_f = \bar{Y}_f$  | 0.03            | 0.20             | 0.26              |
| 7. $Y_h = \bar{Y}_h, Y_f = \bar{Y}_f + 4$  | 0               | 0.04             | 0.08              |
| 8. $Y_h = \bar{Y}_h, Y_f = \bar{Y}_f - 4$  | 0.24            | 0.38             | 0.47              |
| 9. $Y_h = \bar{Y}_h, Y_f = \bar{Y}_f$  | 0.03            | 0.20             | 0.26              |
| 10. $Y_h = \bar{Y}_h, Y_f = \bar{Y}_f + 4$   | 0               | 0.11             | 0.08              |

$\bar{Y}_h$  is \$27,000, and  $\bar{Y}_f$  is \$21,000. Magnitudes are in 1993 dollars.

**Table 3 Descriptive statistics of selected variables**

| Variable                      | Total sample<br>(N=2,022) | If No Transfer<br>(N=1,476) | If Transfer<br>(N=546) |
|-------------------------------|---------------------------|-----------------------------|------------------------|
| Child received money          | 0.23                      | 0                           | 1                      |
| Amount received               | 807                       | 0                           | 2,986                  |
| Age of the husband            | 35.11<br>(7.14)           | 35.81<br>(7.19)             | 33.25<br>(6.67)        |
| Age of the wife               | 32.96<br>(6.75)           | 33.59<br>(6.73)             | 31.24<br>(6.49)        |
| Child's income -husband       | 35,288<br>(17,967)        | 35,269<br>(17,551)          | 35,338<br>(19,062)     |
| Child's income -wife          | 18,586<br>(11,590)        | 18,459<br>(11,520)          | 18,930<br>(11,780)     |
| Child's education -husband    | 12.96<br>(2.59)           | 12.81<br>(2.598)            | 13.36<br>(2.531)       |
| Child's education -wife       | 12.83<br>(2.48)           | 12.68<br>(2.43)             | 13.25<br>(2.574)       |
| Child's race other than white | 0.22                      | 0.243                       | 0.168                  |
| Age of father -husband        | 62.50<br>9.05             | 62.89<br>9.01               | 61.568<br>9.080        |
| Age of father- wife           | 61.25<br>(8.76)           | 61.68<br>(8.686)            | 60.217<br>(8.856)      |
| Parent's income -husband      | 57,573<br>(24,197)        | 55,785<br>(22,661)          | 62,399<br>(27,372)     |
| Parent's income -wife         | 58,824<br>(25,528)        | 56,339<br>(23,473)          | 65,533<br>(29,382)     |
| Father's education -husband   | 10.89<br>(3.35)           | 10.671<br>(3.31)            | 11.424<br>(3.388)      |
| Mother's education-husband    | 11.09<br>(3.36)           | 10.75<br>(3.34)             | 11.587<br>(2.797)      |
| Father's education -wife      | 11.110<br>(2.869)         | 10.75<br>(3.348)            | 11.887<br>(3.279)      |
| Mother's education-wife       | 11.068<br>(2.942)         | 10.799<br>(2.959)           | 11.768<br>(2.779)      |
| Divorced parents -husband     | 0.122                     | 0.117                       | 0.133                  |
| Divorced parents -wife        | 0.115                     | 0.104                       | 0.142                  |
| Parent is a widow -husband    | 0.286                     | 0.306                       | 0.234                  |
| Parent is a widow -wife       | 0.246                     | 0.272                       | 0.175                  |

Standard deviations in parentheses. Monetary variables measured in dollars of 1993.

**Table 4 Reaction of transfers to permanent income: Probit and Tobit**

| Regressors                     | Probit Model    |                  | Tobit Model     |                  |
|--------------------------------|-----------------|------------------|-----------------|------------------|
|                                | Model I         | Model II         | Model I         | Model II         |
| Earnings -child husband        | -.007<br>(.002) | -.010<br>(.002)  | -.022<br>(.008) | -.036<br>(.009)  |
| Earnings -child wife           | -.003<br>(.003) | -.006<br>(.004)  | -.010<br>(.012) | -.024<br>(.015)  |
| Earnings sq. -child husband    | excluded        | 8e-5<br>(4e-5)   | excluded        | .0002<br>(.0002) |
| Earnings sq. -child wife       | excluded        | .0001<br>(.001)  | excluded        | .0003<br>(.0005) |
| Earnings, parents of husband   | .006<br>(.002)  | .005<br>(.002)   | .036<br>(.006)  | .025<br>(.007)   |
| Earnings, parents of wife      | .009<br>(.004)  | .007<br>(.003)   | .036<br>(.006)  | .025<br>(.006)   |
| Education - child husband      | excluded        | .023<br>(.018)   | excluded        | .137<br>(.072)   |
| Education - child wife         | excluded        | .042<br>(.019)   | excluded        | .220<br>(.081)   |
| Education missing - husband    | excluded        | -.342<br>(.389)  | excluded        | -.208<br>(1.924) |
| Education missing - child wife | excluded        | .2730<br>(.358)  | excluded        | .894<br>(1.406)  |
| Education, father of husband   | excluded        | -.015<br>(.014)  | excluded        | -.134<br>(.057)  |
| Education, mother of husband   | excluded        | -.001<br>(.014)  | excluded        | -.019<br>(.059)  |
| Education, father of wife      | excluded        | .017<br>(.013)   | excluded        | .077<br>(.056)   |
| Education, mother of wife      | excluded        | .005<br>(.015)   | excluded        | .027<br>(.060)   |
| Age husband -child             |                 | -.062<br>(.036)  |                 | -.290<br>(.154)  |
| Age husband, sq. -child        |                 | -7e-4<br>(-7e-4) |                 | -.300<br>(.154)  |
| Age wife -child                |                 | .094<br>(.041)   |                 | .330<br>(.181)   |
| Age wife sq -child             |                 | .002<br>(7e-4)   |                 | .008<br>(.003)   |

**Table 4 Reaction of transfers to permanent income: Probit and Tobit (cont.)**

| Regressors                          | Probit model |                   | Tobit model |                   |
|-------------------------------------|--------------|-------------------|-------------|-------------------|
|                                     | Model I      | Model II          | Model I     | Model II          |
| Father of husband widower           |              | .194<br>(.170)    |             | .849<br>(.678)    |
| Mother of husband is a widow        |              | .044<br>(.098)    |             | .188<br>(.409)    |
| Father of wife is a widower         |              | .084<br>(.255)    |             | .466<br>(.679)    |
| Mother of wife is a widow           |              | -.202<br>(.099)   |             | -.609<br>(.414)   |
| Father of husband widower, rem.     |              | -.1019<br>(.2397) |             | -.573<br>(.989)   |
| Mother of husband widow, rem.       |              | -.144<br>(.241)   |             | -.493<br>(.719)   |
| Father of wife widower, rem.        |              | -.411<br>(.255)   |             | -1.824<br>(1.01)  |
| Mother of wife widow, rem.          |              | .231<br>(.170)    |             | .426<br>(.752)    |
| Parents of husband divorced         |              | .105<br>(.161)    |             | .504<br>(.659)    |
| Parents of wife divorced            |              | .200<br>(.156)    |             | .356<br>(.649)    |
| # Children, child hh.               |              | -.053<br>(.037)   |             | -.308<br>(.159)   |
| # Children 1-2, child hh            |              | .072<br>(.070)    |             | .370<br>(.283)    |
| # Children 3-5, child hh            |              | -.051<br>(.068)   |             | -.139<br>(.292)   |
| Child reports race other than white |              | -.088<br>(.093)   |             | -.725<br>(.384)   |
| Constant                            |              | -1.823<br>(.598)  |             | -6.048<br>(2.675) |
| Observations (positive)             |              |                   | 2,022 (546) |                   |

Standard errors (in parentheses) account for correlation across observations involving siblings and generated regressors in the Probit specification. In the Tobit specification, standard errors are not corrected. All income variables are the deviations from sample means. Unless otherwise stated, all models include the same set of controls, only shown for Model II.



**Table 5 Reaction of transfers to permanent income.**

| Estimation method: OLS and selectivity corrected OLS |                 |                  |                 |                  |
|--|-----------------|------------------|-----------------|------------------|
| Dependent variable: Transfer Amount                  |                 |                  |                 |                  |
| Regressors   | OLS             |                  | OLS corrected   |                  |
|  | Model I         | Model II         | Model I         | Model II         |
| Earnings -child husband                              | -.004<br>(.009) | -.004<br>(.011)  | .016<br>(.048)  | .021<br>(.095)   |
| Earnings -child wife                                 | -.004<br>(.015) | -.005<br>(.0200) | .011<br>(.050)  | .009<br>(.075)   |
| Earnings sq. -child husband                          | excluded        | 2e-5<br>(.0003)  | excluded        | .0003<br>(.001)  |
| Earnings sq. -child wife                             | excluded        | 4e-5<br>(.0004)  | excluded        | -.0002<br>(.002) |
| Earnings, parents of husband                         | .016<br>(.011)  | .016<br>(.012)   | .001<br>(.035)  | .006<br>(.04)    |
| Earnings, parents of wife                            | .010<br>(.010)  | .010<br>(.011)   | -.005<br>(.039) | -.002<br>(.049)  |
| Education - child husband                            | included        | .118<br>(.069)   | included        | .056<br>(.30)    |
| Education - child wife                               | included        | .1020<br>(.0865) | included        | -.004<br>(.45)   |
| Education missing -child husband                     |                 | 4.273<br>(3.626) |                 | 5.17<br>(9.77)   |
| Education missing - child wife                       |                 | -.330<br>(1.28)  |                 | -.88<br>(4.58)   |
| Education, father of husband                         | excluded        | -.157<br>(.076)  | excluded        | -.13<br>(.201)   |
| Education, mother of husband                         | excluded        | -.055<br>(.070)  | excluded        | -.01<br>(.24)    |
| Education, father of wife                            |                 | .027<br>(.061)   |                 | -.053<br>(.184)  |
| Education, mother of wife                            |                 | -.002<br>(.062)  |                 | -.008<br>(.227)  |
| Age head -child                                      |                 | -.011<br>(.051)  |                 | .016<br>(.847)   |
| Age head, sq. -child                                 |                 | -.002<br>(.003)  |                 | .0002<br>(.014)  |
| Age wife -child                                      |                 | .007<br>(.043)   |                 | -.278<br>(1.16)  |
| Age wife sq -child                                   |                 | -.002<br>(.003)  |                 | -.006<br>(.024)  |

**Table 5 Reaction of transfers to permanent income (cont.)**

| Estimation method: OLS and selectivity corrected OLS |         |                  |               |                 |
|--|---------|------------------|---------------|-----------------|
| Dependent variable: transfer amount                  |         |                  |               |                 |
| Regressors   | OLS     |                  | OLS corrected |                 |
|  | Model I | Model II         | Model I       | Model II        |
| Father of husband widower                            |         | .493<br>(.655)   |               | .138<br>2.51    |
| Mother of husband is a widow                         |         | .133<br>(.339)   |               | .120<br>1.349   |
| Father of wife is a widower                          |         | .548<br>(.788)   |               | .439<br>2.322   |
| Mother of wife is a widow                            |         | .340<br>(.550)   |               | .777<br>2.24    |
| Father of husband widower, rem.                      |         | -.412<br>(1.018) |               | -.217<br>3.603  |
| Mother of husband widow, rem.                        |         | -.253<br>(.537)  |               | .007<br>2.87    |
| Father of wife widower, rem.                         |         | -.822<br>(.913)  |               | .032<br>5.201   |
| Mother of wife widow, rem.                           |         | -1.094<br>(.626) |               | -1.55<br>3.154  |
| Parents of husband divorced                          |         | .242<br>(.780)   |               | .063<br>1.92    |
| Parents of wife divorced                             |         | -.601<br>(.559)  |               | -1.082<br>2.537 |
| # Children, child hh.                                |         | -.231<br>(.169)  |               | -.124<br>.788   |
| # Children 1-2, child hh                             |         | .154<br>(.296)   |               | -.007<br>1.126  |
| # Children 3-5, child hh                             |         | -.021<br>(.285)  |               | .068<br>1.09    |
| Child's race other than white                        |         | -1.066<br>(.284) |               | -.869<br>1.582  |
| Constant   |         | 2.228<br>(.420)  |               | 11.450<br>28.71 |
| Observations   |         |                  |               | 546             |

Standard errors account for correlation across observations involving siblings and generated regressors in the OLS specification (not in the adjusted OLS specification). Income variables are the deviations from sample means. Transfers are censored.

**Table 6: Reaction of transfers to permanent income**

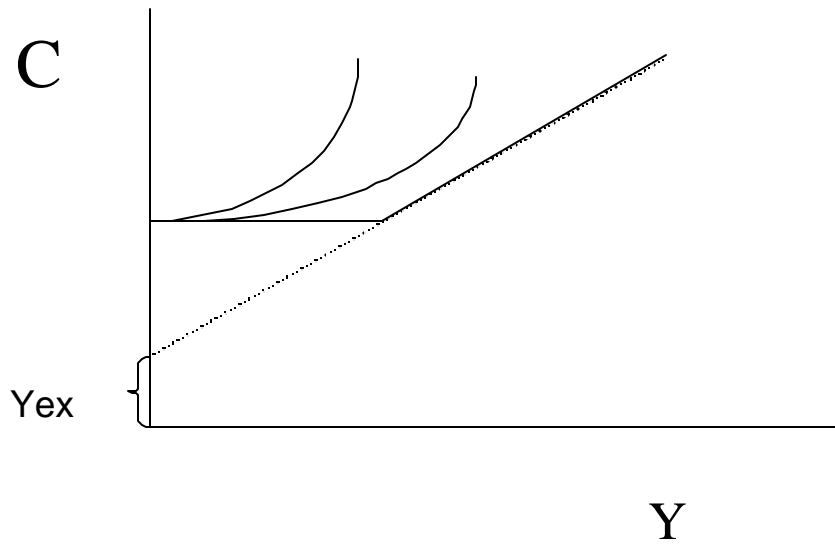
| Household-based sample               |                 |                 |                 |
|--------------------------------------|-----------------|-----------------|-----------------|
| Dependent variable: transfer amount. |                 |                 |                 |
| Estimation method: A-I estimator.    |                 |                 |                 |
| Derivative evaluated at sample means |                 |                 |                 |
| Regressor                            | Model I         | Model II        | Model III       |
| Income of child - husband            | -.023<br>(.013) | -.027<br>(.013) | -.032<br>(.013) |
| Income of child - wife               | -.035<br>(.022) | -.048<br>(.022) | -.048<br>(.023) |
| Other controls                       |                 |                 |                 |
| Education - child husband            | excluded        | included        | included        |
| Education -child wife                | excluded        | included        | included        |
| Education -parents.                  | excluded        | excluded        | included        |
| Observations                         | 546             |                 |                 |

Standard errors in parentheses. They allow for arbitrary correlation between observations belonging to the same dynasty, and are obtained using the delta method. Transfers above 10,000 dollars (in 1993 dollars) are censored and set at 10,000. All models include the same regressors included in Tables 3-5. The sample mean of permanent earnings of the primary earner is \$35,288. The corresponding number for the secondary earner is \$18,586

**Table 7: Reaction of transfers to permanent income**

| Child-based sample                   |                 |                 |                 |
|--------------------------------------|-----------------|-----------------|-----------------|
| Dependent variable: transfer amount. |                 |                 |                 |
| Estimation method: A-I estimator.    |                 |                 |                 |
| Derivative at sample means           |                 |                 |                 |
| Regressor                            | Model I         | Model II        | Model III       |
| Earnings, both children              | -.012<br>(.010) | -.018<br>(.012) | -.018<br>(.012) |
| Earnings, child of donor             | -.002<br>(.015) | -.004<br>(.014) | -.005<br>(.014) |
| Other controls                       |                 |                 |                 |
| Education - child husband            | excluded        | included        | included        |
| Education -child wife                | excluded        | included        | included        |
| Education -parents.                  | excluded        | excluded        | included        |
| Observations                         | 739             |                 |                 |

Standard errors in parentheses. They allow for arbitrary correlation between observations belonging to the same dynasty. All models also include a second order polynomial in the age of the offspring of the donor and on the age of the in-law, separate dummies for whether the donor is divorced, for widow and for widower, the number of grandchildren of the donor, the number of grandchildren between 1 and 2 years of age and the number of grandchildren of the donor between 3 and 5 years.

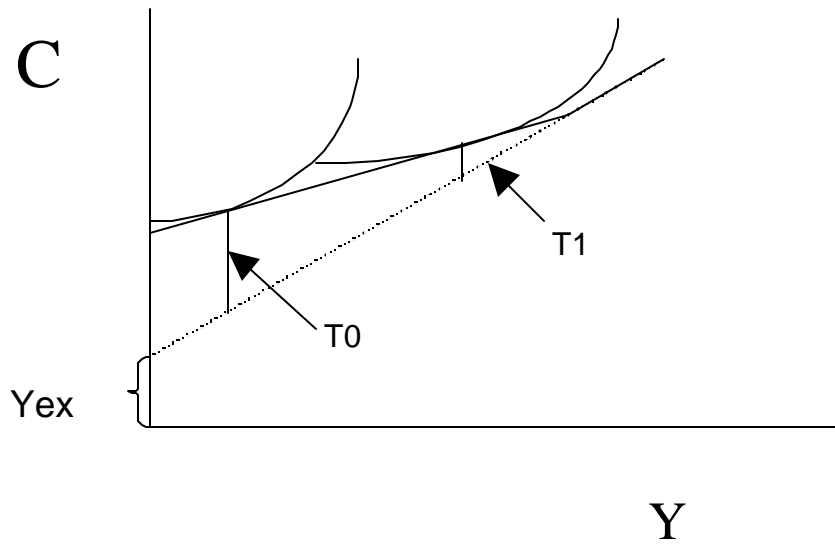


**Figure 1 Allocation with Perfect Information and Preferences of the Child**

C: consumption of the household of the child.

Y: earnings of the secondary earner.

Yex: earnings of the primary earner.



**Figure 2 Optimal Transfer Schedule Under Imperfect Information**

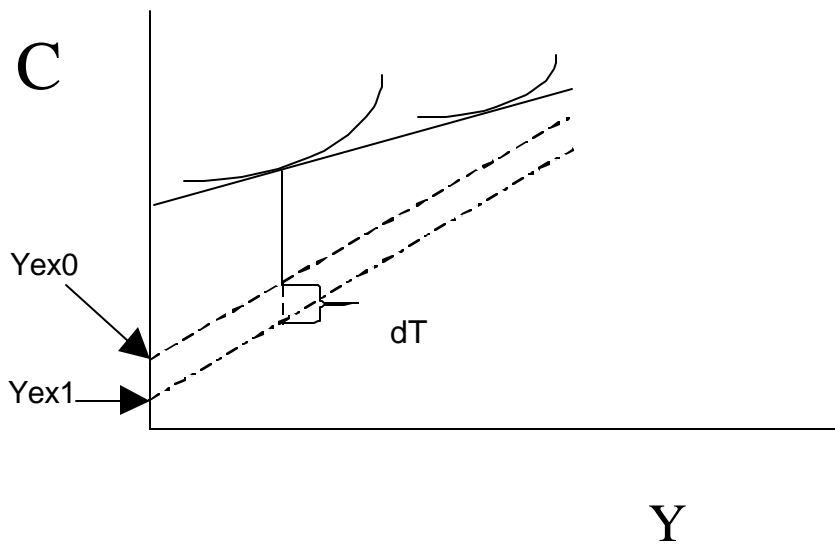
T0: Optimal transfer level if the secondary earner has low wage.

T1: Optimal transfer level if the secondary earner has a high wage.

C: consumption of the household of the child.

Y: earnings of the secondary earner.

Yex: earnings of the primary earner.

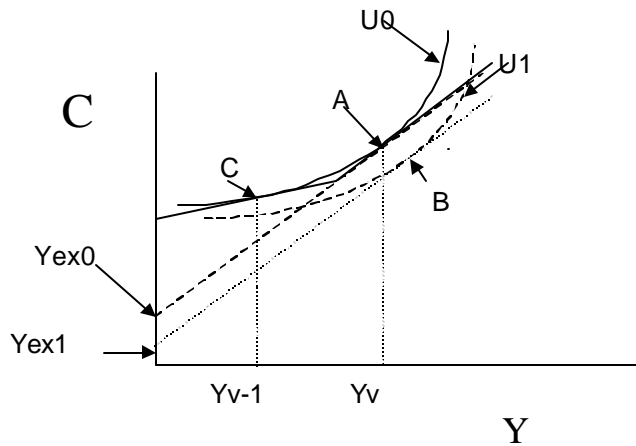


**Figure 3 Response of transfers to variations in the income of the primary earner (I)**

Yex0: Initial earnings level of the primary earner.

Yex1: Final earnings level of the primary earner.

dT: Increase in transfers following a fall in income of the primary earner.



**Figure 4 Response of Transfers to Income of the Primary Earner (case 2)**

Point A: Allocation of consumption and earnings of the child with income of secondary earner  $Y_v$  and income of the primary earner  $Y_{ex0}$ .

Point B: Allocation of consumption and earnings of the child with income of secondary earner  $Y_v$  and income of the primary earner  $Y_{ex1}$ .

Point C: Allocation of consumption and earnings of the child with income of secondary earner  $Y_{v-1}$  and income of the primary earner  $Y_{ex0}$ .

$U_0$ : Utility indifference curve for an child with earnings of the primary earner  $Y_{ex0}$  and wage  $w_v$

$U_1$ : Utility indifference curve for an child with earnings of the primary earner  $Y_{ex1}$  and wage  $w_v$