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 intervivos transfers in the US? This paper expands 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 under imperfect information. Second, I use cross-sectional data to test a 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 suggest that imperfect information accounts for several 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 programs like Social Security, that redistribute 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 authors 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.[1]

Alternative researchers have modified the altruistic model of the family to account for that finding. McGarry (2000) assumes that altruistic parents are uncertain about the future earnings of their children and use current earnings as a signal of permanent earnings. Pollak (1988) argues that transfers from altruistic parents are tied to specific assets, and do not respond to the income variations of the child. Cox (1987) argues that altruistic parents use transfers to buy services from their children. All these explanations overturn Becker's prediction.

This paper assesses whether adding two key modifications to the basic altruism model improves the concordance between the model and the data. I build on a model of Kotlikoff and Razin (1988) who endogenize the effort of children and

[1] 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. See Laitner (1999) for a review of the literature.

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 evidence that young adults modify their labor market decisions because of parental help.[2]

The model in this paper follows the literature on optimal taxation (see Besley and Coate, 1995). Parents observe the income of their (egoistic) children, but observe neither the labor market opportunities nor the effort of their children. The rationale for this assumption is that parents visit their children, and can infer their income from their consumption habits. Nevertheless, it is hard for parents 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.

While previous researchers have modeled the effects of imperfect information about labor market opportunities on the size of parental transfers,[3] 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 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. The paper shows that, under some circumstances, the strategic considerations brought by imperfect information 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

[2] 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.

[3] See, for example, Kotlikoff and Razin (1988), Fernandes (2002) or Nishiyama and Smetters (2002).

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.[4] 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).[5]

[4] This result is very close in spirit to previous results in the literature of optimal taxation. 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.

[5] 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:

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

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).[6] 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 consumption insurance -see Attanasio and Davis (1996).

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

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

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 $(\overline{h}_p^c)$. 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:

$$y_s^c = w_s^c h_s^c \qquad y_{exo}^c = w_p^c \overline{h}_p^c$$

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

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

[6] See the evidence cited in Blundell and MaCurdy (1999). 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 elasticity of labor supply to the wage of primary and secondary earners (regardless of their gender).

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:

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

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. η is a parameter measuring the degree of altruism of the parent.[7]

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 $(0 < w_{p,1}^c < ... < w_{p,n}^c)$ for the primary earner and another distribution of n wage values $(0 < w_{s,1}^c < ... < w_{s,n}^c)$. 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.

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 for parents to observe whether or not the child has the opportunity of working in less pleasant but more lucrative occupations.

On the other hand, it is possible for parents 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

[7] The assumption of risk neutrality imposes that parental transfers are not affected by income of the parent. In the simulations, I relax this assumption.

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.[8]

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:

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

The allocation that solves this problem will be denoted as $\{\widehat{c}^c(w_s^c, y_{exo}^c), \widehat{y}_s^c(w_s^c, y_{exo}^c)\}_{i=1}^{i=n}$. 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.

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.

[8] The model can be reinterpreted to accomodate alternative information setups. For example, 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. 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 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:

$$\max_{\{(t_i, y^c_{s,i})_{i=1}^{i=n}\}} U^p = \sum_{i=1}^{i=n} \pi^c_{s,i}[y^p - t_i + \eta U^c_i(c^c_i, \frac{y^c_{s,i}}{w^c_{s,i}},\ y^c_{exo})] \tag{3.1}$$

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

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

where $U^c_i = v(\ y^c_{exo} + y^c_{s,i} + t_i) + \gamma_s(\bar{l}^c_s - \frac{y^c_{s,i}}{w^c_{s,i}})$. In (3.1), $\pi^c_{s,i}$ is the probability of occurrence of the wage $w^c_{s,i}$, y^p denotes parental resources, t_i the amount of parental monetary transfers, U^c is the level of utility of the child, η is the altruism parameter, c^c_i denotes the consumption of the child, $w^c_{s,i}$ is a particular realization of the wage of the secondary earner, $y^c_{s,i}$ is the earnings of the secondary earner in the household of the child, and y^c_{exo} is the earnings of the primary earner in the household of the child. The parent solves (3.1) for each level of y^c_{exo}.

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:

$$\frac{\partial U^p}{\partial y^c_{s,i}} = v'(y^c_{s,i} + \ y^c_{exo} + t_i) - \gamma'_s(\bar{l}^c_s - \frac{y^c_{s,i}}{w^c_{s,i}})\frac{1}{w^c_{s,i}} \leq 0 \qquad \forall i = 1, ..., n \tag{3.2}$$

$$\frac{\partial U^p}{\partial t_i} = -1 + \eta v'[y^c_{s,i} + y^c_{exo} + t_i] \leq 0 \qquad \forall i = 1, ..., n \tag{3.3}$$

For positive hours of work, equation (3.2) 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. Combining equations (3.2) and (3.3) one can prove that the income earned by the secondary earner is increasing with the own wage when transfers are positive.

Equation (3.3) states that, if parental transfers are positive, the parent equates the (constant) marginal utility of own consumption with the marginal utility derived from one unit of extra consumption of the child. Given the shape of the utility function of the child, equation (3.3) 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, a dollar increase in the income of the child diminishes parental transfers on a dollar for dollar basis, guaranteeing a constant consumption level to the child.[9]

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^c_{exo}). 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 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.

Summarizing, the expanded model of altruism under perfect information 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.

[9] 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 prediction of Becker's model (that does not include effort of the child) 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 the assumptions in the paper:

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

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.[10]

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 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 the child 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

[10] 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. Notable exceptions to this literature are Ligon (1998) and Chiappori and Salanié (2000), who do not focus on the shape of the transfer schedule.

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 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.[11]

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.

[11] 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.

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^c_{exo}. 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:

$$\max_{\{t_i, y_i\}} \sum_{i=1}^{i=n} \pi^c_{s,i} \{ y^p - t_i + \eta U^c_i (c^c, \frac{y^c_{s,i}}{w^c_{s,i}},\ y^c_{exo}) \} \tag{4.1}$$

$$\begin{aligned} s.t. \quad v(\ y^c_{exo} + y^c_{s,i} + t_i) + \gamma_s (\bar{l}^c_s - \frac{y^c_{s,i}}{w^c_{s,i}}) &\geq v(\ y^c_{exo} + y^c_{s,j} + t_j) + \gamma_s (\bar{l}^c_s - \frac{y^c_{s,j}}{w^c_{s,i}}) \\ \forall i &= 1...n \quad \forall j = 1...n, i \neq j \end{aligned} \tag{IC}$$

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

where

$$U^c_i = v(\ y^c_{exo} + y^c_{s,i} + t_i) + \gamma_s (\bar{l}^c_s - \frac{y^c_{s,i}}{w^c_{s,i}})$$

(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] If there exists a wage w_r *for which,* $c_r^{c,*} = \overline{c}, \quad y_{s,r}^{c,*} = 0$*, then, for all wages below* w_r*,* $c_i^{c,*} = \overline{c}$*, and* $\quad y_{s,i}^{c,*} = 0$

[3] There is an intermediate 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 w_i *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, in the next subsection, I to analyze the response of transfers to income of the child.

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

In this section, I present two 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."[12]

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

[12] 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).

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

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.[13]

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

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

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.

Proposition 2 is an important result, showing 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.

[13] 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:

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

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.

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.*

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

Hence, the last result suggest that, if in equilibrium transfers are positive for all wages, the reaction of transfers to exogenous income 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 proposition 3, 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 results for the preferences posed.

4.4. Summary of results

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, imperfect information about labor market opportunities of the child reduces the response of parental transfers to child earnings, so that parental transfers do not diminish with earnings on a dollar for dollar basis. Second, at least in one of the equilibria of the game, imperfect information increases the responsiveness of parental transfers to the income of the primary earner with respect to the income of the secondary earner.

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. Simulations play a key role in this work. First, the qualitative results in the previous subsection do not provide information about the magnitudes of transfer responses to the various components of income. The numerical computations in this section allow an explicit comparison between the predictions of the altruism model of the family and the findings of previous researchers. Second, numerical simulations permit me to establish whether or not the response of transfers to income components is bigger for exogenous income components than the response to labor income components for all cases. Such heterogeneity in the responsiveness of parental transfers to income provide the basis for further empirical tests of the model. Subsection 5.1 presents numerical computations of the response of the transfer amount to the income of the primary and secondary earners, and subsection 5.2 presents numerical computations of the response of the probability of receiving transfers to the income of the primary and secondary earners.

5.1. The transfer amount

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

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

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. ϕ_c is the degree of risk aversion of the child. A higher value of ϕ_c is associated to a more concave utility function (with respect to consumption). An estimate of 2 is used, following Rangazas (1999), who also calibrates parental transfers in the US. ρ_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 ρ_s. This value generates a static labor supply elasticity of 0.13 evaluated at the mean wage in Mroz's sample, 11 dollars (1993 dollars).

The parameter η and the marginal utility that the parent derives from own consumption (ε) are not separately identified in the model, due to the fact that the parent is risk neutral with respect to own consumption. ε is normalized to 1, and η 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 ϕ_c as 2 and ρ_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). Private information reduces in absolute value the response of parental transfers to income to a fifth (for primary earner) and a tenth (for the secondary earner) of the perfect information benchmark.

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. Pointwise, parental transfers are also more responsive to the income of the primary earner than to the income of the secondary earner.

Table 1 presents a second specification where ρ_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. 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 III). Parental preferences take the following form now:

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

A value of 2 is chosen for ϕ_p, consistent with the choice for ϕ_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.

5.2. The transfer decision

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 altruism model of the family predicts that children with lower income levels are more likely to receive transfers (see Altonji et al. 1997, or McGarry, 1999). In this subsection, I investigate if imperfect information about the labor market opportunities of children makes the response of the *probability* of receiving transfers to exogenous income components bigger in absolute value than the response to labor income components.

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 η, drawn from a Normal distribution with an average of 14.[14]. Given that I could not find in the literature an estimate for the variance of η, 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.

[14] Variation in η 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 η, the earnings of the secondary earner would be a perfect predictor of receiving a transfer.

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

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

Rows 1 and 2 in the first panel of Table 2 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^c_s. For all specifications, the coefficients of both earnings components are almost identical.

Rows 3 and 4 in the first panel of 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.

To put the results in numerical perspective, the second panel in Table 2 presents the predicted probability of receiving a transfer at various income levels. For example, if the variance of the altruism parameter is 2, at the sample means, the probability of receiving a transfer is 0.20 (panel 2, row 6). A household in which the secondary earner earns \$4,000 less than the average has a probability of receiving of 0.38 (panel 2, row 8). Conversely, if the primary earner earns \$4,000 less than the average, the probability that the household receives a transfer is 0.54 (panel 2, row 5).

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.

The transfer function can only take positive values, because the parent cannot enforce negative transfers. Hence, 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:

$$T_i = \max\{\beta_0 - \beta_h Y^c_{h,i} - \beta_f Y^c_{f,i} + \beta_p Y^p_i + \delta X_i + U_i, 0\} \tag{6.1}$$

The dependent variable (T_i) is the amount of transfers received by the household of the child, indexed by i. $Y^c_{h,i}$ are a measure of permanent labor earnings of the husband in the household of the child, and $Y^c_{f,i}$ labor earnings of the wife in the household of the child. Y^p_i 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.

The coefficients of interest are β_h and β_f , the degree to which the transfer from the parent decreases with income of each of the earners. 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.[15]

A final cavear is the following. The estimators I use take $Y^c_{f,i}$ 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

[15] The A-I estimator is an analog estimator and is based on the following relationship.

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

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

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 the coefficient on income of the secondary earner in a censored regression model. The presence of heterogeneity in parental altruism is then likely to 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. The data

This section 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 -Altonji et al (1997). Among their findings, it is worth mentioning that reported transfers do not seem to be related to the purchase of a house by the child. They also report that very few children are students, so reported 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.

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, and aggregating transfers reported by the head and wife) 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.[16]

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:

$$\log Y_{it} = \gamma_0 + Z_{it}\gamma_1 + e_{it} + v_i \tag{6.2}$$

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 parameter γ is 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).[17] 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,

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

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

[16] Given the structure of the PSID and the choice of households of children, 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.

[17] 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.

of the individuals are weighted by the proportion of years that they contributed to the regression, i.e.:

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

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 (dollars of 1993). For wives, the corresponding numbers are 6,264, 16,225 and 34,187.[18]

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, 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 to censor the data is to reduce the influence of outliers on the estimates. However, in the sample period transfers above 10,000 dollars could be subject to taxes, and the prediction of Becker (1974) will not hold for them.[19]

[18] 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.

[19] 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).

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.[20] 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). Standard errors are also corrected 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.

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.[21] This result accords with the results from the simulations in section 5. The difference in slopes is robust to

[20] 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.

[21] 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.

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, giving higher transfers to children with lower educational levels. In that case, the sign of the coefficient should be negative. On the other hand might 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 proportional to the slope of the determinants of the probability of reporting a transfer. Hence, the coefficients of the Probit part of the likelihood function may be driving the results concerning the slope of the transfer schedule. To evaluate to what extent is the Probit part affecting the results, I use an alternative estimator that uses the subsample of children receiving positive transfers.[22]

7.1.3. A-I estimator

Table 5 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 hus-

[22] I also experimented with OLS and OLS corrected estimation methods for the subsample of children receiving transfers. The estimates were imprecise.

band 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 of the household of the child is included (models II and III in Table 5), 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 empirical 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.

A possible explanation for this failure of the theory is that the test is not well defined, because parents care more about their own offspring than about their son or daughter in-law. Even in the absence of private information, 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 6 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. From these results, I interpret that the differential degree of altruism toward inlaws is not driving the results from the A-I estimator.

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.[23] I examine whether the

[23] See also the literature on risk sharing in the economy, particularly Cochrane (1991)

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 lay-offs 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

Can the altruism model of the family be modified to reconcile it with the empirical evidence on intergenerational transfers? I have expanded 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. The computations reported in the paper provide derivatives of parental transfers with respect to income of the child that are not far from the empirical estimates of previous researchers. Among households of children who are receiving monetary help, the response of parental transfers to a dollar decrease in labor income is below 20 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 model of altruism under imperfect information is also consistent with new evidence from the PSID: 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. Nevertheless, other predictions are not matched: 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.

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.

Proposition 1 is proved using lemmata 1 through 7. The following notation is used. $\widehat{U}^c(w_j, y^c_{exo})$ is the utility level of the household of child if the secondary earner has a wage w_j in the absence of parental transfers. The utility function is rescaled to make $\gamma_p(\overline{l}^c_p - y^c_{exo})$ equal zero. A hat ($\hat{}$) over a variable denotes that it forms part of the solution to the problem that the child would solve without 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 subscript s in the wage, probability and income is also dropped, once the primary earner is ignored. The problem of the parent under imperfect information is the following

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

$$s.t. \quad v(c_i) + \gamma_s(\overline{l}^c_s - \frac{y_i}{w_i}) \geq v(c_j) + \gamma_s(\overline{l}^c_s - \frac{y_j}{w_i}) \quad i \neq j \quad \forall i, j = 1...n \tag{IC}$$

$$s.t. \quad U^c_i(c_i, \frac{y_i}{w_i}, y_{exo}) \geq \widehat{U}^c_i(w_i, y_{exo}) \quad \forall i = 1...n \tag{PC}$$

$$s.t. \quad c_i - y_{exo} - y_i \geq 0 \quad \forall i = 1...n \tag{PT}$$

where $U^c_i = v(c_i) + \gamma_s(\overline{l}^c_s - \frac{y_i}{w_i})$. IC denotes the "incentive compatibility" constraint, PC denotes the "participation constraint" and PT denotes "positive transfer". 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 those 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. *Let the solution to the problem of the parent under imperfect information* $\{(c_i^*, y_i^*)_{i=1}^{i=n}\}$. *The PC constraint binds if and only if the PT constraint binds.*

First, it cannot be the case that, for a given wage, PC does not bind and PT does. The reason is that in the absence of parental transfers it is not possible for the child to attain an utility level that exceeds $\widehat{U}_i^c(w_i, y_{exo})$

Conversely, assume that there exists only a wage w_k for which the PT constraint does not bind and for which the PC does not. (i.e. $U_k^c(c_k, \frac{y_k}{w_k}, y_{exo}) = \widehat{U}_k^c(w_k, y_{exo})$ Then, the parent may replace (c_k^*, y_k^*) with $(\widehat{c}_k, \widehat{y}_k)$ leaving the rest of the plan unaffected. This change does not alter the utility of the child, and increases the consumption to the parent, since the transfer was strictly positive before, and now is zero. Furthermore, that change cannot affect none of the IC. Assume it affected the IC associated to wage w_i. In such a case, the following chain of inequalities must hold

$$\begin{aligned} \widehat{U}^c(w_i, y_{exo}^c) &\leq v(c_i^*) + \gamma_s(\bar{l}_s^c - \frac{y_i^*}{w_i}) < v(\widehat{c}_k) + \gamma_s(\bar{l}_s^c - \frac{\widehat{y}_k}{w_i}) \\ &\leq v(\widehat{c}_i) + \gamma_s(\bar{l}_s^c - \frac{\widehat{y}_i}{w_i}) = \widehat{U}^c(w_i, y_{exo}^c) \end{aligned} \tag{9.2}$$

The first weak inequality arises from the fact that (c_i^*, y_i^*) is part of the solution, and then, must satisfy PC. The second inequality is by assumption: IC does not hold after the change. The third equality is implied by the fact that $(\widehat{c}_i, \widehat{y}_i)$ solves the problem of the child in the absence of transfers. The set of inequalities entails a contradiction. Hence, in the solution of the problem, it cannnot be the case that PT does not bind and PC does.

Lemma 2. *Any allocation* $\{(c_i, y_i)_{i=1}^{i=n}\}$ *satisfying the informational constraints implies that consumption and income are nondecreasing in the wage. Furthermore, 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} Combining the DAIC associated to wage w_i and the UAIC associated to wage w_{i+1}, it is possible to obtain

$$\int_{y_i}^{y_{i+1}} \gamma_s'(\bar{l}_s^c - \frac{x}{w_i})\frac{1}{w_i}dx \geq \int_{y_i}^{y_{i+1}} \gamma_s'(\bar{l}_s^c - \frac{x}{w_{i+1}})\frac{1}{w_{i+1}}dx \tag{9.3}$$

Using the facts that the marginal utility of leisure is higher for a person with a lower wage, and that $\frac{1}{w_i} > \frac{1}{w_{i+1}}$ it can be shown that $y_{i+1} \geq y_i$ If income is nondecreasing in the wage in equilibrium, consumption must also be nondecreasing in the wage. The second part of the lemma follows from 9.3

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. *Let the solution of the problem under imperfect information,* $\{(c_i^*, y_i^*)_{i=1}^{i=n}\}$. *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* $c_i^* = c_r^*$

Proof: from lemma 2.

Lemma 5. *Let* $\{(c_i^*, y_i^*)_{i=1}^{i=n}\}$ *be the solution to the problem of the parent under imperfect information. For all* $j \in (1, ..., n)$ *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 $(w_{n_0}, ..., w_{n_1})$ 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 exist 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:

$$v'(c_{n_1}^*) \leq v'(c_{n_1-1}^*) \leq ... \leq v'(c_{n0}^*) \tag{9.4}$$

The set of inequalities (9.3) 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:

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

$$c_k^0 = c_k^* + \frac{\sum_{i=n_1-m}^{n_1} \pi_i}{\sum_{i=n_0}^{i=n_1-m-1} \pi_i} \varepsilon = c_k^* + \varepsilon_1 \quad k = n_0, ..., n_1 - m - 1 \tag{9.5}$$

This plan redistributes consumption from the wage types $w_{n_1}...w_{n_1-m}$ to the wage types $w_{n_0}, ...w_{n_1-m-1}$, leaving the expected expenditure of the parent unaffected. It does not violate the AIC constraints, for an ε 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 ε. Finally, due to strict concavity of v, increasing the consumption level of each wage type $w_{n_0}, ...w_{n_1-m-1}$ by the same amount ε_1 will not violate the UAIC between any two adjacent wages.[24] It also improves the utility of the parent. The change in the utility of the parent is:

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

[24] In equilibrium, before the modification, the UAIC between any pair of adjacent wages in the interval $[w_{n_0}, w_{n_0+1}, ..., w_{n_1}]$ was binding in equilibrium. i.e.:

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

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:

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

Combining the two expresions, they imply that:

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

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

$$\sum_{i=n_1-m}^{n_1} \pi_i[1-v'(c^*_{n_1})]\varepsilon - \{\sum_{i=n_0}^{n_1-m-1} \pi_i\}[1-v'(c^*_{n_1-m-1})]\varepsilon_1 =$$

$$\sum_{i=n_1-m}^{n_1} \pi_i[1-v'(c^*_{n_1})]\varepsilon - \sum_{i=n_1-m}^{n_1} \pi_i[1-v'(c^*_{n_1-m-1})]\varepsilon > 0 \tag{9.6}$$

The first inequality uses the fact that marginal utility of consumption is lower for higher wages. The second equality substitutes in the definition of ε_1. The increase is positive, and we get to a contradiction. Hence, in the solution, the UAIC does not bind for any interval.

Lemma 6. *Let $\{(c^*_i, y^*_i)_{i=1}^{i=n}\}$ be the solution of the problem of the parent under imperfect information. 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 $v \in (1, ..., n)$ such that $c^*_v = y^*_v + y_{exo}$, then, for all $k > v$,*

$$c^*_k = y^*_k + y_{exo} \quad \text{and} \quad y^*_k = \widehat{y}_k$$

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:

$$\begin{aligned} \widehat{U}^c(w_{v+1}, y_{exo}) &\leq v(c^*_{v+1}) + \gamma_s(\bar{l}^c_s - \frac{y^*_{v+1}}{w_{v+1}}) = v(\widehat{c}_v) + \gamma_s(\bar{l}^c_s - \frac{\widehat{y}_v}{w_{v+1}}) \\ &< v(\widehat{c}_{v+1}) + \gamma_s(\bar{l}^c_s - \frac{\widehat{y}_{v+1}}{w_{v+1}}) = \widehat{U}^c(w_{v+1}, y_{exo}) \end{aligned} \tag{9.7}$$

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 $y^*_v = \widehat{y}_v$.

Lemmas 1 through 7 complete the proof of proposition 1.

The next step is to prove propositions 2 through 4 in Section 4. First, to simplify the notation, I assume that r=1. Next, I introduce the following notation.

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

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

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

I also introduce the change of variable $c_i = f(U_i^c, y_i)$. Using the results in proposition 1, and the new notation, the problem is now the following:

$$\max_{\{U_1^c,(y_j)_{j=1}^{j=n}\}} \sum_{i=1}^{i=v-1} \pi_i\{y^p - c(U_i^c, y_i) + y_i + \eta U_i^c\}$$

$$s.t. \quad \widehat{U}_v^c \geq U_1^c + \sum_{i=1}^{i=v-1} \{-\gamma_s(\bar{l}_s^c - \frac{y_i}{w_i}) + \gamma_s(\bar{l}_s^c - \frac{y_i}{w_{i+1}})\}$$

$$s.t. \quad c_i \geq y_i + y_{exo} \quad \forall i = 1, ..., n$$

After rearranging, and dropping the income of the parent y^p, the Lagrangian of this problem (ℓ) is

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

The first order conditions of the problem are the following.

$$\frac{\partial \ell}{\partial U_1^c} = \sum_{i=1}^{i=v-1} \pi_i[\eta - \frac{1}{v'(c_i)}] - \lambda = 0 \tag{9.8}$$

$$\frac{\partial \ell}{\partial y_i} = \pi_i(1 - \frac{\partial c}{\partial y_i}) - \{\lambda + \sum_{j=i+1}^{j=v-1} \pi_j[\frac{1}{v'(c_j)} - \eta]\}[\gamma'(\bar{l}_s^c - \frac{y_i}{w_{i+1}})\frac{1}{w_{i+1}} - \gamma'(\bar{l}_s^c - \frac{y_i}{w_i})\frac{1}{w_i}] = 0$$
$$\forall i = 1, ..., v-2 \tag{9.9}$$

$$\pi_{v-1}(1-\frac{\partial c}{\partial y_{v-1}})-\lambda[\gamma'(\bar{l}_s^c-\frac{y_{v-1}}{w_v})\frac{1}{w_v}-\gamma'(\bar{l}_s^c-\frac{y_{v-1}}{w_{v-1}})\frac{1}{w_{v-1}}]=0 \tag{9.10}$$

Lemma 8. *(proposition 2 in the text) The implicit marginal tax on effort income is a number between zero and one.*

From the first order conditions 9.8,9.9 and 9.10 and the fact that consumption is nondecreasing with the wage.

Lemma 9. *(proposition 3 in the text) If the solution is such that, in equilibrium, the child receives a parental transfer regardless of the wage, an increase in y_{exo} of one dollar reduces t_i by a dollar for every i=1,..,v-1*

Proof: In such a case, there is no wage for which the child receives no transfers and λ equals zero. v-1 can be replaced by n in all the first order conditions 9.8,9.9 and 9.10. We can observe that the amount of transfers and y_{exo} appear together in all expressions. This implies that if y_{exo} decreases by one dollar, then the transfer increase by one dollar for any given 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 $\{(\widehat{y}_i)_{i=1}^{i=n}\}$ 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 $\{(\widehat{y}_i + y_{exo}, \widehat{y}_i)_{i=v}^{i=n}\}$.The following problem is solved, for a given w_v:

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

$$s.t. \quad \widehat{U}_v = U_{v-1} - \frac{(\bar{l}_s^c-\frac{y_{v-1}}{w_{v-1}})^{1-\rho_s}}{1-\rho_s} + \frac{(\bar{l}_s^c-\frac{y_{v-1}}{w_v})^{1-\rho_s}}{1-\rho_s} \tag{10.1}$$

$$s.t. \quad y_{i+1} \geq y_i \quad \forall i = 1...v-1 \tag{10.2}$$

$$s.t. \quad U_i \geq \widehat{U}_i \quad \forall i = 1...v-1 \tag{10.3}$$

where $U_i = U_{i-1} - \frac{(\bar{l}_s^c - \frac{y_{i-1}}{w_{i-1}})^{1-\rho_s}}{1-\rho_s} + \frac{(\bar{l}_s^c - \frac{y_{i-1}}{w_i})^{1-\rho_s}}{1-\rho_s}$. It can be shown that the objective function is concave in its arguments. Also, $\gamma'''() > 0$ is a sufficient condition for constraints (10.1)-(10.3) to form a convex set. 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 $\widehat{U}_v$

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 $\sum_{i=1}^{i=v-1} \pi_i (\frac{t_i - t_i^\epsilon}{y_i - y_i^\epsilon})$

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 the following

$$\max_{\{(U_j, y_i)_{i=1}^{i=v}\}} \sum_{i=1}^{i=v-1} \pi_i(w_i)\{(-c(U_i, y_i) + y_i + y_{exo}) + \eta U_i^c\}$$

$$s.t. \quad U_j \geq U_{j-1} - \frac{(\bar{l}_s^c - \frac{y_{j-1}}{w_{j-1}})^{1-\rho_s}}{1-\rho_s} + \frac{(\bar{l}_s^c - \frac{y_{j-1}}{w_j})^{1-\rho_s}}{1-\rho_s} \quad \forall j = 1, ..., v$$

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

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

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

	Specification I	Specification II	Specification III
	$\phi_p = 0 \quad \phi_c = 2$	$\phi_p = 0 \quad \phi_c = 2$	$\phi_c = \phi_p = 2$
	$\rho_s = 2.4 \quad \eta = 14$	$\rho_s = 3 \quad \eta = 14$	$\rho_s = 2.4 \quad \eta = 0.35$
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 $\frac{t_i(w_i, y^c_{exo}) - t_{i-1}(w_i, y^c_{exo})}{y_i(w_i, y^c_{exo}) - y_{i-1}(w_i, y^c_{exo}}$.

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 $V(\eta)=1$	Specification II $V(\eta)=2$	Specification III $V(\eta)=3$
Panel I. Probit coefficients, Perfect information			
1. Income, primary earner	-1.09	-0.56	-0.31
	(0.23)	(0.10)	(0.04)
2. Income, secondary earner	-1.02	-0.56	-0.30
	(0.26)	(0.09)	(0.04)
Imperfect information			
3. Income, primary earner	-0.55	-0.25	-0.19
	(0.06)	(0.02)	(0.02)
4. Income, secondary earner	-0.33	-0.15	-0.12
	(0.04)	(0.01)	(0.01)
Panel II. Probability of transfer, imperfect information			
5. $Y_h=\overline{Y}_h-4, Y_f=\overline{Y}_f$	0.57	0.54	0.55
6. $Y_h=\overline{Y}_h, Y_f=\overline{Y}_f$	0.03	0.20	0.26
7. $Y_h=\overline{Y}_h+4, Y_f=\overline{Y}_f$	0	0.04	0.08
8. $Y_h=\overline{Y}_h, Y_f=\overline{Y}_f-4$	0.24	0.38	0.47
9. $Y_h=\overline{Y}_h, Y_f=\overline{Y}_f$	0.03	0.20	0.26
10. $Y_h=\overline{Y}_h, Y_f=\overline{Y}_f+4$	0	0.11	0.08

$\overline{Y}_h$ is $27,000, and $\overline{Y}_f$ is $21,000. Magnitudes are in 1993 dollars. $\overline{Y}_f-4$ represents income of the secondary earner minus 4,000 dollars (a third of the standard deviation of the distribution of permanent income of secondary earners, see Table 3). $\overline{Y}_h-4$ represents income of the primary earner minus 4,000 dollars (a third of the standard deviation of the observed distribution of permanent income of secondary earners in the PSID, see Table 3)

Table 3 Descriptive statistics of selected variables

Variable	Total sample (N=2,022)	If No Transfer (N=1,476)	If Transfer (N=546)
Child received money	0.23	0	1
Amount received (from both parents)	807	0	2,986
Age of the husband	35.11	35.81	33.25
	(7.14)	(7.19)	(6.67)
Age of the wife	32.96	33.59	31.24
	(6.75)	(6.73)	(6.49)
Child’s income -husband	35,288	35,269	35,338
	(17,967)	(17,551)	(19,062)
Child’s income -wife	18,586	18,459	18,930
	(11,590)	(11,520)	(11,780)
Child´s education -husband	12.96	12.81	13.36
	(2.59)	(2.60)	(2.53)
Child´s education -wife	12.83	12.68	13.25
	(2.48)	(2.43)	(2.57)
Child´s race other than white	0.22	0.24	0.17
Age of father -husband	62.50	62.89	61.57
	(9.05)	(9.01)	(9.08)
Age of father- wife	61.25	61.68	60.22
	(8.76)	(8.69)	(8.86)
Parent´s income -husband	57,573	55,785	62,399
	(24,197)	(22,661)	(27,372)
Parent´s income -wife	58,824	56,339	65,533
	(25,528)	(23,473)	(29,382)
Father´s education -husband	10.89	10.67	11.42
	(3.35)	(3.31)	(3.388)
Mother´s education-husband	11.09	10.75	11.587
	(3.36)	(3.34)	(2.797)
Father´s education -wife	11.11	10.75	11.89
	(2.87)	(3.35)	(3.28)
Mother´s education-wife	11.07	10.80	11.77
	(2.94)	(2.96)	(2.78)
Divorced parents -husband	0.12	0.12	0.13
Divorced parents -wife	0.11	0.10	0.14
Parent is a widow -husband	0.29	0.31	0.23
Parent is a widow -wife	0.25	0.27	0.17

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

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

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

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

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

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	-.027	-.032
	(.013)	(.013)	(.013)
Income of child - wife	-.035	-.048	-.048
	(.022)	(.022)	(.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 6: 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	-.018	-.018
	(.010)	(.012)	(.012)
Earnings, child of donor	-.002	-.004	-.005
	(.015)	(.014)	(.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.

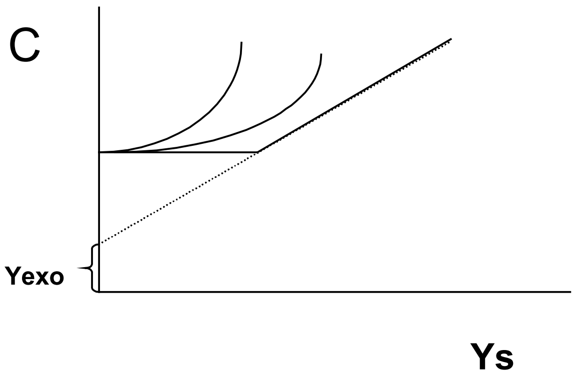

Figure 1 Optimal Allocation of Consumption and Earnings Under Perfect Information.

C: consumption of the household of the child.

Ys: earnings of the secondary earner in the household of the child.

Yexo: earnings of the primary earner in the household of the child.

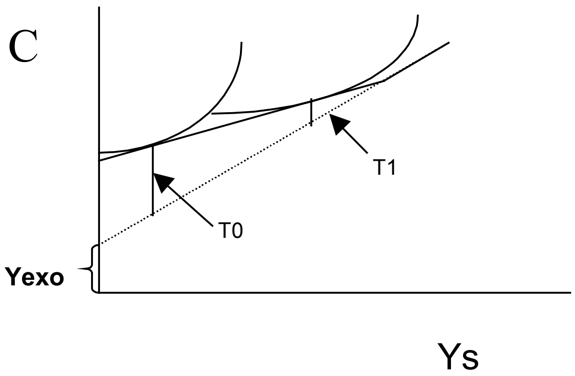

Figure 2 Optimal Allocation of Consumption and Earnings Under Imperfect Information.

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.

Ys: earnings of the secondary earner.

Yexo: earnings of the primary earner.

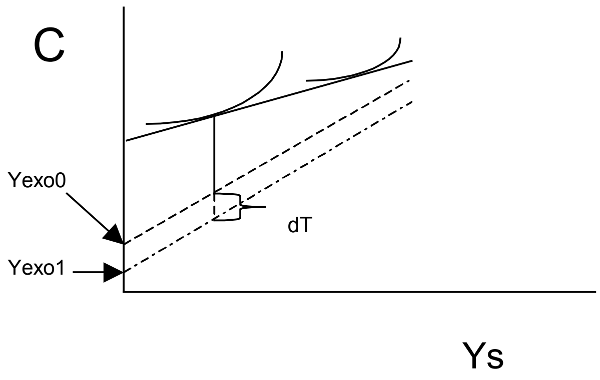

Figure 3 Response of transfers to variations in the income of the primary earner (case 1)

Yexo0: Initial earnings level of the primary earner.

Yexo1: Final earnings level of the primary earner.

dT: (one-dollar) increase in parental transfers following a one-dollar decrease in income of the primary earner in the household of the child.

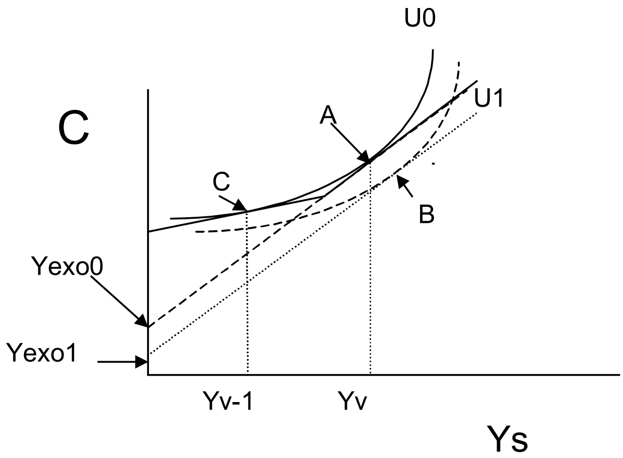

Figure 4 Response of Transfers to Income of the Primary Earner (case 2)

Point A: Allocation of consumption and earnings of the household of the child with income of secondary earner Yv and income of the primary earner Yex0.

Point B: Allocation of consumption and earnings of the household of the child with income of secondary earner Yv and income of the primary earner Yex1.

Point C: Allocation of consumption and earnings of the household of the child with income of secondary earner Yv-1 and income of the primary earner Yex0.

U0: Utility indifference curve for a household of a child in which the primary earner earns Yexo0 and the secondary earner earns Yv (no parental transfers)

U1: Utility indifference curve for a household of a child in which the primary earner earns Yexo1 and the secondary earner earns Yv-1 (no parental transfers)

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