INEQUALITY, PRODUCTIVITY, AND CHILD LABOR: THEORY AND EVIDENCE*

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ABSTRACT

A recent theoretical literature has linked reductions in income inequality to reductions in child labor in countries that are relatively well-off, but has not explored how income distribution affects child labor in very poor countries. We show that while in higher-productivity countries with child labor, a more equal income distribution will reduce or eliminate child labor, in low-productivity countries, a more equal distribution of income will exacerbate child labor. Econometric specifications studying child labor among 10- to-14 year olds yield results generally consistent with these predictions. Policy actions that aim to bring about more equality so as to reduce child labor will likely not have the desired effect unless a country in which they are taken is sufficiently wealthy.

I. Introduction

In June of 1999, by unanimous vote, the 174 member nations of the International Labor Organization passed an international convention on the worst forms of child labor (ILO, 1999a).[1] Upon ratification of this convention, member states are pledged by treaty to eliminate these practices immediately. An intent implicit in the convention is that countries would aim, in the long term, to end all forms of child labor.

One natural area of exploration is whether and under what conditions the goal of eliminating child labor is attainable, given resource constraints faced within individual economies. Another is: if there is to be aid flowing from countries that have eliminated child labor to those that have not, but this aid is limited, how is it to be targeted? These are the practical questions that face the international community in meeting the goals set out in its recent agreement about child labor.

In a path breaking paper, Basu and Van (BV: 1998) developed a theoretical framework that can be adapted to address these questions. BV focused on the question of when an outright ban on child labor could be an effective policy tool. Countries in which a ban could be effective were those that were well-off enough to be able to support all of their children without sending any to work (i.e., in which an equilibrium with no child labor coexisted with the equilibrium with some child labor). Only countries with relatively high labor productivity would fit this description.

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[1] The new convention is meant to be complementary to other instruments aimed at child labor, or more generally, at improving the lives of children. These include ILO Convention 138 on the Minimum Age for Admission to Employment, and the United Nations Convention on the Rights of the Child.

In work that builds on a simple version of the BV framework, Swinnerton and Rogers (SR: 1999) showed that income inequality was related to a nation's child labor force participation. SR found that in precisely those circumstances where, according to BV, a ban on child labor would be effective, child labor exists because the returns to capital are distributed unequally enough that some families still must send their children to work in order to sustain themselves. In those cases, a more equal distribution of those returns could be found for which child labor would be eliminated.

Other recent papers have also linked reductions in inequality to reductions in child labor. Ranjan (2001) explains how child labor can arise due to borrowing constraints. He then goes on to show that if the economy is wealthy enough, a more egalitarian income distribution relaxes credit constraints on enough households to reduce child labor. Dessy and Vencatachellum (2001) show that child labor can arise from a coordination failure between parents and firms. In their model, if an economy is wealthy enough, then child labor arises among the least-wealthy households when wealth is unequally distributed.

A common element in this literature on distribution and child labor is that there should be an inverse relationship between inequality and child labor in economies that are sufficiently well-off, in some sense. Little attention has been paid to the question of how redistribution works in economies that are not so well-off.

This paper reconstructs the result in SR with a somewhat different - - and even simpler - - model, and uses that model to consider the effect on child labor of redistribution within low-productivity (poor) and high-productivity (wealthy) economies. This very simple extension yields a striking finding: more equal distribution of income will not aid in the elimination of

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child labor in countries that are very poor, and may in fact cause child labor to increase. While improving the income distribution raises incomes for the poorest part of the population, it also spreads a given amount of resources more broadly and lowers incomes for wealthier parts of the population. In the poorest countries, a substantial population of wealthier families may be on the margin of sending their children to work, and redistribution away from these families causes child labor to rise among them. Meanwhile, the redistributed resources flowing to the poorer families are not sufficient to lower child labor among them by enough to offset the increase among the wealthier families. In the aggregate, child labor rises.

The next section outlines the theoretical model, and analyzes its comparative static properties. Section 3 presents an econometric model consistent with the theory, discusses data and methodological issues, and presents empirical results. Section 4 concludes and discusses some policy considerations.

2. The Model: Determinants of Child Labor

We begin by describing a very simple household model of child labor, in which our main result can be seen quite starkly. At the end of this section, we discuss how the results are robust to more complicated theoretical specifications.

2.1 The Model

Every household has m children and one adult and lives for a single period. Its adult has an endowment, λ, of a broad measure of efficiency units of capital (including human capital).

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Each child is endowed with $\gamma\lambda$ units of human capital, where $\gamma < 1$.[2] Each unit of capital employed produces one unit of output.

To allow for resource inequality within this economy, we assume λ is distributed over $[1, \hat{\lambda}]$, with mean $\bar{\lambda}$, cumulative distribution function $H(\lambda)$, and associated density $h(\lambda)$. Note that if λ is considered narrowly as a human capital endowment, then $\bar{\lambda}$ has a natural interpretation as the potential average productivity of adult labor. $\gamma\bar{\lambda}$ is then the potential average productivity of child labor.

Adults are assumed to employ all of their capital endowment in production. Children may or may not work: their labor supply is an outcome of the household's utility maximization. Following the Basu and Van (1998) *luxury axiom*, we suppose children do not work unless adult income cannot provide the family with a subsistence level of consumption. If an individual's level of subsistence consumption is *s*, then the family's level of subsistence consumption is $(1 + m)s \equiv S$, and child labor supply, *E*, is decided as follows:

$$E = \begin{cases} 0, & \text{if } \lambda \geq S \\ m, & \lambda < S \end{cases} \tag{1}$$

It follows immediately that the aggregate supply of child labor in this economy, L^C, equals $mH(S)$.[3]

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[2] This is Basu and Van's *substitution axiom*.

2.2 Comparative Statics

We first show how inequality can affect child labor. We model a *decrease* in inequality as any transfer from households with above-average endowments to households with below-average endowments, for which the mean of the post-transfer distribution is the same as the mean of the pre-transfer distribution. We also assume the transfers are not completely confiscatory, that is, they do not move above-average households below the mean or vice versa. Thus, our model of decreasing inequality is a mean-preserving *decrease* in spread [Rothschild and Stiglitz, 1970].

To be more precise, suppose we induce a mean-preserving decrease in spread on $H(\lambda)$, Which leads to a new cumulative distribution function $G(\lambda)$, and density $g(\lambda)$, and which satisfies the following conditions:

$$G(\lambda) < H(\lambda) \text{ for } \lambda < \bar{\lambda} \text{ and } G(\lambda) \geq H(\lambda) \text{ for } \lambda \geq \bar{\lambda} \tag{2a}$$

$$\int_{1}^{y} [G(\lambda) - H(\lambda)]d\lambda \leq 0, \text{ for all } y \in [1, \hat{\lambda}], \text{ with equality at } y = \hat{\lambda} \tag{2b}$$

Condition (2a) requires that the redistribution be from households with endowments above the mean to households with endowments below the mean. Condition (2b) says the "spread" of the distribution has decreased, in the sense that $h(\lambda)$ has a greater probability mass in the tails than does $g(\lambda)$. When y is taken to be the upper limit of the support of the distribution, then the integral in (2b) holds with equality: this is what establishes that the means of the two

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[3] Note that we have assumed no labor-leisure trade-offs. As discussed later, this assumption is not critical to our results.

distributions are the same.

While this model of decreases in inequality does not include all feasible transfers that could affect the standard measures of inequality such as the Gini coefficient or the ratio of the top x percentile's share of income to that of the bottom x percentile,[4] it is nevertheless a fairly general one, which includes as a special case the following common model of reduced inequality: tax all households' endowments at rate θ and redistribute the proceeds of the tax uniformly to all households. Under this redistribution, a household starting out with the endowment λ_0 under $H(\lambda)$ winds up with $(1-\theta)\lambda_0 + \theta\bar{\lambda}$ [eg., Persson and Tabellini (1985)].[5]

Our main proposition follows immediately from this characterization of inequality:

Proposition 1:   If $S < \bar{\lambda}$, then child labor falls with the mean-preserving decrease in spread. If $S > \bar{\lambda}$, then the reduction in inequality increases child labor.

The proof is obvious. Following the reduction in inequality, the aggregate amount of child labor changes by the amount $m[G(S)-H(S)]$. Condition (2a) implies that this change is positive when $S > \bar{\lambda}$ and negative when $S < \bar{\lambda}$. The intuition behind this proposition is straightforward. When a given amount of aggregate resources is more equally distributed, whether this lifts a substantial number of poorer households above the level of resources needed to allow them to

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[4]It does not even include all possible mean-preserving spreads. Distribution of a unit of capital from one household with an above-mean endowment to another with a smaller above-mean endowment qualifies as a mean-preserving decrease in spread, but does not qualify as a decrease in inequality under our definition, since the redistribution is not from above-mean to below-mean households.

[5] Ranjan (2001) uses the related concept of second-order stochastic dominance as a model of inequality. For his model, condition (2b) need not hold with equality when $y = \bar{\lambda}$: the distributions need not have equal means. For

withdraw their children from the labor force, without pushing even more households that were initially somewhat wealthier below that threshold, depends on the average level of resources in the economy.

Proposition 1 suggests that at the economy-wide level, whether marginal decreases in inequality cause child labor to increase or decrease depends on the economy's mean adult productivity. In what follows, we will refer to "low-productivity" economies as those in which decreases in inequality increase child labor. "High-productivity" will denote economies in which decreases in inequality reduce child labor.

Our theory has three further implications, which will be important in the empirical specification that we develop below. The first is that an increase in productivity itself, for a given distribution of resources, reduces child labor. Since we measure the resource endowment in efficiency units, changes in productivity can be modeled as a rescaling of efficiency units in an economy, i.e., by supposing that each value in the support of $h(.)$ is multiplied by a factor k.[6] An increase in productivity is therefore an increase in k. This shifts the entire density rightward without any change in its basic shape. It follows immediately that the proportion of households with endowments greater than S increases; therefore, child labor decreases. A decrease in productivity, that is in k, has the symmetric opposite effect on child labor.

The second implication is that the relationship between child labor and inequality may vary *within* low- or high-productivity economies. Since there can be a range of different

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our purposes in this paper, the mean-preserving spread is more appropriate, as it allows us to separate the effects of changes in the distribution from effects of increases in overall endowments.

[6] Note that this re-scaling leads to a slight restatement of Proposition 1: If $S < k\overline{\lambda}$, then child labor falls with the mean-preserving decrease in spread. If $S > k\overline{\lambda}$, then the reduction in inequality increases child labor.

productivity levels among the countries in either category (i.e., not all economies of either type have exactly the same k), it is of interest to see how the size of the marginal effect of changes in inequality on child labor varies according to differences in productivity among economies of the same type. It turns out that these within-type relationships are nonlinear.

Proposition 2:   The marginal effect on child labor of decreasing inequality has at least one peak within the set of low-productivity economies and at least one-trough within the set of high-productivity economies.

Proof: Appendix

For a wide range of density functions,[7] Propositions 1 and 2 imply that the graph of the marginal effects on child labor of decreasing inequality, when plotted against k, looks as shown in Figure 1. To the left of k_0 the marginal effect on child labor of decreasing inequality is positive, as predicted by Proposition 1. To the right it is negative. We will refer to k_0 as the "switch point" as this is the productivity level at which the sign of the marginal effect switches from positive to negative. Proposition 2 implies that there must be a positive slope to the graph for relatively low values of k to the left of k_0 and for relatively high values of k to the right of k_0. Very low k values characterize the lowest productivity economies that employ all or nearly all of their children. The upward slope over this range k values exists because as nearly all children are employed, marginal decreases in inequality have a diminishing effect on the employment of more children (few non-working children remain who can be introduced to employment). Very

high k values characterize the highest-productivity economies that employ none or nearly none of their children. The upward sloping segment over this range of k values exists because as nearly no children are employed, marginal decreases in inequality have a diminishing effect on how many additional children can be withdrawn from the labor force. Since Proposition 1 implies that the graph must cross the k axis at some point, there is a downward sloping portion over some middle range of k values.

The final implication of the theory is that an increase in m, the number of children in each household, increases S and thereby raises both child labor and the labor force participation rate of children.

2.3 Robustness of the Theoretical Predictions

The model we use here is very stylized: the child labor decision is all-or-nothing, production is linearly related to inputs, there is no model of credit markets or of human capital accumulation. Nevertheless, the main results are quite general. The basic idea behind our results is that household poverty is the underlying cause of child labor. Distributing a country's resources in a more egalitarian way reduces the level of poverty of the poorest households, and can potentially induce them to remove their children from the labor force. If a country is extremely poor, however, more egalitarian redistributions may not suffice to bring the poorest households out of poverty, and the financial sacrifice visited on households at the margin of subsistence, as they are asked to help subsidize the poorest households, may be so great as to force their children to work as well.

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[7] A sufficient condition is that $h(.)$ has no more than one peak or one trough. This condition would include density functions used commonly to model income or wealth distribution, e.g., the Pareto and Log-Normal densities.

In an earlier version of this paper, we were able to derive a result similar to that in Proposition 1 in a version of the model in which there is a labor-leisure tradeoff and production is not linear in labor (but there are diminishing returns to labor). Other recent papers, which study the family's work-versus-schooling choice in a dynamic context, and focus on the role played by credit constraints [Ranjan (2001), Baland and Robinson (2000)] or by strategic complementarities [Dessy and Vencatachelllum (2001)] turn out to share our model's key property: a more equal distribution of income or wealth could be associated with higher or lower levels of child labor, depending on the country's overall level of resources.

Baland and Robinson (2000) develop a two-period model in which all parents would choose an efficient level of schooling for their children if they did not face borrowing constraints. If credit market constraints make it impossible to borrow, and if parents are poor enough to have to borrow to make up for lost child earnings, then they choose a smaller-than-efficient level of schooling (and an inefficiently-high level of child labor).

Baland and Robinson do not take up the question of how redistribution affects aggregate child labor in their model. However, it is easy to see that the same effects can occur in their model as in ours. The families for which credit constraints are binding are poor families. A redistribution of income to these families that is sufficient to relax the borrowing constraint will lead them to substitute schooling for child labor. If the economy is rich enough that a redistribution exists that makes borrowing constraints non-binding for every family, then a mean-preserving decrease in spread (as modeled above) reduces aggregate child labor. However, if an economy is very poor, then it will not be able to compensate poor families sufficiently to reduce their child labor, and could increase child labor among the households that

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are taxed to effect the redistribution. In the aggregate, child labor could increase. A sufficient condition for this to occur would be that an economy was so poor that if all of its resources were distributed uniformly across the population, all families would choose zero schooling for their children.[8]

Ranjan (2001) explores how credit constraints affect the schooling-versus-labor decision in a model that also explicitly examines the effect of redistribution on aggregate child labor.   In his model, sending children to school enables them to earn a household-specific "skilled" wage which exceeds the "unskilled" wage. Child labor arises because of credit constraints. Ranjan shows that if the economy is rich enough, a dollar transferred from a rich household to a poor one increases the probability that the poor household will withdraw its children from work by more than it increases the probability that the rich household will put its children to work. If the economy is so poor that all children are already working, then a more *unequal* redistribution is the only redistribution that can reduce child labor, by channeling enough resources to a few households to induce them to withdraw their children from work.[9]

Finally, Dessy and Vencatachellum (2001) offer a two-period model of the schooling-labor tradeoff in which there are complementarities among educated workers such that no one benefits from education unless a sufficient proportion of the working population is educated. They show that if school enrollment exceeds some threshold, then the benefits of sending

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[8] For economies that are not quite this poor (but not rich enough to eliminate *all* child labor through redistribution), the average income level at which a mean-preserving decrease in spread switches from raising to reducing aggregate child labor will depend on properties of the utility function and of the function describing returns to education.

[9] Ranjan points this out in his paper. In his model, the inverse relationship between inequality and child labor applies only to increases in inequality: decreases in inequality cannot worsen child labor in very poor countries, since all children are already employed.

children to school are increasing in the parent's wealth endowment. There is a critical wealth endowment, for every enrollment level, at which parents decide to send their children to school. If the economy is rich enough to sustain an equilibrium with no child labor, then if child labor exists, it must be due to an unequal resource distribution. What is not explored in their paper is what happens if the economy is not sufficiently rich. It is straightforward to see that in this case, a mean-preserving decrease in spread will bring more families below the critical level of wealth needed to induce them to make the sacrifice of sending their children to school. The effect of equality on child labor therefore changes sign as one moves from rich to poor economies, just as it does in our simple model.[10]

3. Empirical Evidence

Our theory suggests that the level of child labor depends on inequality, on productivity and on household size, and that there is a non-linear cross effect between inequality and productivity. In this section, we specify and implement an empirical model consistent with this theory.

3.1 Data

Our unit of observation is a country in 1990. Whether or not a country is included in our sample is dictated solely by data availability. The maximum (and typical) size of any sample we consider is 89.

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[10] Bell and Gersbach (2001) develop an overlapping generations model in which a program of taxes and transfers may exist that can move an economy out of a child labor "trap." In their analysis, this always requires some initial increase in inequality. Thus, their model identifies a circumstance where reductions in the incidence of child labor could be correlated with increases in inequality.

The most appropriate widely available country-level measure of child labor is the

economically active participation rate for children 10 to 14 years old (EAP90).[11] These data are

available in the Economically Active Population (EAP) database of the International Labor

Organization (ILO, 1997). We use estimates taken from the EAP database which have been

adjusted by the ILO to be "as comparable as possible" across countries. The database presents

estimates or projections for EAP rates for every fifth year starting with 1950 and going up to

2010. We use 1990 data because this is the most recent year for which the database contained

primarily estimates instead of projections.[12]

Our measure of inequality is the percentage of expenditures carried out by the lowest

quintile of the expenditure distribution (Q1). We use observations from the "high-quality" data

set of Deininger and Squire (DS, 1996). The inequality measures for any country in that

database were based on either expenditures or on income, depending on what type of high-

quality survey was available.[13]   Inequality measures are not available for 1990 for every

[11]Rates for younger children are generally not available. The EAP data are believed to understate the true amount of
child labor [Basu (1999)]; however, these are the only data available for a large number of countries.

[12]Each year the ILO publishes yearly estimates of EAP rates in its annual *Yearbook of Labour Force Statistics*;
however, in the *Yearbook* the rates reported are raw in that they come directly from each country's labor force
survey or census and have not been adjusted for cross-national comparability.

[13]Expenditure-based measures, which typically are the only kind available for the lowest-income countries, usually
show less inequality than income-based measures. DS (1996) discuss methods for adjusting these data so that
income measures and expenditure measures are more directly comparable. Making those adjustments made no
notable change to the empirical results we report below; therefore, we do not report empirical results generated
using the adjusted measures.

country.   To increase the size of our sample, we used inequality measures that were as close as possible to 1990.[14] There is little variation in these measures in the short term.

Our choice of Q1 instead of the more commonly-used GINI coefficient [Persson and Tabellini (1985), Alesina and Rodrik (1994), Forbes (2000)] as our empirical inequality measure is motivated both by theoretical and by empirical concerns. First, the GINI coefficient is clearly not the best measure of the type of inequality this paper suggests is relevant for child labor. The theory in this paper predicts that only inequality-enhancing redistributions that increase resources to households at the lowest end of the income distribution will have any effect on child labor. The GINI will decline for <u>any</u> improvements in the income distribution, many of which we would not expect to have any effect on child labor. For instance, a reform that makes income distribution more egalitarian in the top quintile of the income distribution (or even in the top three quintiles) will reduce the GINI, but probably will not affect households with children in the labor force. By contrast, Q1 is higher only if proportionally more of a country's resources go to the poorest households. While it is possible to imagine variations in Q1 that might be inconsistent with our theory, (for instance, even in the poorest of countries it might be possible to carry out a redistribution from the richest households in the economy to the richest household in the lowest quintile which was sufficient to raise the poorer household's income above the subsistence level and reduce its child labor), Q1 nevertheless is a closer concept to this paper's theory than the GINI. Moreover, it is well-known that in cross-country data Lorenz curves commonly cross (Lambert 1993), which implies that as an empirical matter, countries with lower

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[14] For all but six countries, Q1 was available within five years of 1990. in three of the six countries (France, Germany, and Nepal), the closets year for which this measure was available was 1984. In the other three, the closest

GINIs often are <u>not</u> countries in which the lowest-income households have greater command over economic resources. In all pairwise comparisons of the countries in our data set, Lorenz curves cross approximately 16% of the time.

In our theory, we modeled differences in productivity with a re-scaling of all efficiency units in the distribution of productivity across households *within* an economy. A good measure of differences in productivity *across* economies would be the differences in their average productivity. As indicated earlier, it is possible to interpret the theoretical parameter $\bar{\lambda}$ as an economy's average product of adult labor. The closest empirical measure to this concept is real GDP per worker (RGDPW90), which is available from the *Penn World Tables Mark VI* (PWT) and is measured in thousands of 1985 international dollars.[15]

Using the EAP database, we constructed a measure of the relative size of the child to adult populations (*m*) as the ratio of the number of children under 15 to the economically-active population aged 15 and over. Finally, as explained below, concerns about measurement error or simultaneity bias led us to consider instrumental variables estimation. At various points, the instruments include: real GDP per worker in 1989, collected in the same manner as RGDPW90; and telephone mainlines per 1000 people, the percentage of the population aged 65 and over, the percentage of the population in urban areas, life expectancy at birth, paved roads as a percent of total roads, hospital beds per 1000 people, and real GDP per capita, all from the World Bank's (2001) *World Development Indicators* (WDI) database.

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available year was much earlier: Sierra Leone (1968), Gabon (1977), and El Salvador (1977)
[15] For 11 countries ultimately included in our sample (Armenia, the Bahamas, Botswana, the Czech Republic, Estonia, Ethiopia, Latvia, Nepal, Niger, Romania, and the Slovak Republic), RGDPW90 was not available from *PWT*. In these cases we constructed the measure ourselves using data on real GDP in 1990 (measured using 1987

3.2 Methodology

Our theory dictates that our econometric model be specified so that the marginal effect on child labor of changing inequality varies in sign across low- and high-productivity countries, and is non-linear within country types. That is, the econometric specification should be capable of implying a graph that looks like Figure 1. A specification that could do this is:

$$EAP90 = \beta_0 + \beta_1 RGDPW90 + \beta_2 Q1 + \beta_3 Q1*RGDPW90 + \beta_4 Q1*RGDPW90^2$$

$$+ \beta_5 Q1*RGDPW90^3 + \beta_6 m + \varepsilon \tag{3}$$

In principle, this specification could yield parameter estimates that reproduce the shape in Figure 1 and also isolate a switch point, i.e., a level of RGDPW90 at which the marginal effect on child labor of changes in inequality changes sign. However, the full range of productivity levels needed to produce a marginal effect identical to that shown in Figure 1 does not appear in our data: although our data include a number of observations (nearly one-third of the sample) where EAP90 equals zero, there is no country in the sample with EAP90 anywhere close to 100 per cent. In fact, the highest level of EAP90 in our sample is 48.26 per cent (Nepal). Given this issue, and having done some preliminary regressions using the cubic specification (not reported here), [16] we believe a quadratic specification approximates the range of Figure 1 represented in our data:

$$EAP90 = \beta_0 + \beta_1 RGDPW90 + \beta_2 Q1 + \beta_3 Q1*RGDPW90 + \beta_4 Q1*RGDPW90^2 + \beta_5 m + \varepsilon \tag{4}$$

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purchasing power parity dollars), labor force size and GDP deflators (to adjust back to 1985 dollars) from the World Bank's (1998) *World Development Indicators* database.

[16] Tobit regressions with the cubic equation yield a very similar switch point and similar patterns of statistical significance to the quadratic, for the subset of countries that have non-zero EAP90. The quadratic specification has the further virtue of simplicity: it is a very complex task to work with the higher-order cross terms when doing instrumental variables estimation, and avoiding the cube term simplifies things nicely.

Taking the derivative of equation (4) with respect to Q1 gives us the marginal effect on child labor of changes in inequality, i.e.,

$$\frac{\partial EAP90}{\partial Q1} = \beta_2 + \beta_3 RGDPW90 + \beta_4 RGDPW90^2 \qquad (5)$$

Theory predicts that this derivative should be positive for "low" values of RGDPW90 and negative for "high" values: in terms of the parameter estimates, $\beta_2 > 0$, $\beta_3 < 0$, and $\beta_4 > 0$. The switch point can be identified as that level of RGDPW90 at which the derivative in equation (5) equals zero. [17]

In implementing equation (4), we confront a couple of additional methodological issues. The first is a direct outgrowth of the heavy representation in our sample of countries with EAP90 equal to zero. In many countries, the legal age for working is 15 or older, and the country's labor force survey does not collect work-related information on children under that age. The EAP database reports EAP rates of zero for 10-to-14 year-old children in these countries. There is some question as to how to treat these observations. On the one hand, the zeros could be interpreted as "missing values" and these observations could be discarded. However, this is likely to lead to biased estimates if the zero rates reflect reality in those countries. The vast majority of countries for which zeros are reported are wealthier, more developed ones, i.e., ones classified by the World Bank as class three ("upper-middle income") or four ("high income"). Since the presumption amongst most experts on child labor is that child labor falls as poverty eases (U.S. Department of Labor or USDOL, 2000), we treat these zero values as censored data

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[17] Mathematically, equation (5) may imply two such points. As will be illustrated below, in all of our results the second (higher) point is at a level of RGDPW90 that is so high that any economy at that level of productivity would almost surely be predicted to have EAP90=0.

points. That is, if the EAP rates in the wealthier countries are not actually zero, we assume that

they are close enough to zero to round to zero. Accordingly, we use Tobit estimation when

EAP90 is specified as the dependent variable.[18]

The second methodological issue relates to possible simultaneity bias or measurement

error introduced by the explanatory variables. This issue arises with each of the three variables,

RGDPW90, Q1, and *m*.

The main problem with RGDPW90 is measurement error. Our theory bases the child

labor decision on the average productivity of *adult* labor. RGDPW90 is an empirical measure of

the average product of *all* labor. In the notation of our theory, RGDPW90 is

$$\frac{\bar{\lambda} + \gamma \int_1^S \lambda h(\lambda) d\lambda}{1 + mH(S)} \tag{6}$$

If children work, this expression is smaller than $\bar{\lambda}$, so that in countries in which children work

(i.e., those reporting non-zero EAP90), it underestimates the average product of adult labor and

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[18] There are also some countries in which the minimum age for labor force participation data is older than 10 but younger than 15. This does not lead to complete censoring of the EAP90 variable because non-zero values are reported. However, in these cases the data presented by the ILO are not technically EAP rates for 10 to 14 year olds. Rather, they are the number of economically active children in the age range for whom activity information is available as a proportion of all children 10 to 14 years old (Electronic Correspondence dated February 11, 2000 with Farhad Mehran of the ILO Bureau of Statistics, Geneva). There may be underestimation of EAP rates in these cases. Two ILO publications, *Statistical Sources and Methods*, and *Sources and Methods Labour Statistics*, present the minimum age for questioning about economic activity participation in, respectively, labor force surveys and population censuses. Using these sources (for various years) and consulting with officials at ILO's Bureau of Statistics, we were able to identify the initial source for EAP data (survey or census) for each country in our sample and the minimum age at which data on the participation status of children was collected. In our data set, the variable QUESAGE records this minimum age. With respect to our primary interest, i.e., equation (5), specifications in which we include this variable as a control (not reported) yield very similar results to those reported. The significance of the marginal effect of RGDPW90 is sometimes affected, i.e., when QUESAGE is included this marginal effect is sometimes insignificant whereas the point estimate on QUESAGE itself is always significant. However, given the high degree of collinearity between RGDPW90 and QUESAGE ($R^2 = 0.74$), we do not believe it is useful to make too much of this finding. Moreover, when we leave QUESAGE out of our empirical specification, we can be reasonably confident that its effects are being adequately controlled for by RGDPW90.

will be correlated with the error term in equation (4). A common solution to this type of problem is to use instrumental variables, using previous years' values for the endogenous regressor. Accordingly, we use RGDPW89 to instrument for RGDPW90.

Some writers on child labor have pointed out that there may be a relationship between child labor and fertility decisions (Grootaert and Kanbur, 1995). For example, on family farms that rely on a great number of family members to work them, the need for more child labor may lead to higher fertility. To allow for this concern, we recognize that our measure of children per adult, *m*, may be endogenous, so that it may be worthwhile to instrument for this variable. We experimented with a number of different instrumenting equations for *m*, and based on a comparison of correlation coefficients and adjusted correlation coefficients across equations, we chose telephone mainlines per 1000 people, and population over age 65 as instruments.

Q1 may suffer both from measurement error and from simultaneity. The possibility of measurement error arises for the same reason as it did for RGDPW90. The very fact that children are working affects household income and expenditures. If child labor is concentrated in the poorest families in an economy, then *ceteris paribus,* countries with high child labor will tend to have high Q1s. A countervailing bias occurs because the existence of working children may lower adult wages and/or adult employment (Basu and Van, 1998) thereby reducing income shares of the poorest families. The net effect of this bias is unclear.

We attempt to address these concerns by instrumenting for Q1. The empirical literature on inequality and growth [e.g., Persson and Tabellini (1985), and Perotti (1996)] suggests a number of possible instruments, some of which (school enrollment) are also likely to be endogenous in a model of child labor. Based on this literature and on some regression analyses

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of our own, we chose as instruments (i) the percentage of population 65 and over, (ii) the percentage of population in urban areas, (iii) life expectancy at birth, (iv) paved roads as percent of total roads, (v) hospital beds per 1000 people, and (vi) real GDP per capita in 1989.

Two methods of generating consistent estimators using instrumental variables in a Tobit framework have been proposed by Amemiya (1979) and are referred to in the literature as Amemiya's Least Squares (ALS) and Amemiya's Generalized Least Squares (AGLS). Newey (1987) shows that AGLS is asymptotically efficient, and so AGLS is our preferred estimation method.

3.3 Results

We present first the results of a Tobit estimation and AGLS estimations in which we instrument for RGDPW and for m, but not for Q1. We discuss the issues that arise in implementing the instrumenting equation for Q1 at the end of this section.

Our basic results can be seen by looking at Figures 2 and 3, which plot the marginal effects on EAP90 of changes in Q1 that are implied by a Tobit estimation an AGLS estimation that instruments for RGDPW90 only ("Instrument RGDPW90 only") and an AGLS estimation that instruments for RGDPW90 and m ("Instrument RGDPW90 & m"). Figure 3 presents the same results as Figure 2, but excludes very high values of RGDPW90 that the sample suggests are characteristic of countries with zero values of EAP90.

Figures 2 and 3 identify a (lower) switch point for RGDPW90 of approximately $5000.[19] Countries having RGDPW90 below $5000 are the empirical counterpart to our theory's "low-

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[19] Figure 2 also shows a higher switch point. As discussed earlier, this might be expected as a mathematical artifact of the model in equation (4). See footnote 13. As expected, in each of the three estimations shown in Figure 2, the

productivity" countries. In these countries, the marginal effect of Q1 on EAP90 is, as expected, positive: increasing Q1 (reducing inequality) increases child labor. In countries having RGDPW90 above \$5000, the "high-productivity" countries, the marginal effect of Q1 on EAP90 is negative.

Figures 2 and 3 also demonstrate the effects of instrumenting for RGDPW90 and for m. The magnitude of the marginal effect of Q1 is uniformly greater in the Tobit estimation than it is in the "RGDPW90 only" instrumentation, which in turn shows a marginal effect that is uniformly greater than in the "RGDPW90 & m" instrumentation. This suggests that the Tobit appears to be biased towards finding marginal effects of Q1 that are larger in absolute value than the true marginal effects, and that each set of instruments added tends to reduce this bias.

To discuss the statistical significance of our results with respect to Q1, we begin by looking directly at the point estimates and their related t-statistics. These are presented in Table 1. Our predictions about the signs of the relevant coefficients are borne out in each estimation: the coefficients of Q1 and of Q1*RGDPW90^2 are positive and the coefficient of Q1*RDGPW90 is negative. The associated t-statistics suggest that the interaction terms Q1*RGDPW90 and Q1*RGDPW90^2 are always significant at least at the five per cent level, and in all but one case - - Q1*RGDPW90 in column (3) - - they are significant at the one per cent level.

With regard to the coefficient on Q1, it is almost significant at the five per cent level in the Tobit (Table 1, column (1)). It is significant at the 10 per cent level when we instrument for RGDPW90 only (column (2)), but not significant at all when we instrument for both RGDPW90

second switch point occurs at a very high level of RGDPW90. In our sample all but one country with this level of RGDPW reports EAP90 of zero. In Italy, the exception, EAP90 is 0.43%.

and *m* (column (3)). This is our first clue as to when the marginal effect of Q1 is significantly different from zero. Refer back to equation (5), and note that when RGDPW90 is zero, the marginal effect and its significance are identical to the coefficient on Q1 and its significance. The results reported in columns (1) and (2) therefore both suggest that there are very small values of RGDPW90 (near zero) at which the marginal effect on EAP90 of changes in Q1 is positive and significantly different from zero, at least at the ten per cent level. The same cannot be said for the results shown in column (3). At RGDPW90 equal to zero, there is no significance. Moreover, the t-statistic associated with the marginal effect of Q1 is greatest when RGDPW90 is zero, so there are no other low-productivity values of RGDPW90 that imply that Q1 has a significant effect.

Among the high-productivity countries, the Tobit estimates of the coefficient on Q1 are significant at the ten per cent level for values of RGDPW90 of between approximately $9000 and $17,000. In that range, the marginal effect appears most highly significant (t-statistic = -1.93) at around $12,000. In column (2), a 10 per cent level of significance is evidenced in the $10,000-to-$14,000 range, with a peak (in absolute value) once again at $12,000 (t-statistic = -1.76). As in the case with low-productivity countries, the results of column (3) again show no evidence of a marginal effect that differs significantly from zero. The largest t-statistic in magnitude is 0.89, and occurs at an RGDPW90 of $11,000.

A problem with this analysis of significance levels is that it ignores the facts that our specification is set up specifically to yield a zero marginal effect of Q1 at some value of RGDPW90 (the switch point), and that noise from the data and introduced by progressively more data-intensive techniques, may affect the range of values around that point at which evidence of

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insignificant effects is found. That is, we should expect a range of RGDPW90 values around the switch point that are associated with insignificant marginal effects.

An alternative way of analyzing patterns of statistical significance is to ask whether there is evidence of statistically significant differences in the predicted marginal effects of changing Q1 in low- versus in high-productivity countries. In Table 2 we test for differences in marginal effects based on two criteria.   In panel A, we consider this difference at the two levels of RGDPW90 that yield the largest pair-wise difference in marginal effects among any RGDPW90 pairs.[20] From Figure 2, it is clear that one of these RGDPW90 levels will be in the low-productivity range, while the other will be in the high-productivity range.   Column (1) of panel A indicates that in the Tobit results, the difference between the marginal effect when RGDPW90 is zero and when RGDPW90 is $16,000 is the largest of any such difference. This difference is statistically significant at better than the five per cent level.   Using this same criterion, we also find five per cent significance when we instrument for RGDPW90 (panel A, column (2)). When we instrument for both RGDPW90 and m, this test does not reveal significance.

In panel B of Table 2, we present the results of a second alternative criterion for testing for the difference in marginal effects of Q1 in low- and high-productivity countries. In this exercise we consider the difference in marginal effect between the two levels of RGDPW90 that yield the largest pair-wise difference *in the t-statistics* related to the marginal effects among any RGDPW90 pairs. Accordingly, column (1) of this panel effectively reiterates results reported earlier that the t statistic of the marginal effect was largest when RGDPW90 was zero (i.e., 1.94)

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and smallest when it was \$12,000 (i.e., -1.93). Using these two levels of RGDPW90, we

calculate the related marginal effects and test for the difference between the two. This difference

is significant at better than the one per cent level. Repeating the same exercise for the

specification that instruments for RGDPW suggests significance at better than the five per cent

level. When we instrument for both RGDPW and m (column 3), the difference is still significant

at better than the 10 per cent level. These results allow us to conclude that there is some

empirical evidence of statistically different marginal effects on child labor of changes in

inequality between the sets of low- and high-productivity countries. Before moving on to the

issue of instrumenting for Q1, it is worth noting two other pieces of information presented in

Table 1. First, increases in RGDPW ("economy-wide productivity") do appear to be associated

with decreasing employment of child labor. The marginal effect of a change in RGDPW on

EAP90, calculated at the sample's mean RGDPW90, is always negative and highly significant.

Second, larger average household size (*m*) does appear to be associated with greater child labor,

although the statistical significance of this result falls below the 10 per cent level when we

instrument for *m*.

   Earlier we discussed reasons why we might also want to consider what happens to our

results when we instrument for Q1. Table 3 presents two attempts to do this. The first point to

notice from the table is the very low R^2 (0.38) associated with the instrumenting equation. This

suggests that we are not working with very good instruments, even if they are the best available.

This conclusion is reinforced by looking at the two sets of parameter estimates presented in the

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[20] We restrict our analysis to RGDPW90 of \$17,000 and below. As indicated earlier, the sample indicates only one
country with a higher RGDPW90 that is reported to have any economically active 10 to 14 year olds, and the

table. As indicated in our discussion of methodology, both ALS and AGLS produce consistent

estimates. Even though consistency is technically an asymptotic result that may not be terribly

relevant to a sample of 79 observations, we still would not expect the results of the two

estimation procedures to be implausibly different. In our opinion, the two sets of results in Table

3 are implausibly different.   The parameter estimates related to all but one of the variables are

of opposite sign when estimated by ALS instead of AGLS. There are also some remarkable

differences in magnitude. Considering each set of estimate on its own, we note that the ALS

estimates suggest a pattern of coefficients related to the variables that are functions of Q1 which

is opposite of what our theory predicts. Under AGLS these coefficients are as expected, but the

coefficients on the variables that are functions of RGDPW suggest that child labor increases with

productivity. In sum, we believe that attempts to instrument for Q1 with available data are not

informative

4. Conclusions

Our theory suggests that among those economies with child labor, those with relatively

high productivity may reduce child labor by seeking a more equitable distribution of income.[21]

In those economies, there is more than enough aggregate income to eliminate child labor, and

child labor exists largely because the distribution of income is sufficiently unequal. In low-

associated EAP rate is small.

[21]While the theory technically addresses income distribution, we believe the results are valid when interpreted more generally as the distribution of all resources in the economy, including those distributed as private income and in

productivity economies, the theory suggests that such redistribution may be ineffective and can even have the perverse effect of increasing child labor. In these economies, only the highest-income families may be able to survive without child labor; and, even those families may be just on the margin of survival. An equalizing redistribution could lower the income of higher-income families so that their children must work, without raising any other family's income by enough so that they can pull their children out of work. Our empirical results for 10-to-14 year old children are generally consistent with our theoretical predictions.

Our results have implications for policy. Many commentators on child labor, including ourselves (Swinnerton and Rogers, 1999), have expressed the sentiment that "[g]eneral economic development, equitably distributed, is the best and most sustainable way of reducing child labour." (Grootaert and Kanbur, 1995, p. 198). The results of our research suggest some refinement may be needed to make this prescription more precise contextually. In low-productivity countries, the major policy emphasis should probably be on productivity growth with little or perhaps even no emphasis on equity.[22] In higher-productivity countries with child labor, more weight should be given to equity-inducing policies.

This research is relevant to the activities of the most prominent international effort working toward the elimination of child labor in the world today, the ILO's In-Focus Program on the Elimination of Child Labor (IPEC). IPEC's strategy is to motivate "a broad alliance of partners to...act against child labor." In choosing governments as partners, IPEC seeks those

terms of publicly-provided goods such as public schooling. Hanushek, et al (2001), for example, explore the distributive consequences of different educational programs.

with the "political will and commitment...to address child labor in cooperation with...relevant parties in society..." (ILO, "IPEC at a Glance").

Clearly, political will must encompass, or be matched with, the economic means to take child-labor-reducing actions. Practically, IPEC serves as a mechanism for wealthier countries to donate resources to set up child-labor-reducing programs in less well off countries. IPEC hopes these programs will serve as examples to the recipient countries, and others, of actions they can continue to take to address child labor, *without* the long-term financial support of IPEC and its donors (USDOL, 2000). If the resources for the sustained reduction of child labor must at some point come solely from within an economy with child labor, the question of whether sufficient resources exist within that economy becomes particularly germane. In higher-productivity countries with child labor, our research suggests that the resources may be there, and that given IPEC's goals to encourage local action, choosing among this group of countries the ones with the political will to act may be an efficient way of targeting IPEC's resources.

Our research also suggests however that IPEC's strategy may not be particularly workable in low-productivity countries.   It could have a very perverse effect. If these countries seriously commit to trying to minimize child labor, and they do not experience increases in productivity or have access to outside resources, they may take actions that, probably implicitly, redistribute resources away from poor to wealthier families.

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[22]This statement relates only to child labor concerns and need not be appropriate to a host of other competing concerns that may affect policy decisions in these countries, nor is it meant to exclude equity-inducing policies if they also have the effect of raising productivity.

A plausible policy strategy for any country with a child labor problem is to try initially to reduce child labor by first trying to reach those children closest to the margin of leaving it. According to our theory these would be children in wealthier child-labor-providing families. Redistribution toward these families from the wealthiest families in the economy could begin to chip away at the aggregate level of child labor.[23] But our results imply that in low-productivity countries if the goal is to minimize child labor, at some point redistribution away from the poorest families would have to occur. Of course, making these families poorer would only serve to ensure that their children must continue to work. Overall then, there may be some reduction in child labor, but it could not be eliminated. Moreover, the children in the now-even-poorer child-labor families are likely to suffer even more.

Perhaps by placing priority on the "worst forms" of child labor, Convention 182 rules out this strategy. On the other hand, it may simply change the focus to those closest to the margin of leaving the worst forms. If there are "harder to serve" cases in the worst forms, they may not be addressed. The point is the same. Unless the resources are available to deal with the entirety of the problem, regardless of whether the problem is defined as all or just the worst forms of child labor, it is important to be very careful in structuring the incentives that lead to priorities. For example, if the yardstick is just the size and speed of reduction in (worst forms) of child labor, incentives are set up to find the easiest way to do this and this probably does not mean by addressing the most desperate cases.

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[23] If these families themselves are not "close" to subsistence and therefore neither send their children to work, nor are "close" to doing so.

Appendix: Proof of proposition 2

Consider multiplying all values in the support of $h(.)$ by k, i.e., make the change of variable $x = k\lambda$. Note that the support of the transformed density is $[k, k\hat{\lambda}]$. We do not rescale S. That is, we assume that the level of consumption needed to support subsistence is the same in all economies, regardless of differences in productivity among them.

The proportion of **initial** endowments below S is

$$H(\frac{S}{k}) = \begin{cases} 1 & S > k\hat{\lambda} \\ \int_k^S h(\frac{x}{k})\frac{dx}{k} & \text{if, } S \in [k, k\hat{\lambda}] \\ 0 & S < k \end{cases} \tag{A.1}$$

A mean preserving reduction in spread brought about by a one-to-one continuous redistribution, which is represented by the function $y = f(\theta)$, implies:

$$ky \in [kf(1), kf(\hat{\lambda})] \subset [k, k\hat{\lambda}]; \text{and} \tag{A.2}$$

$$\lambda(y) = f^{-1}(y) \text{ exists.}$$

We define $z(y) = k\lambda(y)$ to remain consistent with the re-scaling by k made in deriving (A.1). The proportion of endowments below S **after** implementing the redistribution program, i.e., making the change of variable $y = f(\theta)$, is:

$$G(\frac{S}{k}) = \begin{cases} 1 & S > kf(\hat{\lambda}) \\ \int_{kf(1)}^S h(\frac{z(y)}{k})\frac{|z'(y)| dy}{k} & \text{if, } S \in [kf(1), kf(\hat{\lambda})] \\ 0 & S < kf(1) \end{cases} \tag{A.3}$$

Let $)E$ be the change in child labor brought about by the redistribution scheme $f(.)$. From the text we know that,

$$) E = m[G(\frac{S}{k}) - H(\frac{S}{k})] \tag{A.4}$$

Substituting from (A.1) and (A.3) into (A.4) and using (A.2), we can write:

$$) E = \begin{cases} 0 & S \geq k\hat{\lambda} \\ m[1 - H(\frac{S}{k})] & S \in [kf(\hat{\lambda}), k\hat{\lambda}) \\ m[G(\frac{S}{k}) - H(\frac{S}{k})], & \text{if } \begin{cases} S \in [kf(1), kf(\hat{\lambda})) \\ -mH(\frac{S}{k}) & S \in [k, kf(1)) \\ 0 & S < k \end{cases} \end{cases} \tag{A.5}$$

If $H(.)$ is continuous, then so is $) E$. $) E$ is not necessarily differentiable at all points; however, it is in the interior of each of the non-zero segments defined by (A.5). We now analyze (A.5) to determine how $) E$, the marginal effect on child labor of reducing inequality, differs in economies with different productivity parameters, k.

Consider the first and fifth segments of (A.5). A small change in k in either of these segments brings about no change in child labor. For an economy with a value of k that puts it in the first (top) segment of (A.5), all initial endowments are below S. By Proposition 1, we know that equalizing redistributions in this segment cannot reduce child labor, and since child labor is already at one-hundred per cent of all children, it cannot increase it either. For an economy with a value of k in the fifth (bottom) segment, all initial endowments are above S, so that there is already no child labor and mean-preserving equalizing redistributions can reduce it no more.

In the interior of the second and fourth segments, we have,

$$\frac{\partial \Delta E}{\partial k} = \frac{mS}{k^2} h(\frac{S}{k}) > 0. \tag{A.6}$$

From Proposition 1, it follows that $) E < 0$, if $S < k\overline{\lambda}$: this is the result for "high" productivity economies. Also, $) E > 0$, if $S > k\overline{\lambda}$: this is the result for "low" productivity economies. Since it must also be the case that $k\overline{\lambda} \in (kf(1), kf(\hat{\lambda}))$, it follows that the set of high productivity economies includes those with values of k that put them in the fourth segment of (A.5). While the set of low productivity economies includes those with values of k that put them in the second segment of (A.5). Therefore, the graph of $) E$ against k has a portion that is positive and upward

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sloping (because of the second segment of (A.5)) and negative and upward sloping (because of the fourth segment of (A.5)). Because of the continuity of ∂E, it follows that there must be some downward sloping in the third segment of (A.5), because that segment must connect the second and the fourth. This establishes the non-linearity of the relationship between ∂E and k. It also follows that as we consider increases in k across the low-productivity countries, the graph of ∂E must change direction *at least* once (from positive slope to negative slope). Increases in k across high-productivity countries also must bring *at least* one change in direction in the graph (from negative to positive slope).[24] Figure 1 presents a graph of ∂E against k that satisfies the requirements described in this and the previous paragraph.

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[24] All together then, there must be *at least* two changes in direction in the graph of ∂E against k in the portion of the graph that does not coincide with the k axis. We cannot rule out that the possibility that a density function, $h(.)$, can be found that implies more than two changes in direction. It can be shown, however, that as long as $h(.)$ has no more than one peak or one trough, the graph of ∂E against k makes only two changes in direction. This latter restriction would include density functions used commonly to model income or wealth distribution, e.g., the Pareto and log-normal densities.

Figure 1:   How The Marginal Effect on Child Labor of Decreases in Inequality(ΔE) varies with Productivity Levels (k).
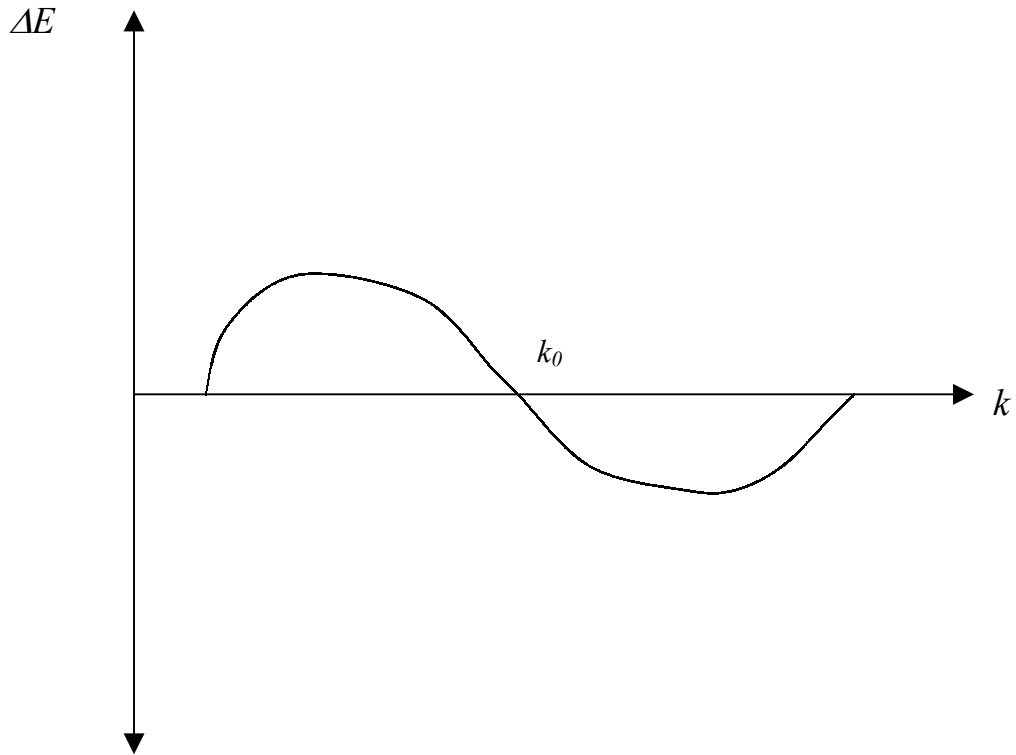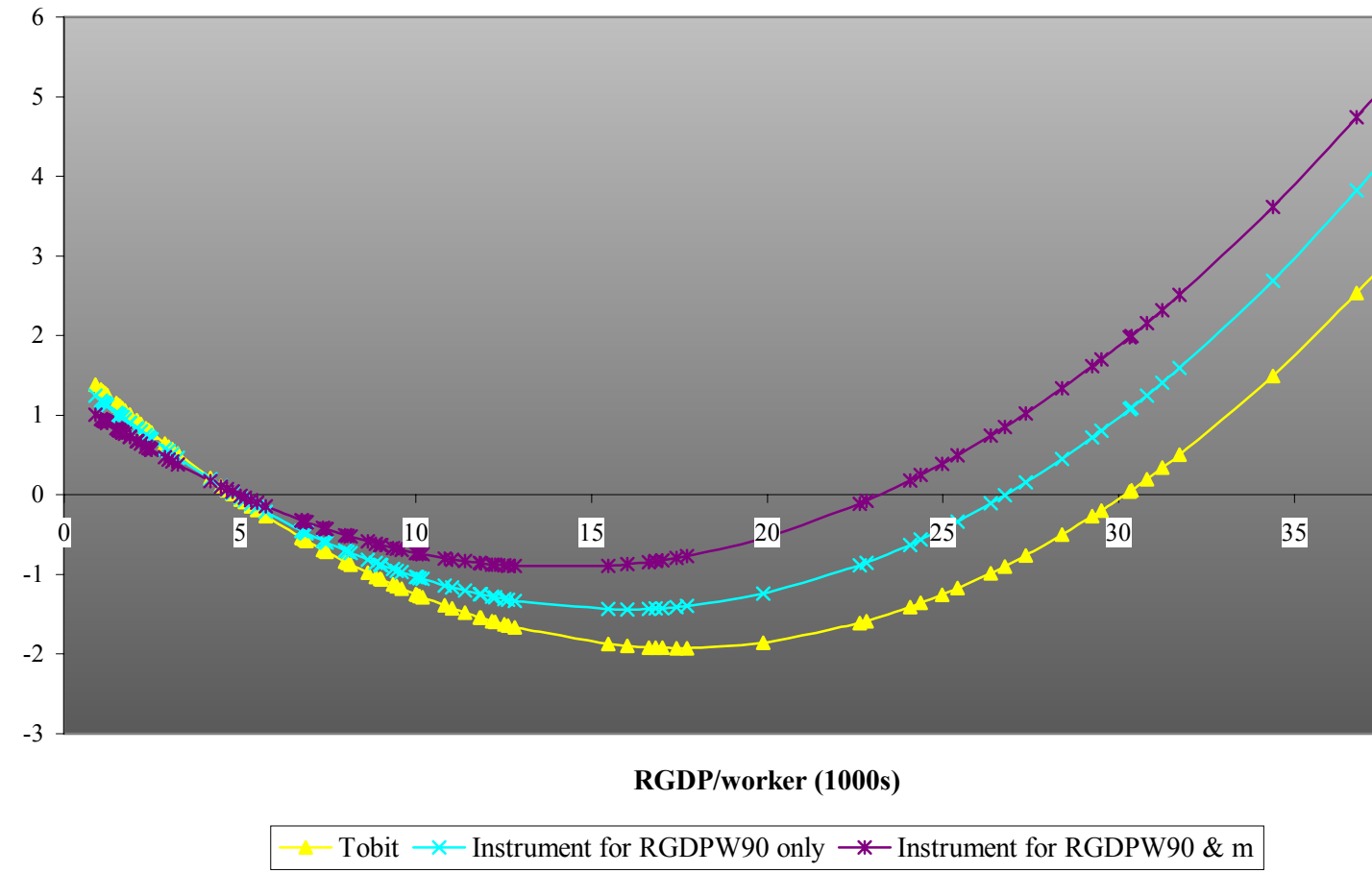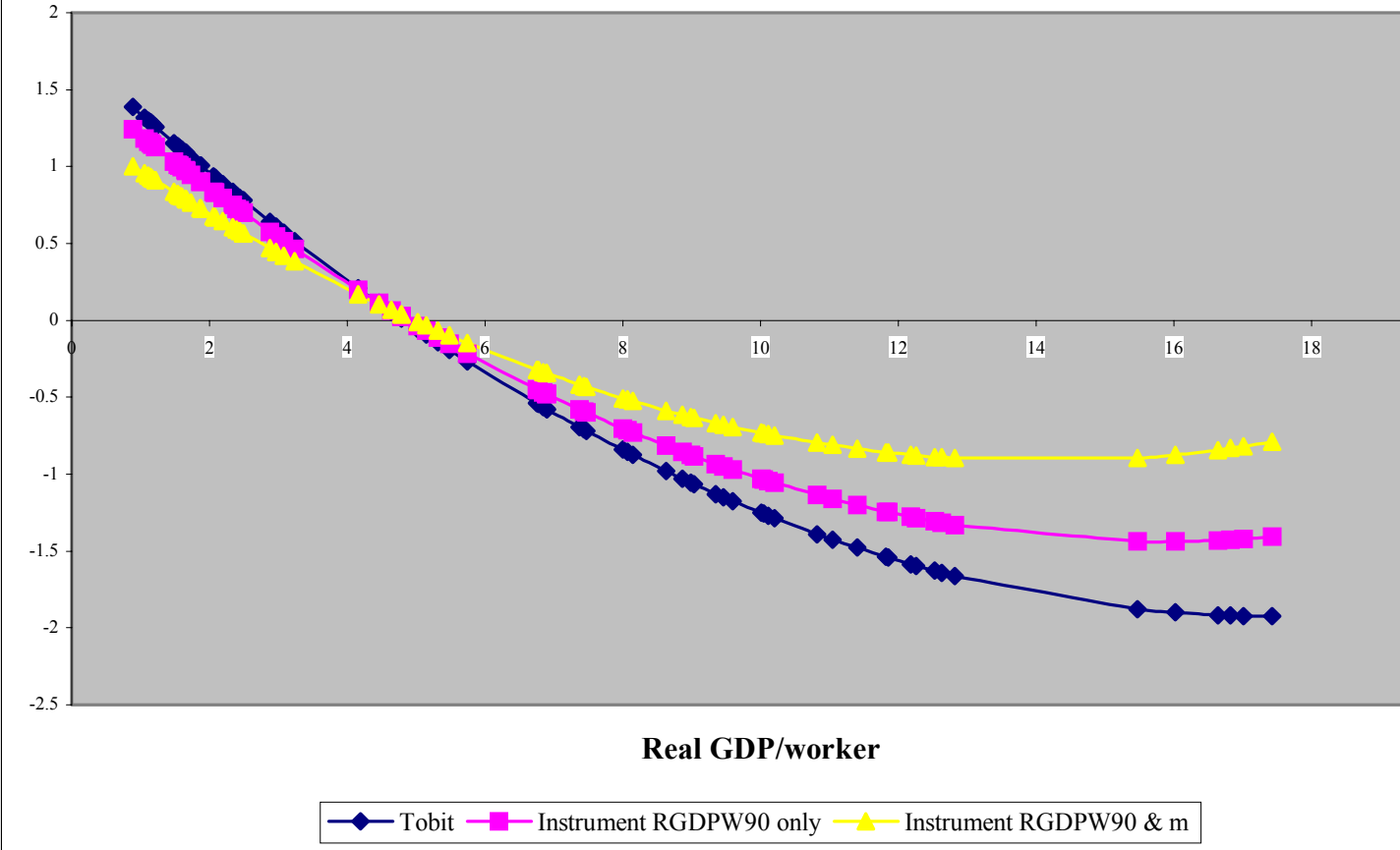
ΔE

k_0

k

Figure 2: Marginal Effect of Changing Q1 by Level of RGDP/worker

RGDP/worker (1000s)

Tobit   Instrument for RGDPW90 only   Instrument for RGDPW90 & m

Figure 3: Marginal Effect of Changing Q1 by Level of RGDP/worker*

Real GDP/worker

Legend: Tobit — Instrument RGDPW90 only — Instrument RGDPW90 & m

*Marginal effects shown are only for countries with positive levels of child labor. Except for Italy, no country with real GDP/worker in excess of $17,500 is recorded as having economically active 10 to 14 year olds. In 1990, Italy's real GDP/worker was $30,796 and the EAP rate for 10-14 year olds was 0.43%. Italy was not included in the sample for the purpose of plotting this chart.

Table 1: Basic Empirical Results

	Means	(1) Tobit	(2) AGLS: RGDPW*	(3) AGLS: RGDPW, m**
Constant		12.73 (1.59)	14.28 (1.81)	5.26 (0.39)
RGDPW (1000s)	12.21	-1.25 (-2.08)	-1.41 (-2.37)	-1.50 (-2.27)
Q1	6.11	1.75 (1.94)	1.57 (1.79)	1.27 (1.35)
Q1*RGDPW	76.50	-0.42 (-3.24)	-0.38 (-3.11)	-0.31 (-2.04)
Q1*RGDPW^2	1621	0.012 (5.34)	0.012 (5.38)	0.11 (4.55)
m	0.82	10.90 (2.27)	10.31 (2.18)	19.62 (1.61)
Sigma		9.57 (10.12)		
switch RGDPW		$4,929	$4,856	$5,066
R^2 of additional instumenting eq.			0.997	0.74
m.e. ave. RGDPW		-1.97 (-8.75)	-1.98 (-13.21)	-1.74 (-6.79)
n	89	89	89	89

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*Instrument for RGDPW (real GDP/worker in 1990) is real GDP/worker in 1989.

**Instruments for m are telephone mainlines per 1000 people and percentage of population 65 and over.

Table 2: Testing for Significant Differences between Marginal Effects of Q1
in Low- vs. High-Productivity Countries

Panel A: Comparing at Levels of RGDPW90 That Yield Largest Difference in Marginal Effect

	(1) Tobit	(2) AGLS:RGDPW*	(3) AGLS: RGDPW,m**
Lower RGDPW90	$0	$0	$0
Higher RGDPW90	$16,000	$16,000	$14,000
t Difference in M.E.	2.15	1.96	1.24
Panel B: Levels of RGDPW90 That Yield Largest Difference in t of Marginal Effect			
Lower RGDPW90	$0	$0	$0
Higher RGDPW90	$12,000	$12,000	$11,000
t Difference in M.E.	2.48	2.28	1.80

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Table 3: Results of Two Methods of Instrumenting for Q1*

	ALS: RGDPW, m, Q1	AGLS: RGDPW, m, Q1
Constant	322.84 (2.30)	-38.66 (-1.47)
RGDPW (1000s)	-16.01 (-1.57)	3.82 (1.46)
Q1	-20.70 (-2.26)	8.69 (3.83)
Q1*RGDPW	0.90 (0.89)	-1.36 (-3.10)
Q1*RGDPW^2	0.16 (1.32)	0.067 (4.23)
m	-20.70 (2.31)	8.69 (1.08)
R^2 of instrumenting equation	0.38	0.38
n	79	79

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* Instruments for Q1 are percentage of population 65 and over, percentage of population in urban areas, life expectancy at birth, paved roads as percent of total roads, hospital beds per 1000 people, and real GDP per capita in 1989. Missing values among some of the new instruments shrink the size of the sample and change sample means slightly. RGDPW90 and m have been instrumented as in Table 1.

Both the least squares and generalized least squares methods suggested by Amemiya (1979) produce consistent estimates; therefore, there should not be extremely wild differences between the two sets of estimates. Indeed, there are not when both methods are applied to the instrumenting exercises in columns (2) and (3) of Table 1. Here, however, the estimates are vastly different. The difference is probably directly related to the poor fit of the instrumenting equation for Q1.

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