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WELFARE IMPACT OF A BAN ON CHILD LABOR

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Welfare Impact of a Ban on Child Labor[*]

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Abstract

This paper presents a new rationale for imposing restrictions on child labor.

In a standard overlapping generations model where parental altruism results in transfers that children allocate to consumption and education, the Nash-Cournot equilibrium results in sub-optimal levels of parental transfers and does not maximize the average level of utility of currently living agents. A ban on child labor decreases children's income and generates an increase in parental transfers bringing their levels closer to the optimum, raising children's welfare as well as average welfare in the short-run and in the long-run.

Moreover, the inability to work allows children to allocate more time to education, and it leads to an increase in human capital. Besides, to increase transfers, parents decrease savings and, hence, physical capital accumulation. When prices are flexible, these effects diminish the positive welfare impact of the ban on child labor.

JEL Classification: D91, E21

Key words: child labor, altruism, overlapping generations, welfare.

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1 Introduction

The issue of child labor has recently been the subject of a surge in formal economic analysis. According to ILO (2006) there has been a significant decrease in child labor and an even steeper decline in hazardous child labor; nevertheless in 2004 there were still 218 million child laborers, of whom 126 million were in hazardous work. The increase in research around this topic is in part the result of the growing awareness of the persistence of child labor around the world and the importance of developing theoretical models that help us understand the incidence of child labor and its implications, as only then can we recommend and implement effective policy interventions.

The economics literature is ambiguous on the desirability of a ban on child labor. Child labor is typically viewed as the result of some deeper problem in the economy, and addressing child labor without solving the problem that leads to its occurrence can make children worse off. For example, Dessy and Pallage (2005) present an environment where, although child labor has a negative direct impact on children's well-being, it is the best available choice for children. Hence, a ban on child labor, even on its worst forms, deprives children of their best possible choice and can make children worse off.

Standard arguments for the imposition of restrictions on child labor are based on the existence of externalities, such as positive externalities from a well-educated population (see Udry, 2006). A ban on child labor leads children to allocate more resources to education, brings the average levels of human capital closer to the optimal, and consequently increases welfare. Constraining the amount of labor supplied by children is also often suggested as an instrument to move the economy towards a desired equilibrium in environments where multiple equilibria can emerge, as in Dessy and Pallage (2001) and Basu and Van (1998). Banning child labor can also be an instrument to achieve increases in efficiency in the presence of capital market imperfections. In Baland and Robinson (2000), capital market imperfections do not allow altruistic parents to internalize the negative impact of child labor on children's human capital accumulation. A restriction on the amount of time allocated to work by

children is suggested to reduce the resulting inefficiently high levels of child labor. Finally, Rogers and Swinnerton (2002) advance parents' incomplete information on the type of work, safe or hazardous, their children perform as an argument for a ban on the worst forms of child labor.[1]

In this paper, I show that, in a standard overlapping generations economy with parental altruism calibrated to the 1880's, a ban on child labor increases parental transfers and raises children's as well as the average levels of welfare in the short-run and in the long-run.

This result introduces a new rationale for imposing restrictions on child labor adding to a debate still in its early stages of development.[2] In an overlapping generations economy with altruism, the unconstrained Nash-Cournot equilibrium does not maximize the average welfare of currently living agents, as was shown in Bernheim (1989), nor the welfare of children and generates sub-optimal levels of parental transfers. By reducing the income earned by children, a ban on child labor reduces children's consumption, raising their marginal utility of consumption, and parents respond by increasing transfers to children. Hence, the ban places children at a point in their parents' reaction function that results in a higher level of parental transfers. By inducing an increase in parental transfers, the ban on child labor moves the economy closer to the social optimal, generating aggregate welfare gains. Children are made better off because they receive more transfers and do not work. Parents are made worse off because they need to decrease consumption and leisure to increase parental transfers; however, the raise in their children's life-time utility partially off-sets this effect.

Additionally, the inability to work allows children to allocate more time to education, which raises the return to human capital accumulation. Thus, more of the parental transfers are allocated to education and the level of skills increases. Future parents' labor income increases which bolsters the increase in parental transfers. Consequently, in the long-run, the rise in parental transfers allows for a more significant increase in education spending,

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[1] See Basu (1999) for a survey of the theoretical and empirical literature on child labor legislation.

[2] This paper does not present a theory of the emergence of a ban on child labor which would hinge on the impact of this policy on the well-being of adult agents, namely the ones with decisive political power.

human capital, and welfare.

However, to increase parental transfers, agents decrease savings and, hence, physical capital. When prices are flexible, the increase in human capital and the decrease in physical capital lower the wage rate and diminish the positive welfare impact of the ban on child labor.

The paper is organized as follows. In Section 2, I use a simple model economy to present some important analytical results. In Section 3, I present the completely developed economic environment. In Section 4, the parameters of the economy are calibrated to match long run features of the US economy. Section 5 presents and analyses the different equilibria. Finally, Section 6 concludes and suggests some directions for future research.

2   Some Preliminary Analytical Results

In this section, I revisit the sub-optimality of the Nash-Cournot equilibrium in models with altruism, and use a simple economic environment to develop a good understanding of the interaction between child labor, parental transfers and welfare, and to derive analytical theoretical results.

2.1   Child labor in a static model with altruism

I analyze child labor in a static economy where two types of agents live. Age-1 agent, the child, derives utility from her own consumption and leisure while age-2 agent, the parent, derives utility from her own consumption and also from her child's utility. The utility functions of age-1 and age-2 agents are respectively:

$$V_1 = U(c_1, l_1), \tag{1}$$

and

$$V_2 = U(c_2, l_2) + \beta_a U(c_1, l_1), \tag{2}$$

where c_i is consumption and l_i is leisure of agent i. $\beta_a > 0$ is the altruism discount factor, the factor at which a parent discounts her child's lifetime utility. The utility function, $U(.)$, is strictly increasing, strictly concave, twice continuously differentiable and satisfies the Inada conditions. Additionally, consumption and leisure are assumed to be complements.

Individuals have one unit of time to allocate to work and leisure. They supply h_i hours of labor, earning $w\, h_i$ where w is the real hourly wage rate.

The budget constraints facing each agent are

$$c_1 = wh_1 + g_2, \tag{3}$$

$$c_2 = wh_2 - g_2 \tag{4}$$

where g_2 represents the resources given by a parent to her child.

I assume that both agents are Cournot players. That is, each agent takes as given the decisions of the other when making her own decisions. As shown in O'Connel and Zeldes (1993), the equilibrium is the same as when we assume that parents are Stackelberg leaders in the interaction with their children and account for their children's optimal response when making decisions, and it is also the same as when parents make all decisions in behalf of their children. The crucial assumption is that children are Cournot players and cannot manipulate their parent's transfer decision.

2.1.1 Nash-Cournot Equilibrium

Assuming interior solutions, the first-order conditions with respect to the choices of h_i and g_2 are respectively:

$$U_l(c_i, l_i) = wU_c(c_i, l_i), \quad i = 1, 2, \tag{5}$$

$$U_c(c_2, l_2) = \beta_a U_c(c_1, l_1). \tag{6}$$

The conditions that determine parent's labor supply (equation 5 for $i = 2$) and the level of parental transfers for any given level of the child's decision (equation 6), can be used to derive a relation between parental transfers and the child's supply of labor: $g_2 = g(h_1)$. For an utility function that is increasing and strictly concave in consumption, any factor that generates a decrease in the child's consumption, increasing her marginal utility of consumption, results in an increase in transfers. So, parental transfers decrease with the child's labor supply, h_1.

2.1.2 Welfare maximization

In this static model with altruism, the transfer from parents to children, $g_{2,t}$, and the amounts of work that maximize the social welfare function

$$SW = V_1 + V_2 \tag{7}$$

are such that:

$$U_c(c_1, l_1)(1 + \beta_a) = U_c(c_2, l_2) \tag{8}$$

$$U_l(c_i, l_i) = wU_c(c_i, l_i), \quad \forall i, \tag{9}$$

which imply that, the Nash-Cournot equilibrium does not maximize welfare, as was shown by Bernheim (1989). The level of parental transfers, g_2, that maximizes social welfare is higher than the one chosen by parents in the Nash-Cournot equilibrium while the welfare

optimal level of child labor is lower.

The sub-optimality of the Nash-Cournot equilibrium results from the presence of the positive externality of the child's consumption and leisure on her parent's utility. In the Nash-Cournot equilibrium the child is not fully compensated for the impact of her decisions on her parent's utility and enjoys sub-optimal levels of consumption and leisure. For any level of altruism, a social planner that cares for the lifetime utility of all currently living agents always gives more weight to the utility of children than do parents. The social planner cares for the lifetime utility of children directly and through their parent's lifetime utility. Transfers to children make young agents better off which raises their own lifetime utility as well as their parents' lifetime utility because of altruism. Therefore, a social planner that weights children's utility positively prefers a level of parental transfers larger than in the Nash-Cournot equilibrium.

It is also clear that the Second Fundamental Welfare Theorem does not hold, at it is not possible to achieve the optimal allocation of resources in the Nash-Cournot equilibrium with a reallocation of endowments. Any redistribution of resources across agents would be exactly offset by a change in transfers from a parent to her child.

2.1.3   Child Labor and Welfare

Soares (2008) shows that, by increasing children's savings and inducing an increase in parental transfers, the imposition of a borrowing constraint can increase children's welfare as well as the average level of welfare in the economy. More generally, any factor that generates a decrease in children's resources leads to an increase in parental transfers, that is it places children in a point of their parents reaction function that corresponds to a higher level of parental transfers, bringing them closer to their optimal level. For children that work, it is immediate to consider that a reduction in the amount of hours of work supplied decreases their labor income and hence generates the desired response from parents.

Proposition 1: When the economy is in a Nash-Cournot equilibrium, a marginal decrease

in children's labor supply increases children's lifetime utility and the average level of welfare.[3]

Proof: The social welfare gains of an increase on the child's supply of labor are given by

$$\frac{dSW}{dh_1} = (1 + \beta_a) \left[wU_c(c_1, l_1) - U_l(c_1, l_1) \right] + U_c(c_1, l_1) \frac{dg_2}{dh_1}.$$

The first component on the right side of this equation describes the welfare impact of a change in child labor through the distortion it introduces on the child's supply of labor, while the second component relates to its impact on the child's utility through the response it generates in parental transfers.

If the economy is at the Nash-Cournot equilibrium, we have

$$\frac{dSW}{dh_1} = U_c(c_1, l_1) \frac{dg_2}{dh_1} = \frac{dV_1}{dh_1} \tag{10}$$

and

$$\frac{dV_2}{dh_1} = 0.$$

Moreover,

$$\frac{dg_2}{dh_1} = \frac{\beta_a \left(U_{cl}(c_1, l_1) - wU_{cc}(c_1, l_1) \right)}{\beta_a U_{cc}(c_1, l_1) - B}$$

where

$$B = \frac{\overbrace{-U_{ll}(c_2, l_2)U_{cc}(c_2, l_2) + U_{lc}(c_2, l_2)U_{lc}(c_2, l_2)}^{<0}}{\underbrace{U_{ll}(c_2, l_2) - 2wU_{cl}(c_2, l_2) + w^2 U_{cc}(c_2, l_2)}_{<0}} > 0. \tag{11}$$

Because $\partial g_2 / \partial h_1 < 0$, when children's labor, h_1, decreases, parental transfers, g_2, increase. Hence, $\frac{dV_1}{dh_1}$, $\frac{dSW}{dh_1} < 0.$∎

The decrease in child labor increases the child's leisure, and reduces her income and hence her consumption, raising her marginal utility of consumption. The optimal response for the

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[3]While this proposition is similar to proposition 6 in Baland and Robinson (2000), its rationale is different. Moreover, Baland and Robinson (2000) make the stronger claim that a small decrease in child labor generates a Pareto improvement as it increases children's lifetime utility while maintaining parents' lifetime utility. This is not true in this case because the Nash-Cournot equilibrium maximizes parents' utility and any movement away from this equilibrium makes parents worse off.

parent is to increase transfers to children. By inducing an increase in parental transfers, the forced decrease in child labor moves the economy closer to the social optimal generating aggregate welfare gains. The child is made better off because she receives more transfers and works less. The parent is made worse off because of the decrease in consumption and leisure implied by the increase in parental transfers; however, the raise in her child's life-time utility off-sets this effect.

Proposition 1 shows that a small reduction on child labor increases children's lifetime utility and the average level of welfare and suggests that the imposition of a ban on child labor can move the economy closer to the social optimal by inducing an increase in parental transfers. We can therefore postulate that a ban on child labor can be welfare improving.

This simple model allows us to underline an effect of restrictions to child labor that have been ignored in the literature. From the analysis, it is evident that the question concerning the effects of this constraint is whether a restriction on child labor places the economy closer to the optimum, enhancing welfare, or farther away beyond it, decreasing welfare.

Moreover, constraints on child labor might have important implications to the accumulation of human capital. If, in the one hand, a decrease in child labor reduces the resources available to finance education, on the other hand, it increases the time available to education with an overall ambiguous impact on the accumulation of human capital. The effect of restrictions on the ability of children to work on the accumulation of human capital can be crucial, for instance, in determining their long-run effects as it affects future parents' wealth and hence future parental transfers. Given the potential importance of the impact of child labor on human capital accumulation, I develop a realistic economic environment where I allow for the endogenous accumulation of human and physical capital and where prices are flexible.

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3 The Economic Environment

I study an economy where a large number of identical agents are born in each period and live for T periods, first as children then as adults. Individuals in each generation maximize their discounted lifetime utility. For someone born in period t this is given by

$$\sum_{i=1}^{T} \beta^{i-1} u(c_{i,t+i-1}, l_{i,t+i-1}) + \beta\,\beta_a\,f\,V_{1,t+1}, \tag{12}$$

where $\beta > 0$ is the subjective discount factor, $c_{i,t}$ is consumption and $l_{i,t}$ is leisure of an $age-i$ individual in period t. Each agent is assumed to have f children in the second period of her life and $\beta_a \in [0, 1/(\beta\,f))$ is the altruism discount factor, the factor at which she discounts her child's lifetime utility. A parent values her children's consumption and leisure because she cares for their well-being. Furthermore, children have the same preferences as adults over own consumption and leisure. The "momentary" utility function takes the constant relative risk aversion form of a Cobb-Douglas consumption-leisure index,

$$u(c_{i,t+i-1}, l_{i,t+i-1}) = \frac{\left(c_{i,t+i-1}^{\sigma} l_{i,t+i-1}^{1-\sigma}\right)^{1-\rho}}{1-\rho} \tag{13}$$

where ρ is the coefficient of risk aversion, and σ is the coefficient of consumption on the Cobb-Douglas index.

As the exogenous fertility rate is f, a younger generation is f times bigger than the preceding one. The share of $age - i$ individuals in the population, given by the measure μ_i, $i = 1, 2, .., T$, is constant over time and $\mu_{i+1} = \mu_i/f$, with $\sum_{i=1}^{T} \mu_i = 1$.

Individuals have one unit of time each period. In the first period of their lives, they can choose how much time they allocate to leisure, education, and work. Agents can work during any period of their lives, unless a ban on child labor is in place in which case they can only work when adults, ages two to T. They supply $h_{i,t}$ hours of labor and earn $w_t\,h_{i,t}s_{i,t}$ where w_t and $s_{i,t}$ are the real hourly wage rate per unit of human capital and $age - i$ agent's level

of human capital in period t, respectively.

The budget constraint facing an individual of age i at time t can be written as

$$a_{i+1,t+1} = (1 + r_t)a_{i,t} - g_{i,t} + g_{i+1,t}/f + w_t\, h_{i,t}s_{i,t} - c_{i,t} - e_{i,t}, \qquad (14)$$

where $a_{i,t}$ denotes the beginning-of-period asset holdings of an $age-i$ individual at time t, and r_t denotes the rate of return on these assets. The variable $e_{i,t}$ describes private investment in education. Finally, $g_{i,t}$ represents the resources given by a parent to her children while $g_{i+1,t}/f$ are the resources received by $age - i$ agent from her $age - (i + 1)$ parent. For simplicity, I allow these transfers from parents to occur only twice during their lifetime, in the second period of parents' lives, when their offspring are children, and in the last period of parents' lives.

I assume that children cannot borrow against their future income:

$$a_{2,t} \geq 0, \ \forall\, t. \qquad (15)$$

I make this assumption because it is a more realistic representation of the actual economic environment. It is important to observe that, as in Soares (2008), in this model economy a constraint to children's ability to borrow increases welfare and thus does not generate inefficient levels of child labor.

In regards to the strategic behavior of agents in the game played between parents and their children, I assume that parents and children are Cournot players and analyze Nash-Cournot equilibria.[4] Hence, I assume away equilibria where children have an active role in the bargaining process. This is a common assumption in the literature and is also the most realistic one when dealing with the relationship between parents and underage children: children have no bargaining power and parents usually make most decisions for their

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[4]Recall that, as shown in O'Connel and Zeldes (1993), as long as we assume that the offspring are Cournot players the equilibrium is the same whether we assume that parents are Cournot players, Stackelberg leaders, or make all decisions in behalf of their children.

children.[5]

Gifts from $age - T$ parents to their offspring, $g_{T,t}$ cannot be negative, but I allow the gifts from $age - 2$ parents to children, $g_{2,t}$ to be negative. That is, $age - 2$ parents can make children transfer resources to them. In this environment, this is equivalent to letting parents manage all the family's resources whether they are brought home by them or by their children.

Children are born with a given level of skills, $s_{1,t}$, and can accumulate human capital by going to school. The level of human capital accumulated by each child increases with the time allocated to learning, $d_{1,t}$, and the level of physical resources invested in education, $e_{1,t}$. This education process is represented by the following technology:

$$s_{2,t+1} = \theta e_{1,t}^{\eta_e} d_{1,t}^{\eta_d}, \tag{16}$$

where the parameters η_d and η_e are respectively the coefficients of time and physical resources in the learning technology while θ is the total factor productivity of the education process. Adults cannot accumulate human capital and their skill level evolves according to

$$s_{i+1,t+1} = s_{i,t} \ \forall i = 2, ..., T.$$

Hence this model incorporates the findings of Patrinos and Psacharapoulos (1997) that show that child labor might not be detrimental to education. In effect, all else constant, children that can work are able to supplement the resources they receive from their parents and assign more resources to education than if they were not allowed to work. So on the one hand, child labor might hinder the education of children by decreasing the amount of time they have available for education. On the other hand, child labor might help children accumulate human capital by increasing the resources that they can devote to education.

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[5]I abstract from the possibility of strategic behavior between adult children and their parents to focus on the role of the relationship between adult parents and their underage children.

The time constraint facing an individual of age i at time t is

$$h_{i,t} + l_{i,t} + d_{i,t} = 1$$

The production technology of the economy is described by a constant-returns-to-scale function,

$$Y_t = K_t^{1-\alpha} L_t^{\alpha}, \tag{17}$$

where $\alpha \in (0,1)$ is the labor share of output, and Y_t, K_t, and L_t are the levels of output, capital input and effective labor input, respectively.

The capital stock is equal to the aggregate asset holdings of individuals in the economy. It depreciates at a constant rate δ and evolves according to the law of motion,

$$K_{t+1} = (1 - \delta)K_t + I_t. \tag{18}$$

The effective labor input is given by the number of hours worked by agents in the economy weighted by their levels of human capital,

$$L_t = N_t \sum_{i=1}^{T} \mu_{i,t} \, s_{i,t} \, h_{i,t}, \tag{19}$$

where N_t is the population size in period t.

Competitive firms maximize profits, equal to $Y_t - \delta K_t - w_t L_t - r_t K_t$, taking the wage, w_t, and the interest rate, r_t, as given. The first-order conditions for the firm's problem determine the following functions for the net real return to capital and the real wage rate:

$$r_t = (1 - \alpha)\left(\tfrac{K_t}{L_t}\right)^{-\alpha} - \delta,$$

$$\tag{20}$$

$$w_t = \alpha\left(\tfrac{K_t}{L_t}\right)^{1-\alpha}.$$

4 Calibration

To solve the model numerically, I assign values to the parameters of preferences and technologies. I calibrate the model parameters so that the steady-state of the economy matches observations for selected variables in the U.S. economy around 1870-80, when child labor laws had not yet been adopted and there were significant levels of child labor. The calibration is mostly based on observations for the period in question. For some parameter values, I have not found any sources for the 1870's, and I use common parametrizations from the macroeconomics literature.

Assuming that the model period is 10 years long, agents in this economy live for five periods. They are born, i.e., become economically active, at the age of 5 and full-time workers at age 15, working 40 years more to a total real-life age of 55. Although the life-expectation at birth in 1870 was about 45 years, at age 20 it was around 42 more years (see Pope, 2003), so I target a reasonable intermediate value.

Fertility Rate

The exogenous fertility rate is calibrated so that the population growth rate for the model will match the average population annual growth rate in the US economy around 1860-90, 2.34% (US Department of Commerce). For the five generation model, this translates to a fertility rate of $f = 1.2602$.

Preferences

I choose the values for the discount factor, β, to be 0.81 so that the annual risk free real interest rate in steady-state is approximately 7.78%, the average ex-post real interest rate for the period 1870-1893 computed by Jovanovic and Rousseau (2005) using Commercial paper rates data from Homer and Sylla (1991) and implicit price deflator for GNP data from Berry (1988). I set the coefficient of consumption in the utility function, σ, equal to 0.44 so that, on average, adult agents allocate 33% of their available time to work, corresponding to about 1600 hours a year and assuming a net time endowment of 94 hours per week (see Ramey and

Francis, 2005). I set the coefficient of relative risk aversion ρ equal to the standard value, 2.

Altruism

The altruism discount factor is chosen to match the average ratio of spending on education per child to GDP per capita in the US economy, as in Krueger and Donahue (2005). A year of education per child cost in current dollars $15.55 in 1870 and $12.71 in 1880 (US Department of Education, 1997) while the ratio of kindergarten to grade 12 enrollment to 5- to 17- year old children for those years was respectively, 57.04 and 65.54 (see Goldin, 1999). The average level of GDP per capita in current dollars was $187.50 between 1869 and 1888 ($170 in 1870) (US Department of Commerce). Thus, I choose the altruism discount factor to obtain a ratio of spending on education per child to GDP per capita of 4.6%.

Production Technology

The share of capital in the production function is set to 0.34, the capital share of income reported by Williamson and Lindert (1980) for the US in 1871. The depreciation rate is 3% on an annual basis (see Williamson, 1974).

Education Technology

I set the coefficient of expenditures on education in the education production function, η_e, to 0.2, as in Fernandez and Rogerson (1994). I set the total factor productivity in the education sector, θ, to 10 and calibrate the coefficient of time allocated to education in the education production function, η_d, to match the average percentage of available time dedicated to education.[6] According to Goldin (1999) between 1869 and 1900 children attend school for 60 days per year on average. Assuming that they spend on average 6 hours at school per attendance, the average percentage of time available allocated to education is about 7.36%.

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[6]With an appropriate adjustment of $s_{1,t}$, total factor productivity in the education technology only has a scale effect on most variables; it does not affect the time allocations or factor prices and impacts on the absolute levels of all other variables by a factor of $\theta^{\frac{1}{1-\eta_e}}$. I set its value to 10 for computational reasons.

Finally, the level of children's skills, $s_{1,t}$, is set to match the amount of time children allocate to work. Carter and Sutch (1996) report a labor force participation rate for boys in 1880 of 32% and of 12% for girls which corresponds to an average participation rate of about 22%. If we assume that children that work work on average 10 hours per day, the average time children spend working is of about 20.80% of their available time.

The parameter choices for the benchmark model are summarized in Table 1.[7]

5 Findings

5.1 Impact of a ban on child labor

I study the welfare impact of an effective ban on child labor in an economy where children cannot borrow against future income to finance their consumption or education. I investigate the introduction of a ban on child labor in this environment because it is representative of the actual economic environment in the U.S. economy around 1870-80.

I first shut down the general equilibrium effects of the ban on child labor and look at a partial equilibrium where I maintain the factor prices constant; I set the wage and interest rate to their equilibrium levels in the steady-state of the economy where children can work. This allows me to analyze the impact of the ban on child labor while abstracting from its pecuniary externalities. I then take into account the pecuniary effect of the ban on child labor on individuals' welfare by looking at the general equilibrium where factor prices are endogenous.

5.1.1 Steady-States

The steady-state results are presented in Table 2. In the first column, I summarize the results for the economy with child labor. In the second column, I present the partial equilibrium

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[7]The equilibria are found by solving for the optimality first order conditions and the market equilibrium conditions using a standard non linear equation solver. An Appendix describing details of the computational procedure is available on request.

results for the economy where children cannot work, and, in the last column, I present the general equilibrium results.

I find that agents are better off in the steady-states where children are not allowed to work. The ban on child labor eliminates income that children would allocate to education and consumption and generates an increase in the level of transfers they receive from parents.

A ban on child labor increases children's leisure and reduces their consumption, raising their marginal utility of consumption. The optimal response for a parent is to increase transfers to children. So, by inducing an increase in parental transfers, the forced decrease in child labor moves the economy closer to the social optimal generating aggregate welfare gains. That is, a ban on child labor places children at a point of their parent's reaction function that corresponds to a higher level of parental transfers, bringing them closer to their optimal level.

I measure the welfare benefit of an agent in the economy where child labor is not allowed as the fixed percentage increase in the lifetime consumption of an individual of the same age and her descendents in the steady-state of the economy with child labor needed to equate the level of welfare of both individuals. This measure, which I refer to as the compensating variation, is positive (negative) if there is a welfare gain (loss) relatively to the steady-state with child labor.

In partial equilibrium, the ban leads to a decrease in children's consumption, but investment in education increases. As children have more time to allocate to education, the return to human capital accumulation is higher. Consequently, more of the parental transfers are allocated to education. Because the level of skills increases, parents' labor income increases which bolsters the increase in parental transfers. As a result, in the long-run, the rise in parental transfers is higher than the decrease in children's labor income allowing for a significant increase in education spending. This effect underlines the importance of accounting for the human capital accumulation when evaluating the impact of a ban on child labor. There is a significant decrease in savings; in order to increase transfers, parents save less for future

consumption.

Although, given the level of parental transfers, children would like to work, they are better off in the steady-state where they are not allowed to work. Consumption would have to increase by about 3.24% in every period for a newly born agent to be as well off in the steady-state with child labor as in the steady-state where child labor is not allowed.

In general equilibrium, the decrease in aggregate savings generates a fall in capital that together with the increase in human capital results in a decrease in wages, an increase in interest rates, and a drop in income. The decline in the wage rate dampens down the accumulation of human capital, because the return to education is lower, and parents' with a lower income transfer fewer resources to their children. As there is a significant decrease in wealth relative to the partial equilibrium, leisure and consumption also decrease for most generations, and the rise in welfare is much lower than when factor prices remain constant. Consumption would have to increase by about 1.5% in every period for a newly born agent to be as well off in the steady-state with child labor as in the steady-state where child labor is not allowed.

Notice that income decreases with the ban on child labor. In partial equilibrium, human capital increases with the ban on child labor, and this results in an increase in the effective wage rate, and the adult labor supply increases. However, savings decrease as parents choose to allocate more resources to their children and less to their future consumption, and capital income decreases. The latter effect is stronger, and income decreases. In general equilibrium, the response of factor prices leads to a lower increase in human capital and in the effective labor supply in the long-run, and income decreases by even more. So, for the benchmark calibration, the ban on child labor increases average welfare but decreases per capita income.

5.1.2   Transition Paths

To analyze the short-run impact of the ban on child labor on welfare, I look at the transition from the steady-state of the economy with child labor to the steady-states of the economy

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where children cannot work. Again, I focus first on the partial equilibrium transition where I keep the factor prices constant, and then I analyze the general equilibrium transition where factor prices are endogenous.

Partial Equilibrium: It is clear that altruism plays a central role; as we observe in Figure 1 Panel d, when the ban on child labor is implemented, the transfers from parents increase significantly. Parents care about the lifetime utility of their children, and when children can no longer work to finance consumption and education, they give them more resources. Because children have more time to allocate to education, the return to the investment in human capital accumulation rises sharply. Therefore, the resources allocated to education jump to close to their new steady-state values, (Figure 1 Panels e and f), drastically above their initial levels. Some of the additional parental transfers are allocated by children to consumption which decreases only slightly (Figure 1 Panel a).

Future adult generations work more to take advantage of their increased skills. As future parents generate a higher labor income they transfer more resources to their children which helps sustain the increase in human capital.

Children's lifetime utility increases as we can see in Figure 2 Panel a. This increase in welfare is related to the surge in children's leisure (Figure 1 Panel b), as the initial period's children no longer work, although they allocate much more time to education and in their future consumption as adults.

These findings show that a ban on child labor can make children better off by inducing an increase in parental transfers. More importantly, in Figure 2 Panel f, it is clear that the average lifetime utility of agents increases immediately in response to the ban on child labor.

As both average welfare and the lifetime utility of children are higher in every period after the implementation of the ban on child labor, we can infer that any measure of welfare

of the type described by

$$SW_t = \sum_{i=1}^{T} \mu_i V_{i,t} + \sum_{j=1}^{\infty} \left(\beta_p f \right)^j \mu_1 V_{1,t+j} \tag{21}$$

is also higher than in the equilibrium where children can work. Hence the ban on child labor generates an increase in welfare for any welfare function of this form.

Notice also that in the period where the ban on child labor starts, parents' welfare only decreases slightly (see Figure 2 Panel b). Parents want to increase the resources they transfer to their children. In order to do so they increase the time allocated to work (see Figure 1 Panel c) and reduce current and future consumption (see Figure 1 Panel a). So, the increase in transfers comes at the cost of lower consumption and leisure levels for the remaining of their lives. This implies that the non-altruistic utility of the initial period's parents decreases (see Figure 3 Panel b). However, the significant rise in children's lifetime utility increases parents' lifetime utility for altruistic reasons almost off-setting the previous effect. Nonetheless, a parent is made worse off with the ban and will want to send her children to work; a ban on child labor would need to be enforced taking these incentives into account.

As can be seen in Figure 4, initially, as adults save less to transfer more resources to their children upon the imposition of the ban on child labor, the accumulation of assets decreases drastically. In contrast, human capital increases very significantly because of the increase in resources allocated to education. We also observe an initial decrease in the effective labor supply as a direct result of the ban on child labor. However, the increase in human capital and in adult labor supply generates a subsequent raise in the effective labor supply.

General Equilibrium: In general equilibrium, the initial decrease in labor supply results in a large increase in wages (figure 5 Panels c an d). Then, as physical capital decreases and the effective labor supply increases with human capital, the wage rate falls. The response of the wage rate implies a decline both in the return to education and in parents' labor income

generating a decrease in the funds that are channeled to education (figure 6 panels e and f), and we observe a significant dampening down of the investment in education relative to the partial equilibrium path. As a result, initially, human capital rises much less than in partial equilibrium and converges to considerably lower levels afterward. Even though there is an increase in interest rate, in the long-run physical capital decreases by more, which keeps wages down and contains the increase in human capital.

While children's and the average levels of welfare still increase, they are lower than in partial equilibrium (see figure 7 Panels a and f). So the general equilibrium effects diminish the positive impact of the ban on child labor on welfare.

Note that in both cases, although the ban on child labor increases average welfare, it has a negative impact on some agents' utility. It is therefore not a pareto improvement. Moreover, a ban on child labor decreases the well-being of the initial adults and children do not vote, thus it would not be implemented as a result of a democratic process where adult agents vote for or against the adoption of the ban.[8]

5.1.3 Sensitivity Analysis

In this section, I perform some sensitivity analysis with respect to several important parameters of the economic environment. In these experiments, I change the value of the corresponding parameter while maintaining all the other parameters constant; that is, I do not re-calibrate the remaining parameters using the procedure described in Section 4. Table 3 shows the sensitivity of the welfare measures and of the equilibrium levels of some key variables to substantial variations in the altruism discount factor, the coefficient of time in the education process, and the coefficient of consumption in the utility function.

As the altruism discount factor decreases parents care less about their children's well-being, and they are more willing to send them to work in order to supplement the family's

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[8]Although the objective of this paper is to evaluate the welfare implications of a ban on child labor, it would be interesting to build on this economic environment to develop a positive theory of the emergence of a ban on child labor which would hinge on the impact of this policy on human capital accumulation and would contrast with the rational presented in Doepke and Zillibotti (2005).

income. When $\beta_a = 0.15$ parents make children allocate approximately 60% of their time to work and use children's labor income to finance their own consumption. The ban on child labor eliminates children's only source of income; parents are then willing to use their own income to finance their children's education and consumption. Although the qualitative response of the variables is similar to what we saw in the benchmark economy, the quantitative impact on welfare is much more significant. Consumption would have to increase by between around 15% to 25% in every period for a child to be as well off in the steady-state with child labor as in an equilibrium where child labor is not allowed.

When the coefficient associated with the amount of time allocated to education in the human capital production function is increased to $\eta_d = 0.2$, the ban on child labor generates a long-run increase in income, in contrast to what we observed in the benchmark calibration. A ban on child labor allows children to allocate more time to the accumulation of human capital and to leisure. As time is more productive in the education process, the increase in time allocated to education has a much stronger impact on human capital accumulation. The resulting increase in the effective labor supply outweighs the decrease in savings leading to an increase in income. In general equilibrium, the impact on factor prices leads to a lower increase in human capital, and there is a lesser increase in income. So, in this case, the ban on child labor increases average welfare and per capita income.

When the coefficient of consumption in the utility function, σ, is one and the coefficient associated with the amount of time allocated to education in the human capital production function, η_d, is zero, there is no cost of opportunity for children to allocate time to work. Under these conditions, a ban on child labor has a negative impact on children's welfare as a costless source of income would be taken away from them.

Although the benchmark level of parameter η_d is very low, we have to increase the coefficient of consumption in the utility function to about 0.6 for a ban on child labor to have a negative impact on the initial level of average welfare. But even then the ban on child labor still increases current children and future agents' well-being. There are two important

factors that are affected by this parameter. On the one hand, a high σ implies a large amount of labor supplied by children; when $\sigma = 0.6$, 40% of children's time is allocated to work while 12% is allocated to education. This means that a ban on child labor has a bigger impact on children's labor supply and income. On the other hand, agents do not care as much about leisure, so the release of time from child labor has little direct impact on utility, while its impact on human capital accumulation is limited by the low coefficient of time and the diminishing returns in the education process. Therefore, the opportunity cost of children's labor is diminished by the decreased weight of leisure in the utility function and the low impact of time on the human capital accumulation process, while the negative impact of the ban increases with the amount of labor supplied by children. The response of parental transfers is still significant and offsets the net negative impact of the ban on child labor on children's well-being. But the reduced increase in children's utility, due to the lower cost of opportunity of child labor, is not enough to induce an increase in the initial average level of welfare.

6   Final Comments

In this paper, I showed that a ban on child labor can be desirable as it increases the average level of welfare as well as children's welfare, and advanced a new rationale for imposing restrictions on child labor. In an overlapping generations model with altruism, the level of parental transfers that maximizes average welfare is higher than the level that is optimal for parents in an economy where children can work. By reducing the income earned by children, a ban on child labor leads parents to increase transfers to children, moving the economy closer to the social optimum and generating aggregate welfare gains. Children are made better off because they receive more transfers and do not have to work; they move closer to the levels of parental transfers and leisure that maximize their welfare. Parents are made worse off because of the decrease in consumption and leisure implied by the increase in

parental transfers; however, the raise in their children's life-time utility partially off-sets this effect. The average level of welfare also increases because more weight is given to children's well-being than to their parents' well-being as it enters average welfare directly and through their parents' lifetime utility.

This paper stresses the importance of considering explicitly the impact of a ban on child labor on children's well-being and of accounting for its general equilibrium effects. But, while it introduces a new rational for impeding child labor, the present framework abstracts from several features that are potentially interesting.

Firstly, the model does not allow for human capital externalities. A ban on child labor generates a strong increase in the long-run level of human capital. In the presence of an economy-wide human capital externality, the impact of the ban would be amplified, and the welfare gains would be significantly higher. Furthermore, the short-run impact on wages and interest rates might be such that a majority of older generations supports its implementation.

Secondly, having endogenized child labor and human capital education, it is then natural to also include harmful forms of child labor by allowing for endogenous changes in health. However, the qualitative results of a ban child labor in that case should not differ from the ones in this paper which are driven mostly by the nature of the game played between parents and their children.

Finally, the investigation in this paper focuses on extreme cases, namely children are allowed to work as much as they want or not at all. In practice, it is very costly for governments to ban child labor. Hence, developing alternative policies that can increase welfare and reduce the incidence of child labor in environments where a ban on child labor is infeasible would represent a significant step towards practical policy analysis. Moreover, like with most arguments for a ban on child labor, the one provided in this paper means that a constraint on child labor is at most a second-best solution and not an optimal policy. Although the first-best is not achievable through purely redistributive policies in an unconstrained economy, as changes in parental transfers would offset those policies, because there are binding

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constraints on children's borrowing, an appropriately designed transfer policy might place the economy closer to the social optimum.

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7 Tables and Figures

Table 1 - Calibration											
T	**f**	**β**	**ρ**	**β_a**	**σ**	**θ**	**η_e**	**η_d**	**α**	**δ**	**$s_{1,t}$**
5	1.2602	.87	2	.44	.44	10	0.2	0.068	0.66	0.2626	1.4

Table 2

Impact of a Ban on Child Labor

	Economy with Child Labor	Economy with Ban on Child Labor	
		Partial Eq.	General Eq.
Skills	5.5874	5.8101	5.7543
Labor			
Age-1	0.2099	0.0000	0.0000
Age-2	0.6121	0.6238	0.6260
Age-3	0.4713	0.4873	0.4836
Age-4	0.2793	0.3011	0.2871
Age-5	0.0177	0.0474	0.0157
Assets			
Age-2	0.0000	0.0000	0.0000
Age-3	0.2033	0.1608	0.1678
Age-4	0.5336	0.4995	0.5076
Age-5	0.6286	0.6077	0.6214
Consumption			
Age-1	0.2443	0.2238	0.2154
Age-2	0.5425	0.5471	0.5281
Age-3	0.7395	0.7457	0.7290
Age-4	1.0079	1.0164	1.0065
Age-5	1.3739	1.3854	1.3896
Leisure			
Age-1	0.6970	0.8650	0.8659
Age-2	0.3879	0.3762	0.3740
Age-3	0.5287	0.5127	0.5164
Age-4	0.7207	0.6989	0.7129
Age-5	0.9823	0.9526	0.9843
Parental Transfers (received)	0.2727	0.3546	0.3403
Education Time	0.0931	0.1350	0.1341
Private Funding of Education	0.1221	0.1308	0.1249
Interest rate	1.1355	1.1355	1.1909
Wage rate	0.3186	0.3186	0.3123
Income (NNP)	0.7466	0.7439	0.7320
Welfare Level of Age-1 Agent	-13.0171	-12.7868	-12.9093
Compensating Variation		3.2384%	1.4963%

Table 3

Sensitivity Analysis of the Impact of a Ban on Child Labor

|	Unconstrained Economy	Borrowing Constrained Economy			
		Partial Eq.		General Eq.	
		First Period	Steady-State	First Period	Steady-state
$\beta_a = 0.15$					
Skill accumulation	3.8193	4.2943	4.4958	4.2906	4.3181
Child labor	0.5983	0.0000	0.0000	0.0000	0.0000
Parental Transfers (received)	-0.1230	0.1277	0.1525	0.1276	0.1291
Income (GNP)	0.6097	0.5338	0.6115	0.5541	0.5696
Lifetime utility - Age-1 agent	-9.9224	-9.0891	-8.7836	-9.0962	-9.1877
Comp. Var. - Age-1 agent		16.9576%	24.3211%	16.7967%	14.7264%
$\eta_d = 0.2$					
Skill accumulation	4.7439	4.9835	5.0885	4.9819	5.0386
Child labor	0.1550	0.0000	0.0000	0.0000	0.0000
Parental Transfers (received)	0.2472	0.2977	0.3217	0.2973	0.3092
Income (GNP)	0.6282	0.6113	0.6490	0.6161	0.6387
Lifetime utility - Age-1 agent	-14.3914	-14.1821	-14.0521	-14.2171	-14.1838
Comp. Var. - Age-1 agent		2.6500%	4.3523%	2.1991%	2.6286%
$\sigma = .6$					
Skill accumulation	5.8370	6.0980	6.2158	6.1363	6.1712
Child labor	0.4002	0.0000	0.0000	0.0000	0.0000
Parental Transfers (received)	0.3264	0.4262	0.4573	0.4312	0.4980
Income (GNP)	1.0362	0.9947	1.0232	1.0015	1.0417
Lifetime utility - Age-1 agent	-12.8760	-12.7746	-12.6096	-12.8062	-12.4378
Comp. Var. - Age-1 agent		2.2850%	6.1570%	1.5648%	10.3992%

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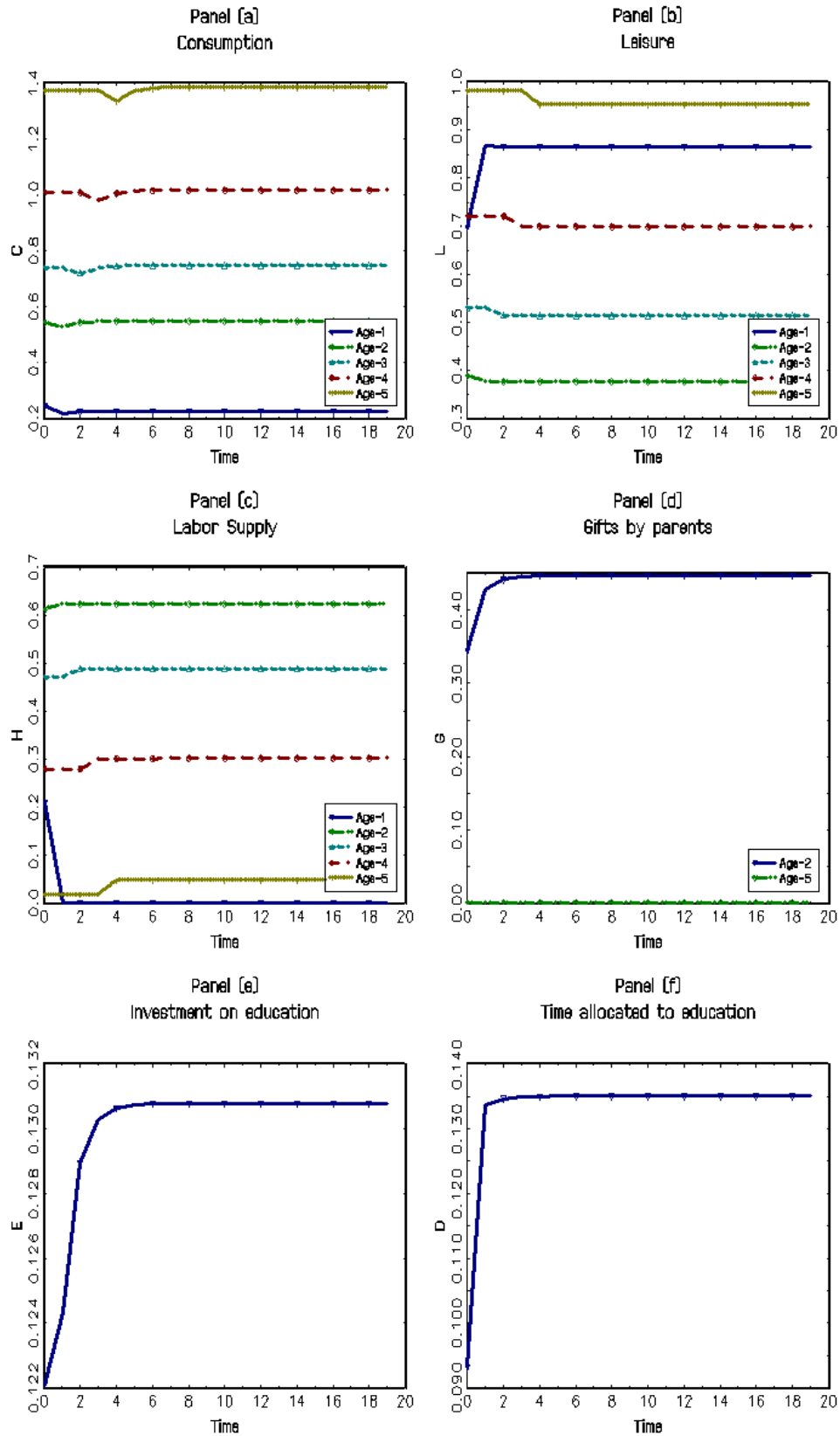
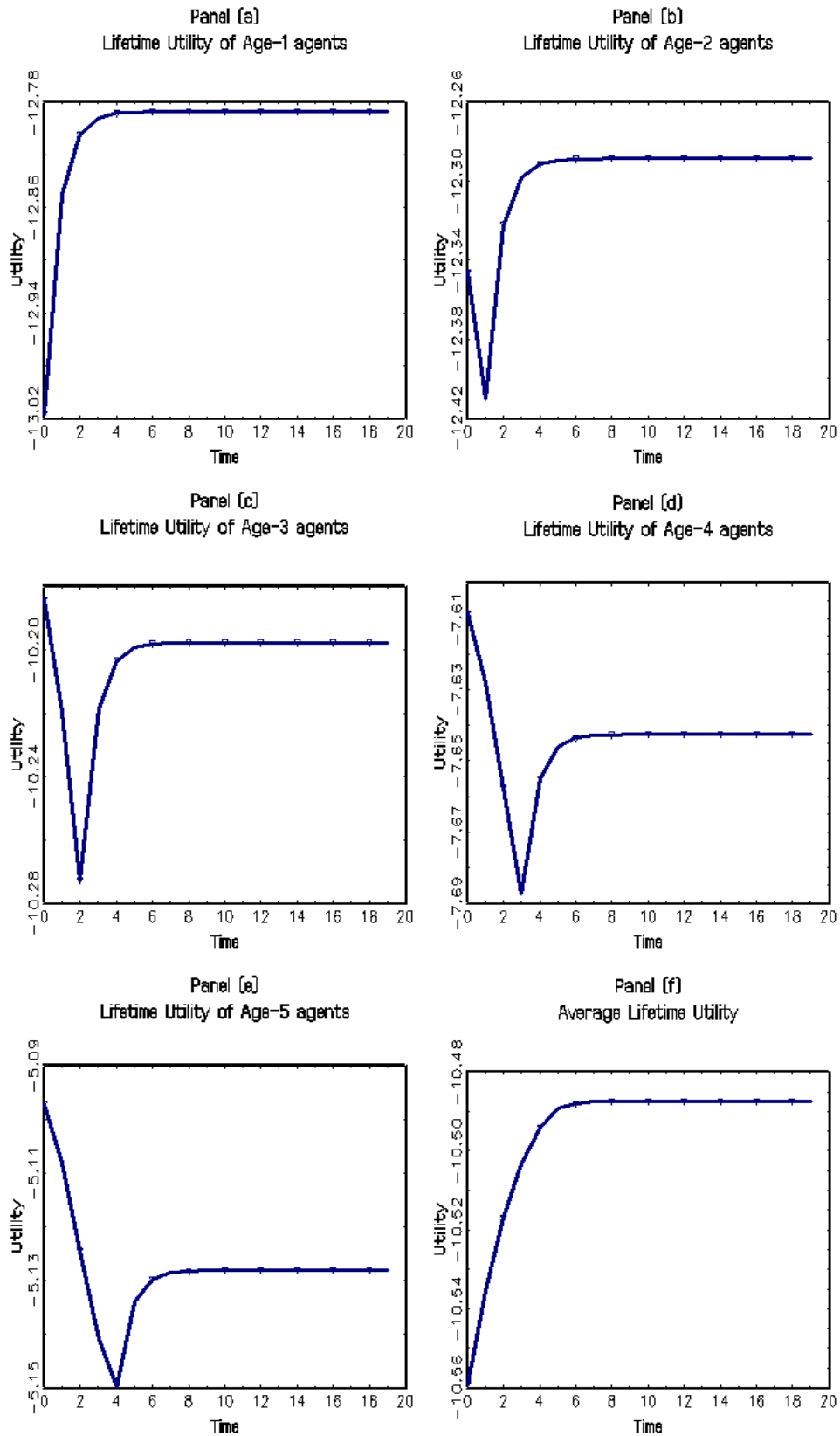Figure 1: Ban on Child Labor - Individual Variables along Partial Equilibrium Path

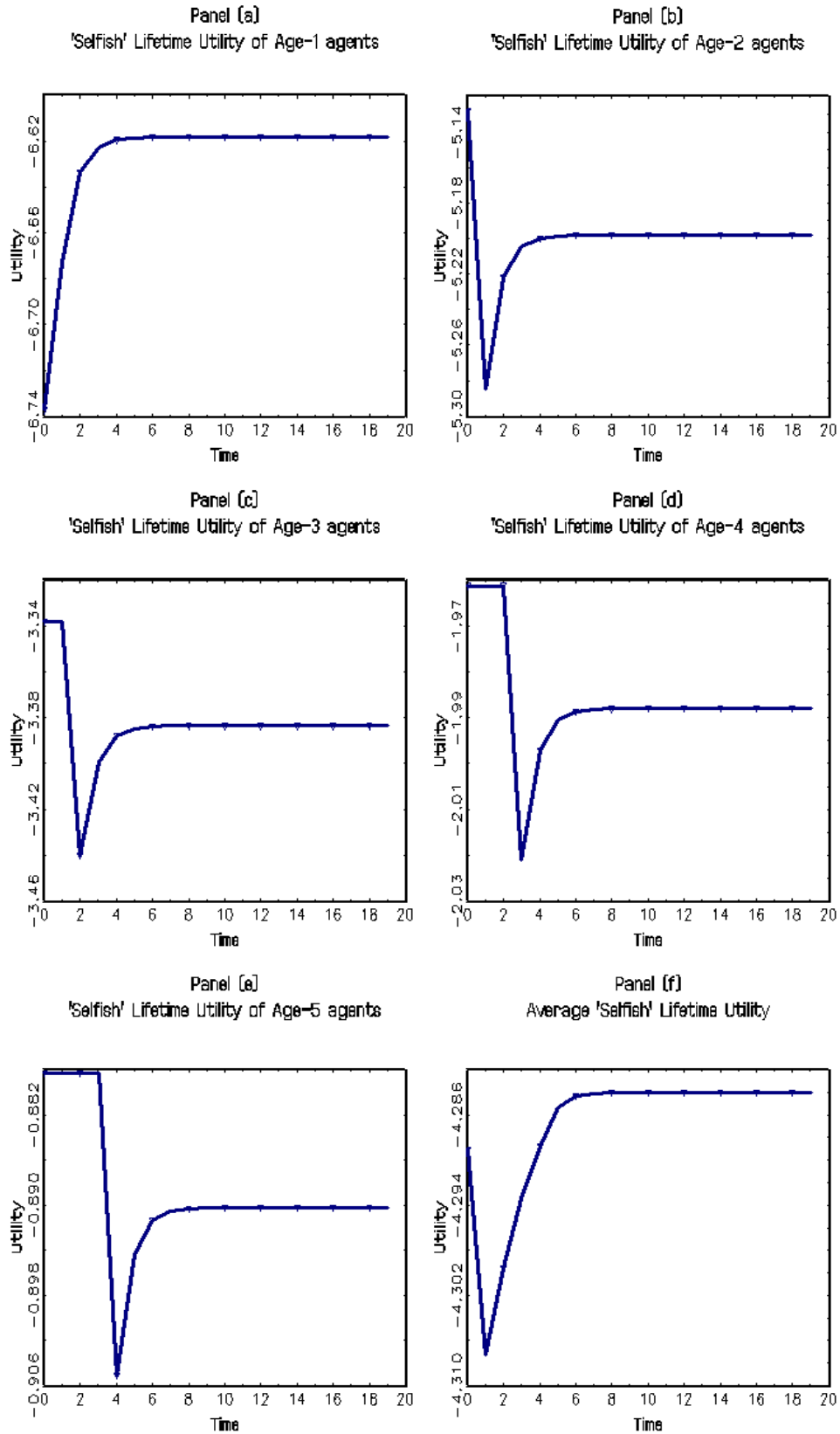Figure 2: Ban on Child Labor - Welfare Levels along Partial Equilibrium Path

Figure 3: Ban on Child Labor - "Selfish" Welfare Levels along Partial Equilibrium Path
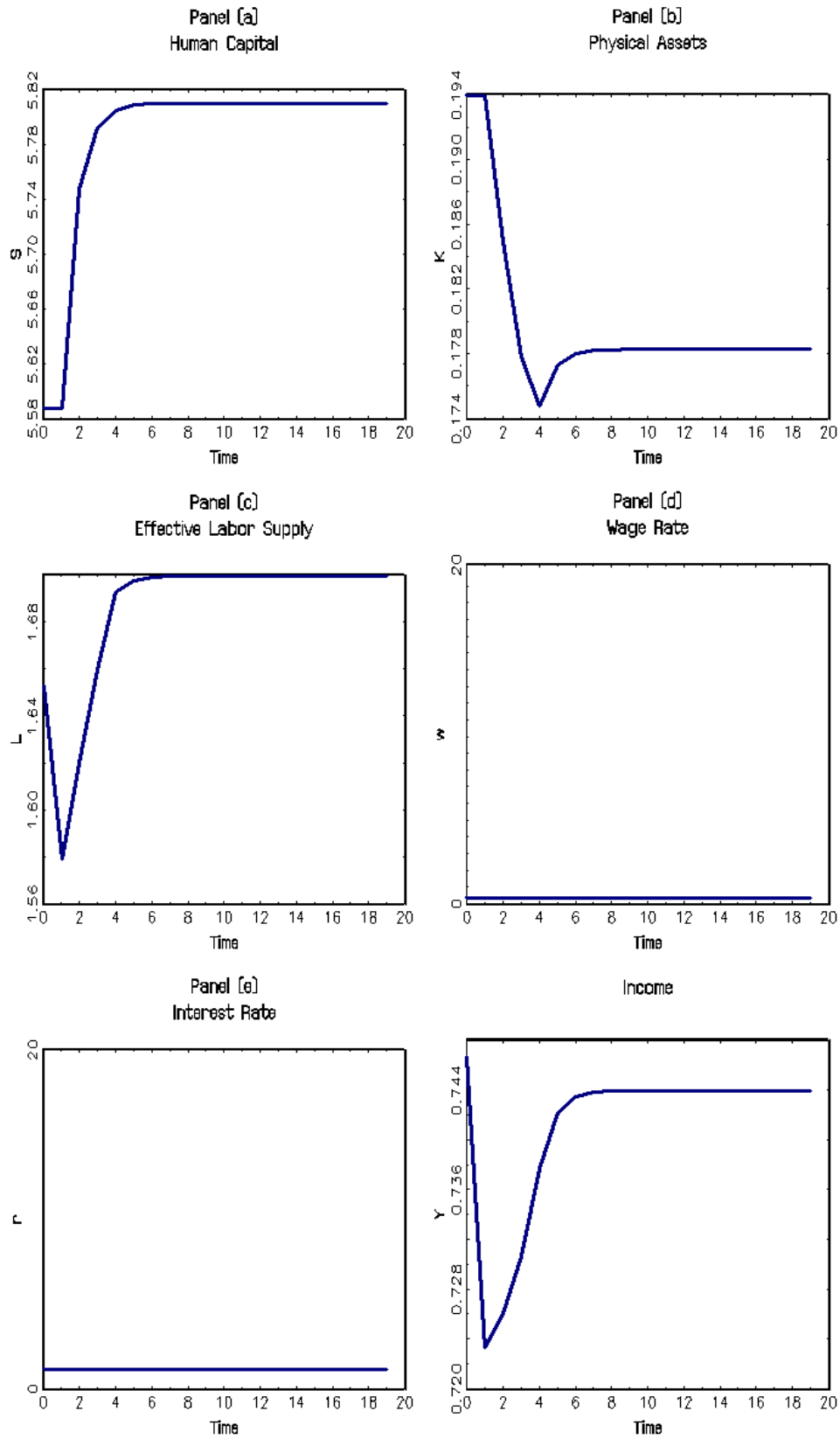
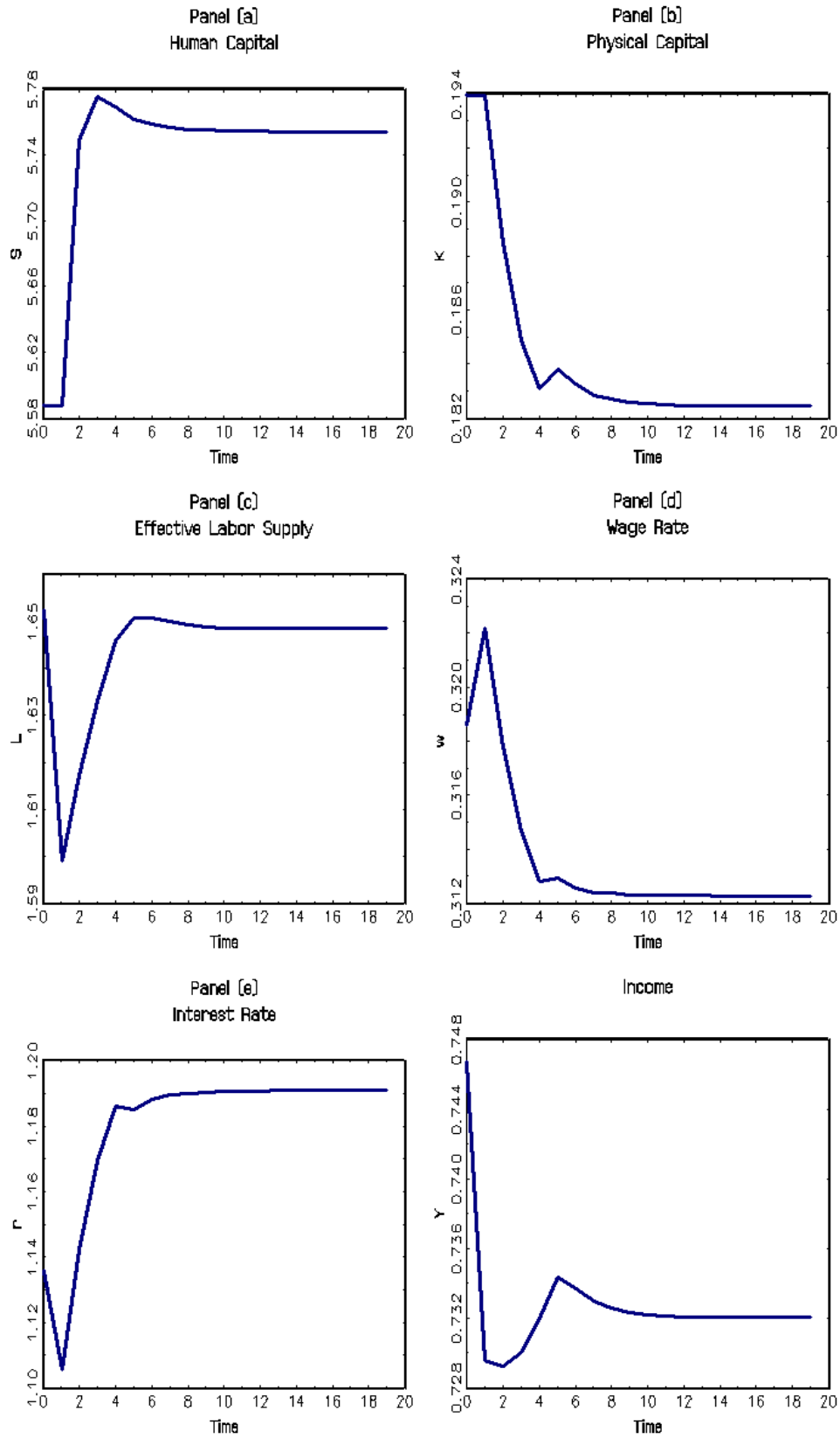Figure 4: Ban on Child Labor - Aggregate Variables along Partial Equilibrium Path

Figure 5: Ban on Child Labor - Aggregate Variables along General Equilibrium Path
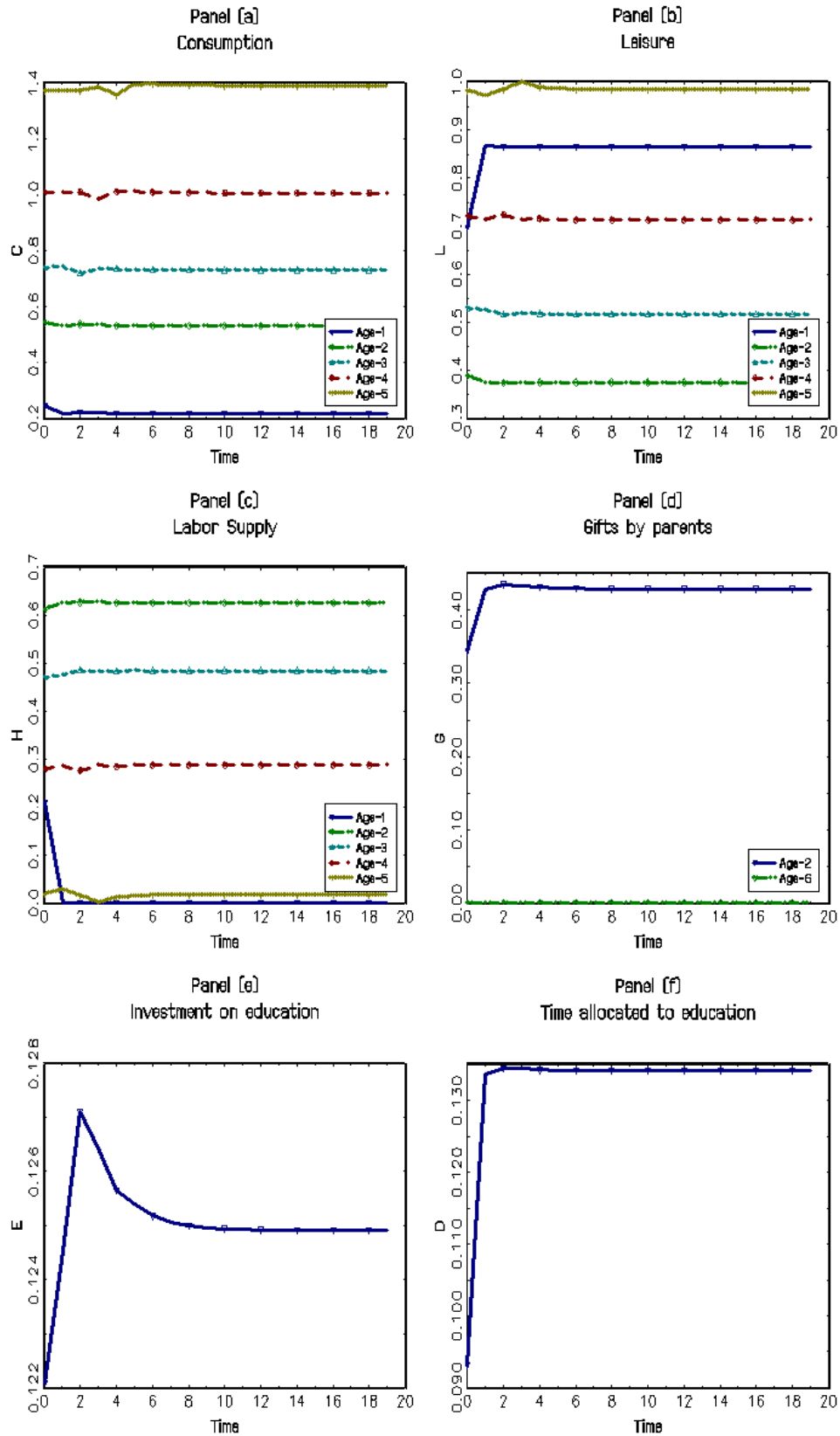
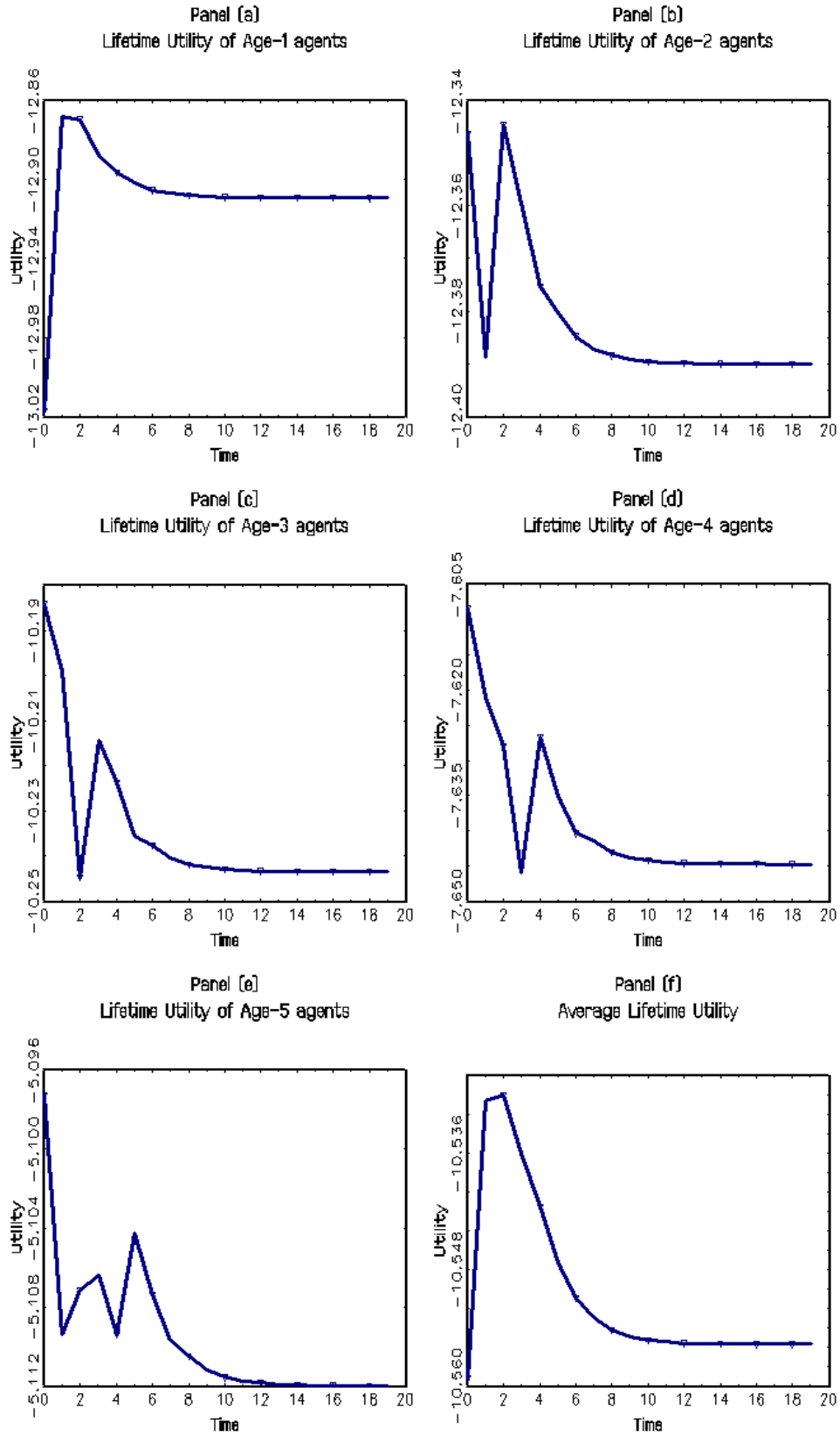Figure 6: Ban on Child Labor - Individual Variables along General Equilibrium Path

Figure 7: Ban on Child Labor - Welfare Levels along General Equilibrium Path