The Effect of Trade Liberalization on Child Labor*

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Abstract

The question of how trade liberalization affects the employment of children in developing economies is at the core of the debate on globalization. Trade theory predicts that an increase in the price of an exported good could either increase or decrease child labor depending on the magnitudes of the substitution and income effects. In this paper, we study the relationship between changes in the relative price of an exported commodity and child labor using household level panel data from within a poor country. In particular, we relate child labor to regional and intertemporal variation in the real price of rice surrounding national and international rice market integration in Vietnam. We find that higher rice prices are associated with declines in child labor. Income effects play an important role in this relationship. Rice price increases are associated with the largest declines in child labor in households that are large net producers of rice. These findings show that greater market integration can be associated with less child labor. Moreover, our results suggest that the use of punitive trade sanctions on exports from developing countries to eradicate child labor is unlikely to yield the desired outcome.

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1. Introduction

The effect of international trade on the employment of child labor in poor, predominately agricultural countries has stirred a heated debate.\(^1\) The opponents of globalization argue that market integration, by increasing labor demand, expands the earnings opportunities of children and thereby inevitably leads to more child labor. Some even propose the use of trade sanctions against the exports of countries with high levels of child labor as a way to eradicate child labor.\(^2\) However, the proponents of globalization point out that income gains associated with free trade could potentially reduce child labor if child labor is a bad in parental preferences as in Basu and Van (1999) or if households face credit constraints as in Baland and Robinson (2000) and Ranjan (2001).\(^3\)

At the heart of this debate is the relationship between movements in relative prices and child labor. Trade theory predicts that product market integration affects domestic labor markets through changes in relative product prices. Consequently, product price movements have been used extensively to estimate the potential effects of trade liberalization on labor markets (see Leamer and Levinsohn (1995), Hanson and Harrison (1999)). However, the existing empirical literature provides no evidence on how product prices affect child labor (see Basu (1999), Brown, Deardorff, and Stern (2001)).

In this study, we take the first step to empirically address the relationship between relative price movements of an exported good and child labor. We begin with a simple theoretical discussion of how trade liberalization (via relative price shifts) can affect child labor.

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\(^1\)For example, the current WTO negotiations in part focus on liberalizing trade in agriculture and bringing poor (primarily agricultural) countries into the world market. Krueger (1996) finds that most child labor occurs in countries with extremely low GNP per capita. However, the implications of market integration on well-being in these countries are poorly understood (Levinsohn, Berry, and Friedman (1999), Levinsohn (2002)).

\(^2\) See Maskus (1997), and Ranjan (2001) for theory on the impact of trade sanctions on child labor.

\(^3\) Although the effect of trade on a country's standard of living is ambiguous in theory, Frankel and Romer (1999) provide evidence that more open economies enjoy higher real income.
We consider an environment where households both produce and consume the product that will be exported after liberalization. This reflects the reality of many developing countries that export staples such as rice, corn, coffee, etc. Moreover, the model takes into account that almost all child labor occurs within households. The model suggests that the net effect of liberalization on child labor is ambiguous and depends on the substitution elasticity between child labor and the goods over which households have preferences (a pure substitution effect in consumption), how important child labor is in production (a pure substitution effect in production), and whether there is an income effect on child labor. Moreover, if there is a positive income effect on child labor, child labor should decline by more (or increase by less) in households that are large net producers of the liberalized commodity whose relative price has increased.

We next consider the link between relative price movements and child labor empirically by studying the response of child labor to changes in the price of rice in Vietnam during its episode of rice market liberalizations in the 1990s. Between 1993 and 1998 the real price of rice increased on average by almost 30% relative to the consumer price index in Vietnam. Brandt and Benjamin (2003) find that much of this increase in the relative price of rice can be attributed to international and national rice market integration. They highlight two policies as being particularly important. First, by 1998 Vietnam's rice export quota was no longer binding. Out of a concern for domestic food security, Vietnam imposed stringent export controls on its rice exports in 1989. Coupled with internal restrictions on the flow of rice across regions, these trade restrictions suppressed the domestic price of rice and lowered the relative incomes of rice producing households. The government gradually liberalized its export regime by increasing the

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4 In a series of surveys conducted in more than 30 developing countries in the late nineties, UNICEF found that most children work in agriculture or household production. The survey also reveals that, although much of the public attention focuses on the exploitation of children in manufacturing establishments, only 3 percent of working children work outside of their household. We find similar pattern in child labor in the household survey used in this study.
quota from less than 1 million metric tons in 1992 to a non-binding 4.5 million metric tons in 1998. Second, the government lifted internal barriers to rice trade across regions of Vietnam in early 1997. Thus, rice-producing communities could easily export their rice to other communities, raising the real price of rice in rice surplus communities. Because communities differ in the demand and supply of rice and the degree of integration into national and international markets, rice price changes vary across communities. Rice is the dominant commodity in the Vietnamese economy and the primary staple in the Vietnamese diet, so these rice price movements could at least in principle have an effect on child labor.

We relate this regional and intertemporal variation in the relative price of rice to variation in child labor using household level panel data on over 3,000 rural households collected in 1993 and 1998 from the Vietnam Living Standards Survey (VLSS). The basic idea behind our empirical approach is to compare changes in child labor across communities that experience different changes in the relative price of rice over time. Obviously, not all price changes in our data stem from product market integration. However, to the extent that trade liberalization affects the price of a commodity, our analysis illustrates the potential impact of integration on child labor. Moreover, the panel structure and the detail of our data enable us to control for unobserved differences across communities and households that may be correlated with changes in the relative price of rice and child labor. We consider the use of the household level panel data from within a country an attractive alternative to studies that consider the effect of globalization on various outcomes such as growth and inequality with cross-country data.5

Relying on cross-country data to evaluate the impact of trade on child labor might be problematic for several reasons. To begin with, differences in data definitions and collection

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5Several previous studies have relied on within-country data to explore a trade-related phenomenon. See Davis, Weinstein, Bradford, and Shimpo (1997) and Hanson and Slaughter (2001) as examples. Rodriguez and Rodrik (2000) provide a discussion of potential shortfalls of cross-country studies.
methods across countries often make it difficult to compare data across countries. Our data on child labor and relative rice prices are based on one data source and thus are more likely comparable across communities and time. Moreover, unobserved characteristics that might affect a spurious correlation between relative prices and child labor, thereby generating misleading results, are a more difficult problem across countries than within a country. Most importantly, the theory literature models child labor as an outcome of household decision making and the effects of relative prices on child labor vary across households depending on household exposure to relative rice prices. Thus, the relationship between child labor and trade should ideally be addressed with household level data.

We find that increases in the relative price of rice are associated with large declines in child labor. The observed 30 percent increase in the price of rice is associated with about a 9 percentage point decline in child labor in rural Vietnam. Moreover, our results emphasize the importance of accounting for the income effect of relative price changes. The response of child labor to rice price increases varies with household exposure to rice prices through production and consumption. Children in households with landholdings such that the household is a large net producer of rice experience especially large reductions in child labor. The observed income effect on child labor is sufficiently large in magnitude that even child participation in agriculture declines despite the increased earnings opportunities in agriculture that accompany rice price increases in households that are large net producers. In contrast, a negative income effect associated with higher rice prices actually increases child labor in households that are large net consumers of rice. However, land is sufficiently equitably distributed in Vietnam such that most households are positioned to gain from rice price increases. Overall, rice price increases can explain almost half of the decline in child labor in rural Vietnam between 1993 and 1998. Our
results suggest that trade liberalization, to the extent that it affects relative price movements, does not necessarily lead to an increase in child labor and can actually be associated with a decline in child labor. As a consequence, policies such as trade sanctions that limit or contract integration may, at least in the short-term, lead to higher levels of child labor.

The rest of the paper is structured as follows. Section 2 describes the model. Section 3 discusses the data. Section 4 describes our empirical methodology and presents the results. Section 5 concludes.

2. Theory Motivation

This section develops a descriptive model of how relative price movements affect child labor supply. This model captures two salient features of child labor and rice production. First, almost all child labor (97 percent) in Vietnam takes place inside the child's own household. This feature of child labor is not unique in Vietnam. In the late 1990s, UNICEF interviewed working children in 30 developing countries and found that only 3 percent of working children work outside of their household. Second, most households in Vietnam are exposed to rice price increases through both consumption (44 percent of food expenditure is on rice) and through production (98 percent of all communities in Vietnam produce rice).

The model encompasses three mechanisms for how relative price shifts affect child labor. First, there is a pure substitution effect in production. Relative price increases change the cost to the household of using child labor. Second, there is a pure substitution effect in consumption away from the more expensive good (rice) towards the relatively cheaper good (child leisure). Third, there is a terms of trade or net income effect that depends on whether the household is a net consumer or producer of the good (rice) that experiences a relative price increase. Theory
cannot predict the relative importance of these channels. Ultimately, how child labor responds to relative price shifts is an empirical question.

**Production**

Consider a household in a small open economy that produces an agricultural commodity \( a \) and a non-agricultural good \( n \). The production of both goods is characterized by a constant returns to scale production technology that uses child labor, \( L \), and land, \( K \), as factors of production. Let good \( n \) be the numeraire and denote the relative price of the agricultural commodity as \( p \equiv \frac{p_a}{p_n} \). Because all factors of production are employed within the household (i.e. not traded), we treat each household as a small open economy. Aggregate household income is then given by the revenue (restricted profit) function:

\[
I \equiv G(p,K,L) \tag{1}
\]

We assume \( G_p > 0, G_k > 0, G_L > 0, G_{pp} > 0, G_{kk} < 0 \) and \( G_{LL} < 0 \).6 Because our interest is in child labor supply, we do not explicitly model adult labor supply. It is implicit in the revenue function. The revenue function defines the household's demand for child labor. Define \( w \) to be the household's value of the marginal product of labor: \( w \equiv G_L(p,K,L) \). This is the inverse demand function for child labor in the household's production problem.

**Consumption**

Household welfare depends on household consumption of the agricultural \( a \) and non-agricultural \( n \) goods as well as child labor \( L \). Child labor is considered a bad. The indirect utility function of a household with respect to child labor is given by

\[
v(p,I,L) = u \left( \frac{I}{\beta(p)} \right) - h(L) \tag{2}
\]

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6 See Dixit and Norman (1980) for a nice discussion of the revenue function.
where $\beta(p)$ is the price index, $u$ is increasing and concave (i.e. $u'>0$, $u''<0$), and $h$ is increasing and convex (i.e. $h'>0$, $h''>0$). This set-up assumes separability between consumption and child labor and homotheticity of preferences over consumption goods $a$ and $n$.\footnote{Antweiler, Copeland, and Taylor (2001) use a similar indirect utility function in their study of trade and pollution.} For notational simplicity, define $R \equiv \frac{1}{\beta(p)}$. The child labor supply function follows out of the household's optimization problem:

$$\frac{\partial v}{\partial L} = u'(R) \frac{\partial R}{\partial L} - h'(L) = 0.$$  

Because  

$$\frac{dR}{dL} = \frac{1}{\beta(p)} G_L \equiv \frac{w}{\beta(p)},$$

the household's child labor supply function is defined by $w = \frac{h'(L)\beta(p)}{u'(R)}$.

The solution to the household's problem is to equate child labor supply with child labor demand. Thus, equilibrium is defined by:

$$G_L(p, K, L) = \frac{h'(L)\beta(p)}{u'(R)} \quad (3)$$

and is an implicit function of market prices, family resources, and tastes.

**The effect of trade liberalization on child labor**

Let us assume that the country is a small exporter of agricultural goods, but that the existence of trade and transportation costs drives a wedge between world and domestic prices. The domestic price of the agricultural product is given by $p^d = \frac{p^w}{\delta}$, where $p^w$ is the world relative price of the agricultural good, and $\delta$ is a measure of trade frictions. Because the country is a net exporter of the good $\delta>1$, and the movement of $\delta$ toward 1 implies trade liberalization and an increase in the domestic price $p^d$. Notice that the effect of an internal liberalization of restrictions on trade across communities is identical from the household's perspective to a lifting of external controls on the export of the agricultural commodity outside of the economy. Thus,
relative price movements can be used in general to study the effects of trade even if trade is not itself the sole source of relative price movements.

In order to consider the effect of trade liberalization (i.e. decline in trade cost $\delta$, an increase in $p^d$) on the incidence of child labor, we need to rewrite the household's problem in terms of the domestic price $p^d$. Then, totally differentiating the equilibrium condition (3) yields:

$$
\frac{h''(L)\beta(p)}{u'(R)}dL - \frac{h'(L)\beta(p)u''}{u'(R)^2}\frac{\partial R}{\partial L}dL + \frac{h'(L)\beta'(p)}{u'(R)}dp^d = \frac{h'(L)\beta(p)u''}{u'(R)^2}\frac{\partial R}{\partial p^d}dp^d = G_{LL}dL + G_{LP}dp^d
$$

Rearranging terms and plugging in for $\frac{\partial R}{\partial L}$ yields:

$$
(\frac{h''(L)\beta}{u'(R)} - G_{LL} - \frac{h'(L)u''G_{L}}{u'(R)^2})dL = \frac{h'(L)\beta u''}{u'(R)^2}\frac{\partial R}{\partial p^d}dp^d + (G_{LP} - \frac{h'(L)\beta'}{u'(R)})dp^d
$$

Define $\Delta \equiv (\frac{h''(L)\beta}{u'(R)} - G_{LL} - \frac{h'(L)u''G_{L}}{u'(R)^2})$. Note that $\Delta > 0$ by assumption ($G_{LL}<0$, $h''>0$, and $u''<0$). Thus the response of child labor to a change in the domestic price of the agricultural commodity is:

$$
dL = \frac{1}{\Delta} \left[ \left( \frac{h'(L)\beta u''}{u'(R)^2} \frac{\partial R}{\partial p^d} \right) dp^d + (G_{LP} - \frac{h'(L)\beta'}{u'(R)}) dp^d \right]
$$

Note that $\frac{\partial R}{\partial p^d} = \frac{\beta G_{p}-G_{\beta'}}{\beta^2} = \frac{G_{p}}{\beta} - \frac{G_{\beta'}}{\beta} \frac{1}{\beta}$. The derivative of the revenue function with respect to the price of the agricultural commodity is just output, $G_p = y_s$. Roy's identity implies that $\frac{G_{\beta'}}{\beta} = y_d$. Thus, $\frac{\partial R}{\partial p^d} = \frac{1}{\beta}(y' - y^d) = \frac{1}{\beta} m$ where $m \equiv (y_s - y_d)$ is the household's net production of the agricultural commodity. Plugging in, we get an expression for how child labor responds to a change in the relative price of an agricultural commodity:

$$
dL = \frac{1}{\Delta} \left[ G_{LP}dp^d - \left( \frac{h'\beta'}{u'(R)} \right) dp^d + \left( \frac{h'u''}{u'(R)^2} m \right) dp^d \right] \quad (4)
$$
This emphasizes three ways in which child labor may decline with an increase in the relative price of the agricultural commodity. The first term of (4) denotes the pure substitution effect in production towards or away from child labor. If we assume that agriculture is child labor intensive (i.e. wages rise as the relative price of the agricultural commodity increases), this term is greater than zero. The second term is the pure substitution effect in consumption towards child leisure. When the price of the agricultural good increases, the price index \( \beta(p) \) increases. Thus, \( h' \beta'/u'(R) \) is positive. The last term is the terms of trade or net income effect for the household. If the household is a net importer of the agricultural commodity (\( m<0 \)), then this term leads to an increase in child labor. If the household is a net exporter of agricultural commodity (i.e. \( m>0 \)), then the net income effect of an increase in the price of the agricultural commodity is to reduce child labor.

Overall, then, the net effect of a trade liberalization induced increase in the relative price of the agricultural commodity is ambiguous. The aim of the empirical work is to first identify the net effect of a relative price movements on child labor (e.g. \( dL/dp^d \)), then to separately identify the magnitude of the net income effect.

3. **Data description and preliminary evidence**

We examine the relationship between product prices in the rice sector and child labor using two rounds of the Vietnam Living Standards Survey (VLSS), a multi-purpose household survey. The two rounds of the VLSS span the period of rice market liberalization in Vietnam. The first round of the VLSS was conducted between September 1992 and October 1993 and the second round of the VLSS was conducted between December 1997 and December 1998. 115 rural communities are visited both in the first and second round of the VLSS, and our analysis focuses on children in these rural panel communities. This restriction leads to a sample size of
4,850 children ages 6-15 in the first round and 4,703 children ages 6-15 in the second round. At times, we restrict our analysis to children that reside in the 3,397 panel households from rural panel communities.8

Our analysis uses data from several parts of the VLSS. First, the VLSS includes a detailed price survey conducted in a community's market at the same time as the household survey. We use the consumer price of a kilogram of ordinary rice in 1993 and 1998 collected in the community price survey as our source of price variation.9 We deflate the price of rice with the monthly consumer price index so that all prices are in 000s of 1998 (January) Dong.10 Throughout this paper, whenever we refer to rice price changes, we mean changes in the real (deflated) price of a kilogram of rice. Second, the household survey includes information on the economic activities of each resident child between the ages of 6 and 15 within the last seven days. The VLSS documents whether each child works outside of the household for pay (cash or in-kind), works in agriculture for the household, works in a household business, or participates in household production activities such as collecting water and wood, building and maintaining the house and livestock enclosures, making or repairing tools, vehicles, and means of production, and household chores. We focus on an aggregation of these categories of work as a definition of child labor. Namely, a child engages in child labor if it works for seven or more hours per week

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8 Glewwe and Nguyen (2003) argue that the restricted sample of panel households appears nationally representative. They document a 90 percent retention rate. The present study primarily uses children in panel communities rather than panel households. In panel communities, missing households were replaced with randomly selected households.

9 We have also compared the prices reported in the price survey with the average community price based on unit values of purchased rice from the household survey. The correlation between the two is .68. Moreover, 6 communities do not report a price in at least one of the survey rounds. We have replicated the results of this paper omitting these communities, but in the present draft, we impute rice prices for these communities. Based on the unit value of rice purchased by households reported in the VLSS, we calculate the mean unit value of a kg of rice for a community in a given survey year. We regress the price of rice reported in the price survey on a third order polynomial of the mean unit value of rice in a community. We replace the missing price data with the predicted community price based on this regression.

10 One U.S. dollar corresponds to approximately 14,000 Dong in 1998. The price deflator does not vary by region, because we do not want the deflator to drive the variation in rice prices.
In household production or if the child works in agriculture, wage employment, or a family business.\footnote{This definition of child labor matches the definition employed by the International Labor Organization in many of its SIMPOC country studies. Moreover, it overcomes three main conceptual problems that would arise from failing to consider the activities performed by children in the production of nontradable goods (home production). First, when a child works outside of its household as a paid domestic servant or a slave that child is classified as a child laborer under the most stringent of definitions. Reclassifying the child's production activities as something other than work if the child's employer changes (even if it changes to a parent) seems arbitrary. Second, treating the production of nontradables as "not-working" makes it difficult to interpret the meaning of the state of "not working." For example, if home production is ignored in the definition of child labor, a child that stops limited work in a family business to take over extensive household responsibilities (say, because of the absence of a parent) would appear to stop working. Third, an assertion that child participation in the production of nontradables is not an economic phenomenon (or of economic interest) implies that including home production in a definition of child labor should attenuate our results. To the extent that participation in the production of nontradables varies with changes in the relative price of a market good, it clearly is of economic importance.} In addition to participation, we use the data on total hours worked in all these categories by a child during the last week. Unfortunately, between survey rounds the VLSS questionnaire changed how it collects information on time spent in agricultural work within the child's household (participation questions and hours in all other types of work are identical between rounds of the VLSS). This might affect the reported hours worked in agriculture and bias our results if changes in reporting are correlated with changes in rice prices in a systematic fashion. Finally, the survey also provides information on household annual cropland assignments and household net rice production in 1992/93. These data are used below to separate income and substitution effects in the framework of section 2.

Table 1 reports basic summary statistics for the data. The fraction of children working declines from 60 percent in 92/93 to 48 percent in 97/98. A decline in total hours worked accompanies this drop in participation. During the same time, the average domestic price of rice in rural areas increases by 27 percent relative to the rise in the consumer price index. The main goal of our empirical work in the next section is to examine whether these observed declines in child labor are associated with the observed increases in rice prices. Prior to that analysis, we consider the relationship nonparametrically. For each community, we compute the fraction of children working in 1993 and 1998 and subtract the 1998 mean from the 1993 mean to obtain the
decline in the share of children working in the community. We plot the decline in child labor in a community against the increase in the community real rice prices in figure 1. The regression line pictured in figure 1 is the result of a nonparametric (local) regression of the decline in child labor against the increase in rice prices where we have weighted observations by the number of children in each community in 1993. The figure suggests that rice price increases are associated with declines in child labor for most of the distribution of increases in the relative price of rice.\textsuperscript{12} Thus, an extreme outlier is not driving the results below. Moreover, when we turn to a parametric regression framework, we expect that small increases in rice prices are associated with declines in child labor.

4. Empirical Methodology and Results

The model in section 2 provides an ambiguous prediction on the overall sign of the relationship between child labor and rice prices depending on the relative magnitude of the income and substitution effects. In addition, the model suggests that households that vary in their exposure to rice prices as producers and consumers experience differential changes in child labor. In this section, we begin our empirical analysis by examining the overall association between rice prices and child labor. We next focus on separately identifying the magnitude of the net income effect of rice prices on child labor.

4.1 Overall relationship between rice prices and child labor

We consider the relationship between child labor and rice prices using a linear probability model.\textsuperscript{13} For a child \( j \) in community \( i \) at time \( t \), we estimate:

\[
y_{ijt} = \beta_i R P_{it} + \alpha_1 X_{jt} + \alpha_2 T_i + \lambda_i + \epsilon_{ijt}.
\]

\textsuperscript{12} The correlation between rice prices and the probability of child labor is also negative when we consider the 1993 and 1998 cross section separately.

\textsuperscript{13} Alternatively, we could use a probit model. Our conclusions are not sensitive to the choice of assumption about the regression error distribution.
$y$ is the indicator for whether the child engages in child labor and $RP$ is the natural logarithm of the real price of a kilogram of ordinary rice.\(^{14}\) The coefficient on rice prices $\beta_1$ is the change in the probability that a child works associated with a 1 percent increase in the price of rice. Several features of this framework should be highlighted. First, the probability a child labors might differ across children because of differences in the gender and age. We control for gender and age differences using a third order polynomial in child's gender and age and all of their interactions. Second, child labor and rice prices might vary across seasons. We control for seasonal variation in rice prices and child labor by including season indicators in our regression. In addition, we control for the harvesting time by an indicator that is one if the interview took place during the harvest. We similarly control for the planting period. These factors (and a constant) are represented in vector $X$. Third, economy-wide time differences in the probability a child works are captured by a year indicator $T$ that is one if the survey year is 1997/98 (1992/93 is the omitted year). Finally, communities vary in the availability of schooling, school quality, returns to education, labor market conditions, land and resource endowments, and integration into the Vietnamese economy. These community characteristics might independently affect the relative price of rice and child labor and bias our estimate of the relationship between child labor and rice prices. To the extent these community characteristics are time-invariant, their effects are captured by community fixed effects $\lambda$ in (5). Our analysis thus compares changes in the probability that a child works across communities experiencing different price changes over time. All standard errors are corrected for heteroskedasticity and clustering at the community (commune - psu)/survey round level.

\(^{14}\) The findings in this paper are not sensitive to the choice of including prices in logs or levels.
Table 2 provides the basic results. Column 1 presents estimates of $\beta_1$ and $\alpha_2$ from (5). We find a positive and significant association between increases in rice prices and declines in child labor. The magnitude of the association is large. A 30 percent increase in price of rice is associated with an almost 10 percentage point decline in child labor. Moreover, rice prices changes are significant in explaining the overall decline in child labor observed in rural Vietnam. Conditional on rice prices (and other controls), the coefficient on the year indicator is -.104. This coefficient increases in absolute value to -.188 when we exclude rice prices from the regression in (5). Thus, rice price increases can account for 45 percent (i.e. (.188-.104)/.188) of the decline in child labor in rural Vietnam between 1993 and 1998.

The obvious concern with the finding that increased rice prices are associated with less child labor is whether we can interpret this positive correlation as a causal effect of rice price movements on child labor. In the model in section 2, the relative rice price changes are driven by exogenous factors (i.e. factors that do not affect child labor independent of rice price changes). Obviously, in the empirical work, the observed declines in child labor with rice price increases could simply reflect unobserved, time-varying, community-specific shocks that affect both rice prices and child labor but have nothing to do with the link between the two. Let us first clarify the nature of the time-varying factors that concern us. Differential changes in the price of rice across communities might be driven by supply or demand shocks to local rice markets. If there is a causal effect of rice prices on child labor, these supply and demand shocks will be associated with a change in child labor. This is the type of variation that we wish to exploit. For example, some communities improve their roads between 1993 and 1998. Setting aside the concern that these road improvements may be financed by additional rice income, improved roads facilitate a community’s integration into rice markets and thereby increase rice prices. We
wish to capture the effect of these increased prices on child labor. However, we do not want our measure of the effect of rice prices on child labor to reflect an effect of improved roads on child labor that has nothing to do with rice price increases. The latter is the spurious correlation that concerns us.

We are mostly concerned about two sources of a spurious correlation between rice prices and child labor. First, rice price increases vary across regions in Vietnam. Benjamin and Brandt (2003), for example, show that regions account for 56 percent of the variation in changes in rice prices between 1998 and 1992. Likewise, regions differ in both the types and scope of the reforms experienced in Vietnam in the 1990s. Further, regions may be segmented somewhat so that it is difficult for labor to move easily between them. Hence, changes in the returns to schooling may vary across regions.¹⁵ These unobserved, region-specific, time-varying shocks could potentially bias the link between child labor and rice prices. We control for them by including the interactions of each region indicator with a year indicator in (5).¹⁶ Second, rice price increases vary with a community’s accessibility. More accessible communities might experience larger rice price changes, because they are more integrated into regional and international markets. Likewise, children in more accessible communities might have better access to schools or employment opportunities. In the VLSS, we measure accessibility by an indicator for whether regular transportation is available to a community and an indicator for whether the road to a community is paved.¹⁷ We interact these accessibility measures with year indicators to allow for a different change in child labor in accessible communities in (5).

¹⁵ Foster and Rosenzweig (1996) find changes in the return to education to be a primary determinant of changes in educational enrollment in Green Revolution India. Glewwe and Jacoby (2001) rule out differential changes in the return to education as an explanation for increases in school enrollment in Vietnam. Instead, they find that increases in household income drive Vietnam's increases in secondary school enrollment.
¹⁶ There are between 4 to 35 sampled communities per region (the mean and median are both 25 communities per region).
¹⁷ Data on accessibility (and infrastructure in general) is only available in the 1998 survey.
Estimates of (5) with additional controls that allow trends in child labor to vary with regions and community accessibility conditional on rice price changes are reported in column 2 of table 2. Note that heterogeneity in rice price changes within regions or across accessible communities still allows us to identify an effect of rice prices on child labor. If there is spurious correlation between rice price changes and child labor associated with accessibility or regional differences, we should observe a significant change in our estimates of the effect of rice prices on child labor, but column 2 estimates of the coefficient on rice prices are well within the 95 percent confidence interval of the coefficient in column 1.

Although we are mostly concerned with region-specific and community accessibility related time-varying unobserved shocks, we nonetheless consider other sources of time-varying factors that could affect our results. First, infrastructure improvements might be an additional source of omitted heterogeneity driving the relationship between child labor and rice prices. Van de Walle (1998) finds that public infrastructure (and in particular, irrigation) improvements could dramatically enhance living standards in Vietnam. The 1998 community survey asks whether the community has experienced any infrastructure improvements since the 1993 in roads, irrigation, health facilities, electricity, schools, and "other" public infrastructure. In estimation, we allow communities to experience differential changes in child labor through time with each of these infrastructure improvements. We do this by including an interaction of whether the community experiences each type of infrastructure improvement between 1993 and 1998 with the year effect. Second, child labor might change differentially over time in communities that experience pest problems, natural disasters, or use high-yields seeds. As a result, we control for whether the community has experienced a flood, draught, pest problem,

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18 The 1998 questionnaire asks whether there have been improvements in any of the listed types of infrastructure. It does not distinguish between new infrastructure and physical or quality improvements in existing infrastructure.
typhoon, or other natural disasters in the last year in the regression. We also observe whether the community uses high yield seed varieties of rice in 1998, and include this in the regression by interacting it with the year indicator. Moreover, we allow for differential changes in child labor on the province level. There are 61 provinces in Vietnam, and there are on average two communities per province in the VLSS data. Hence, including province*time indicators controls for considerable location specific time-varying factors. The estimates of equation (5) that include infrastructure controls, controls for agricultural characteristics, community accessibility indicators, and province-year indicators are presented in column 3 of table 2. Our estimate of the relationship between child labor and rice prices is within a 95 percent confidence interval of our estimate in column 1. Overall, we do not find any evidence in table 2 that suggests that spurious correlation drives the relationship between rice prices and child labor.

Finally, we also repeat our analysis from column 3 using total hours worked in a week rather child labor participation as a dependent variable. A large share of observations reports zero hours worked. We report both OLS and Tobit estimates of the relationship between hours worked and rice prices in columns 4 and 5 respectively. The data suggest a negative association between hours worked and rice price increases. The OLS estimates in column 4 suggest that a 30 percent increase in the price of rice is associated on average with a 2.5 hour decline in total hours worked in a week. This corresponds to a 19 percent decline in hours worked over the 1993 base. Unfortunately, as discussed in section 3, the VLSS changed the way it collects information on time spent in household agriculture between the survey rounds. This might affect the reported hours worked in agriculture (and thus total hours worked) in 1998. The year effect potentially controls for this questionnaire change. However, the results based on total hours worked could still be biased if changes in reported hours are correlated with changes in rice prices in a
systematic fashion. As a result, the results in columns 4 and 5 should be interpreted with caution.

In sum, this section suggests a negative relationship between product price increases and child labor. The data do not contain any suggestion that these results are driven by likely sources of spurious correlation between child labor declines and rice price increases. The estimates are economically significant: a 10 percent increase in the relative price of rice is associated with a 3 percentage point decline in the probability that a child works. Our results imply that the observed 30% increase in the average price of rice leads to about 9 percentage point decline in the probability that the child works. Overall, increases in rice prices explain 43 percent of the 19 percentage point decline in child labor in rural Vietnam between 1993 and 1998. These findings suggest that greater product market integration can be associated with less child labor.

4.2 Net Income Effect of Rice Prices on Child Labor

The model in section 2 implies that the association between rice prices and child labor depends on a household’s exposure to rice prices through production and consumption. In particular, everything else equal, higher rice prices should be associated with declines in child labor in households that are large net producers of rice and increases in child labor in households that are net consumers of rice. In order to investigate the net income effect of rice prices on child labor, we augment equation (5) and allow the relationship between rice prices and child labor to vary across households with household net production in 1992/93. For a child \( j \) in household \( h \) resident in community \( i \) at time \( t \), we estimate:

\[
y_{iht} = \beta_1 R_{it} + \beta_2 R_{it} * M_h + \alpha_1 X_{ijht} + \alpha_2 T_t + \lambda_i + \mu_h + \epsilon_{iht},
\]

\( M_h \) denotes household net production in 1993, \( R_{it} * M_h \) is the interaction of rice prices with household net production in 1993, \( \mu_h \) is a household fixed effect, and all other notation follows
the notation in equation (5). With household fixed effects, we cannot include household net production in 1993 independently in the regression because it does not vary within household through time. However, the inclusion of the household fixed effects controls for the impact of observable and unobservable time-invariant household characteristics (including the direct effect of $M_h$) on child labor. $\beta$ is the change in the probability a child works associated with a 1 percent increase in rice prices in a household with no net production of rice (the net effect of both substitution effects), $\beta_2 * M_h$ is the extra increment in the probability a child works associated with the rice price increase in a household with net production of $M_h$. In the framework of section 2, $\beta_2 * M_h$ provides an estimate of the income effect of rice prices. Note that the model predicts that $\beta_2$ should be negative, so that $\beta_2 * M_h$ is negative for net rice producers (i.e. households with $M_h > 0$) and positive for net price consumers (i.e. households with $M_h < 0$).

The identification of income and substitution effects is developed in section 2 for households that are exposed to rice through both production and consumption. Thus, we limit our analysis to children in the 92 percent of sample households that hold annual cropland in the first round of the VLSS. The results are reported in table 3. In column 1, we reestimate (5) with the sample of households that hold annual land. The coefficient on rice prices is -.28, similar to the coefficients in table 1. The estimated coefficients on rice prices and the interaction of rice prices with net production from (6) are reported in column 2.

Several interesting findings emerge. First, the coefficient $\beta_2$ on the interaction of rice prices with household net production is negative and significant. The negative sign is exactly what the theory predicts: everything else equal, rice price increases are associated with declines
in child labor in households that are net producers of rice (i.e. $\beta_z * M_h$ is negative for net rice producers) and increases in child labor in households that are net consumers of rice (i.e. $\beta_z * M_h$ is positive for net rice consumers). Moreover, differences in net production are associated with large differences in how households respond to rice price increases. Moving from the 10th to the 90th percentile of the net production distribution more than doubles the decline in child labor associated with an increase in rice prices.19

Second, the coefficient on rice prices drops from -.28 in column 1 (that does not condition on net production) to -.19 in column 2 (that conditions on net production). Theory yields ambiguous predictions on the sign of the coefficient on rice prices conditional on net production. The negative coefficient on rice prices could reflect that parents substitute towards the consumption of child leisure as rice becomes relatively more expensive (i.e. pure substitution effect in consumption). Alternatively, this negative coefficient may reflect a substitution effect away from child labor in production. This could occur because our definition of child labor includes work in household production, work outside household, and work for household nonfarm business in addition to work in agriculture.20 Most children work either in agriculture or in household production. Although agriculture is child labor intensive relative to household nonfarm business activities, the data suggest that agriculture is actually less child labor intensive than household production. Thus, the overall labor demand for child labor could decline after rice price increases.

To explore this further, we estimate equation (6) separately for work in agriculture and work in household production activities. Results for participation in agriculture and household

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19 Table 1 reports summary statistics on net production and landholdings.
20 Household production activities are defined in the dataset as collecting water and wood, building and maintaining the house and livestock enclosures, making or repairing tools, vehicles, and means of production, and various household chores.
production are in columns 3 and 4 of table 3, respectively. Consistent with the idea that rice price increases lead to different changes in household labor demand in agriculture and household production, the coefficient on the rice price is negative in the case of household production and positive (albeit insignificant) in the case of agricultural work. Moreover, the coefficient on the interaction of rice prices with net production is negative and significant in both regressions, which again confirms the importance of the income effect. That is, everything else equal (including substitution effects), higher rice prices are associated with less child labor in agriculture and household production in households that benefit from rice price increases as net rice producers. In addition, in column 5, we estimate equation (6) for participation in market work (defined as work in agriculture, work for household nonfarm business, or work outside the household). This definition of work abstracts from household production. As in the case of agriculture only, we find that the coefficient on rice prices is positive (albeit insignificant). Moreover, the negative and significant coefficient on the interaction of rice prices with net production confirms the importance of the income effect. These results illustrate that even in sectors directly experiencing growth as a result of relative price movements (or product market integration), income effects can be large enough to affect a decline in child labor.

Given that child labor in agriculture may increase with increased earning opportunities for children in agriculture (i.e. the coefficient on rice prices conditional on net production is positive), the question arises which households experience declines in agricultural child labor. Overall, the increases in rice prices are associated with declines in child labor in agriculture in households that have net production greater than 2.3 thousand kg of rice per year, which corresponds to households above the 82nd percentile of the net production distribution. However, column 2 suggests that overall child labor actually declines throughout all but the
bottom percentile of the net production distribution despite these increases in agricultural work in most households.

The above analysis allows the change in child labor with rice price movements to vary across households based on household net production in 1993 rather than contemporaneous net production \( (M_h \) rather than \( M_{ht} \)). Because equation (6) conditions on household fixed effects, an empirical specification that interacts rice prices with \( M_{ht} \) in (6) would identify the coefficient \( \beta_2 \) based on changes in net production. If household production depends on own-household labor supply (as in a non-separable farm household model like Strauss 1986) or rice consumption depends on work effort, then changes in child labor could drive changes in net production. Thus, endogeneity bias is a concern.

By interacting rice prices with net production in 1993, we avoid endogeneity problems caused by changes in net production. Instead, our identification requires that 1993 household net production is exogenous to factors associated with changes in child labor between 1993 and 1998 (conditional on time invariant household characteristics and seasonal, age, and gender patterns in child labor). Thus, the endogeneity bias is not at issue because it seems unlikely that households would choose their net production in 1993 in anticipation of changes in child labor 5 years hence. Rather, our main concern is that net rice production in 1993 proxies for some household characteristic (other than exposure to rice price movements) that is associated with larger declines in child labor in communities that experience larger rice price increases.

This concern is not borne out in the data. First, one might potentially worry that the coefficient \( \beta_2 \) simply captures the fact that households with greater net rice production in 1993 are wealthier and thereby better positioned to experience declines in child labor through time. However, wealthier households experience smaller declines in child labor between 1993 and
1998 in Vietnam (Edmonds 2002). Moreover, there is no apparent correlation between household expenditure per capita in 1993 and net rice production in 1993 (the correlation coefficient is 0.006). Second, the empirical evidence in section 4.1 suggests that the association between rice price movements and child labor is not driven by some omitted time-varying community attribute. Consequently, any interpretation problem associated with the coefficient \( \beta \) on the interaction of \( M_h \) and rice prices would likely stem from time variation in child labor associated with \( M_h \). In order to examine this possibility, we consider whether child labor patterns vary through time with \( M_h \) in communities that experience small rice price changes (i.e. less than a 10 percent change in rice prices). In particular, we regress the child labor indicator on all the controls in (6) except for rice prices. Instead, we include the interaction of the year indicator with net production in 1993, \( M_h \). This framework enables us to test the hypothesis that changes in child labor are not associated with net production in 1993 in the absence of large rice price increases by testing whether the coefficient on the interaction is different from zero. The data fail to reject our assumption that household net production in 1993 is unrelated to changes in child labor absent large rice price changes.\(^{21}\)

Finally, variation in net production in 1993 across households appears to be driven by household land assignments under the 1988 land redistribution program.\(^{22}\) 40 percent of the variation in net production in 1993 can be explained by household land assignments during the 1988 reform. As of 1993, households did not have the ability to transfer the assigned land under the 1988 land redistribution. In this sense, household land assignments under the land law do not represent a household choice. Thus, a possible robustness check is to use household land assignments under the 1988 land law as a control variable.

\(^{21}\) The coefficient on the interaction of net rice production with the year indicator is 0.001 with a t-statistic of 0.21.

\(^{22}\) The decollectivization of agriculture in Vietnam in 1988 was accompanied by a land redistribution program that assigned households long-term use rights. Implementation of the law was decentralized so that local authorities had considerable discretion about how land was allocated across households in 1988 (Ravallion and van de Walle 2001).
assignments as an instrumental variable for net production in 1993. Because of the strong correlation between net rice production in 1993 and household land assignments, our results do not change substantively with this robustness check.

We begin by examining the reduced form relationship between land assignments and child labor. That is, we estimate (6), but include the log of the household's holdings of assigned annual land (as reported in the 1993 survey) rather than net production. Column 1 of table 4 contains these results and documents two interesting findings. First, the coefficient on rice prices is positive .61 (albeit it is statistically insignificant). Second, the coefficient on the interaction of rice prices with land holdings is negative and significant. This suggests that, everything else equal, households that hold proportionately more land and thus have greater potential to benefit from rice price increases experience larger declines in child labor. At median landholdings, a 30 percent increase in the price of rice is associated with 8 percentage point decline in child labor. Moreover, increased rice prices are actually associated with increases in child labor in households with annual landholdings in the bottom 3 percent of the landholdings distribution. Children living in households with large landholdings face the largest reductions in child labor. For example, a 30 percent increase in the relative price of rice is associated with almost 3 percentage points greater decline in child labor for children living in a household in the 75th percentile of the annual landholding distribution relative to children living in the household at the 25th percentile of the landholdings.

To examine the robustness of our results in table 3, we instrument for the interaction of net production and rice prices in equation (6) with the interaction of rice prices and the log of total annual landholdings. The first stage results are column 2 of table 4. For the interaction of rice prices and land assignments to be a valid instrument, it needs to be strongly correlated with
the interaction of rice prices and net production in 1993. The F-statistics associated with the null that the instruments are jointly insignificant in the first stage is 89.04. This reflects the strong link between household annual landholdings and net production.

The second assumption necessary for the interaction of rice prices and landholdings to be a valid instrument for the interaction of rice prices and net production in 1993 is that the instrument has no effect on child labor except through the interaction of rice prices and net production. Notice that this is not the same as an assumption that landholdings have no effect on child labor except through net production. We do not need the latter assumption, because the direct effects of both landholdings and net production on child labor are captured by the household fixed effect that is included in both first and second stage regressions. Column 3 of table 4 presents the 2SLS results. The coefficient estimates are virtually the same as those in column 2 of table 3. Moreover, columns 4, 5, and 6 present 2SLS results for work in agriculture, work in household production, and market work, and yield similar conclusions as the results in table 3.

In sum, the previous section found a robust negative relationship between child labor and rice prices. The evidence in this section suggests that these average effects vary across households based on household net production and landholdings. In particular, everything else equal, higher rice prices are associated with declines in child labor in households that are net producers of rice and increases in child labor in households that are net consumers of rice. This is exactly what the model in section 2 predicts. Similarly, we find that rice price increases are

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23 One possible source of trouble for our identification assumption is if the value of child time changes with the interaction of rice prices and landholdings. Thus, we have (in unreported regressions) included measures of child and adult wages (as in Edmonds and Pavcnik 2002) or a proxy for the value of child time in the household (as in Appendix 3 of Edmonds 2002). In practice, given the strong correlation between land assignments and net production, the inclusion of these controls has no effect on our second stage results. Thus, we do not include them in the results in table 4 and keep the regressions in identical form to those in table 3.
associated with larger declines in child labor in households with larger landholdings. Overall, our results emphasize the importance of accounting for the income effects of relative price changes when considering the effects of market integration on child labor.

5. Conclusions

This paper provides some empirical evidence on the relationship between product market integration and the incidence of child labor in poor, relatively unskilled-labor abundant economies through exploiting regional and intertemporal variation in the relative price of an agricultural staple. We find that in the present case, increases in the relative price of rice result in declines in child labor. A thirty percent rise in the relative price of rice (as experienced in Vietnam) is associated on average with a 9 percentage point decrease in child labor. Rice price increases can account for 45 percent of the decline in child labor experienced in rural Vietnam between 1993 and 1998 in Vietnam. In considering the mechanisms through which rice prices affect child labor, our results suggest the households that are net producers of rice and households better endowed with land experience larger reductions in child labor when rice prices increase.

Because relative price changes are at the core of the debate on child labor and globalization, this study has several policy implications. First, the increased earnings opportunities associated with globalization for children working in export-oriented sectors do not necessarily lead to more child labor. In the present case, households that are large net producers of rice appear to have taken advantage of higher income after the rice price increase to reduce child labor despite increased earnings opportunities for children. The pure income effect is large enough that child work declines in agriculture in households that are large net producers of rice. Second, many globalization opponents and trade policy-makers advocate that higher income
countries employ trade sanctions to force domestic policies in poor countries to eradicate child labor. These trade measures likely lower the price of the exported good, so our results suggest that sanctions could instigate more rather than less child labor.\textsuperscript{24} Our results are also consistent with a model by Ranjan (2001), where trade measures not only lower the returns to child labor, but also adversely affect adult income (or how credit constrained households are), and hence increase the incidence of child labor. Third, the impact on child labor of punitive trade sanctions against a country's exports depends on the distribution of the resources used in production of the exported good. In the present case, rice production is so widespread in Vietnam (most household produce rice directly or as hired labor) that the lower prices of the exported good associated with trade sanctions would affect most households. It is possible to imagine a world where production was so concentrated that the "costs" of any such sanctions were restricted to a relative minority. Finally, the sign of the effect of international market integration on local prices is obviously of great importance. Integration lowers prices of import-competing goods and might have different implications for child labor in households associated with the production of an import-competing product. However, as in the present case, most child (and adult) labor in poor, relatively unskilled labor abundant economies occurs in either nontraded sectors or export-oriented sectors. Integration leads to higher prices in export sectors. These price increases appear to be associated with a substantial reduction in child labor in the Vietnamese households studied in this paper.

\textsuperscript{24} It is possible, of course, that punitive sanctions may induce countries to adopt reforms that benefit children in the long run. Opponents of globalization often advocate sanctions to induce official bans on child labor. Whether or not these benefit children is an open question. Vietnam was one of the first countries (in the late 1980s) to officially ban all forms of child labor.
References


Figure 1: Community Level Rice Price Increases and Declines in Child Labor
Table 1: Descriptive Statistics for Rural Children 6-15 and their Households

<table>
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</tr>
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</tr>
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<tr>
<td>75th Percentile</td>
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<td>90th Percentile</td>
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<td>Ln(Total annual landholdings)</td>
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Notes: Sample restricted to children 6-15 in rural households in communes visited in both survey rounds. All means weighted to reflect sample design. Net production and total landholdings are based on 1992/93 data. Net rice production is in 1000s of kg in last 12 months. Rice prices are deflated by the monthly national consumer price index to be in 000s of Jan 98 Dongs.
Table 2: Child Labor and Rice Prices, Basic Results
Children 6-15 in households in rural panel communes

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Notes: Columns 1-3 are estimated using linear probability model. Column 4 is estimated using OLS. Column 5 is estimated using Tobit. All regressions also include a constant. Robust standard errors, corrected for psu/time clustering, in brackets.

* significant at 10%; ** significant at 5%. The sample size decreases between columns 2 and 3, because agricultural information is missing for several communes. 11 children are missing hours in household production and are thereby omitted from columns 4 and 5.

Season effects include controls for the season of the year and for whether the household is interviewed during a rice planting or a rice harvesting season. Accessibility controls include indicators for whether the commune has year round transportation access and whether the commune has access to a cement or tar road. Agricultural attributes include indicators for whether the commune in the last year has experienced a flood, drought, pest problem, typhoon, or other other natural disaster as well as whether high yield seed varieties are present in the commune in 1998 interacted with the year indicator. Infrastructure improvements include indicators for whether the commune has experienced improvements in roads, electrification, irrigation, schools, or health care clinics in the years between survey rounds.
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Notes: All regressions also include a constant. Robust standard errors, corrected for psu/time clustering, in brackets. * significant at 10%; ** significant at 5%. 6 children that participate in agricultural work have missing data on work in household production and are omitted from column 4.
### Table 4: Rice Prices, Land, and Net Production (2SLS)

Children 6-15 in rural panel households

<table>
<thead>
<tr>
<th>Reduced Form</th>
<th>First stage</th>
<th>Second Stage</th>
<th>Work in Hh Production</th>
<th>Market work</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child labor</td>
<td>Work in Agriculture</td>
</tr>
<tr>
<td>Ln(Rice Price)</td>
<td>0.610</td>
<td>-12.190</td>
<td>-0.187</td>
<td>0.113</td>
</tr>
<tr>
<td></td>
<td>[0.398]</td>
<td>[1.566]**</td>
<td>[0.096]*</td>
<td>[0.096]</td>
</tr>
<tr>
<td>Ln(Rice Price)*Net Production</td>
<td>-0.065</td>
<td>-0.055</td>
<td>-0.080</td>
<td>-0.043</td>
</tr>
<tr>
<td></td>
<td>[0.028]**</td>
<td>[0.022]**</td>
<td>[0.035]**</td>
<td>[0.022]**</td>
</tr>
<tr>
<td>Ln(Rice Price)*Ln(Landholdings)</td>
<td>-0.107</td>
<td>1.640</td>
<td>-0.177</td>
<td>-0.146</td>
</tr>
<tr>
<td></td>
<td>[0.047]**</td>
<td>[0.193]**</td>
<td>[0.025]**</td>
<td>[0.038]</td>
</tr>
<tr>
<td>Time=1998</td>
<td>-0.179</td>
<td>0.040</td>
<td>-0.177</td>
<td>-0.146</td>
</tr>
<tr>
<td></td>
<td>[0.025]**</td>
<td>[0.038]</td>
<td>[0.025]**</td>
<td>[0.031]**</td>
</tr>
<tr>
<td>Household Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Season Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Age*Gender Series</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Observations</td>
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<td>8223</td>
<td>8223</td>
<td>8223</td>
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<tr>
<td>R-squared</td>
<td>0.6</td>
<td>0.99</td>
<td>0.6</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Notes: All regressions also include a constant. Robust standard errors, corrected for psu/time clustering, in brackets. * significant at 10%; ** significant at 5%. IV regressions instrument for Ln(Rice Price)*Net Production with Ln(Rice Price)*LN(total annual land holdings). 6 children that work in agriculture have missing observations on work in household production and are omitted from column 5.