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## Impacts of the Doha Development Agenda on People's Republic of China: The Role of Complementary Education Reforms

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Development Agenda  
on People's Republic of China:  
The Role of Complementary  
Education Reforms

Fan Zhai and Thomas Hertel

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**IMPACTS OF THE DOHA DEVELOPMENT AGENDA  
ON PEOPLE'S REPUBLIC OF CHINA:  
THE ROLE OF COMPLEMENTARY EDUCATION REFORMS**

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October 2005

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## **FOREWORD**

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## **ABSTRACT**

This paper evaluates the poverty impact of multilateral trade liberalization under Doha Round WTO negotiation, using a household-disaggregated, recursive dynamic computable general equilibrium (CGE) model of the People's Republic of China (PRC). It explores how trade liberalization interacts with the reform of improving rural education. Simulation results show that multilateral trade reforms reduce poverty in the PRC, with biggest reductions occurring in the rural areas due to higher prices for farm products. Furthermore, the complementary reform on rural education generates substantial gains for the PRC's economy by boosting rural incomes and reducing the incidence of rural poverty significantly.

## I. INTRODUCTION

With its rapid economic growth and integration into the world economy over the last two decades, the PRC has emerged as a global economic force. Now it is the fourth largest trader and the largest foreign direct investment recipient in the world. The PRC's foreign trade and investment is expected to be further boosted by its accession into the World Trade Organization (WTO), including the elimination recently of textile and apparel quotas, as well as prospective multilateral trade liberalization in the context of the Doha Development Agenda. However, against the background of rapid economic growth and openness, income distribution has deteriorated sharply in the PRC. The ratio of urban to rural incomes has increased from 2.2 in 1990 to 3.1 in 2002, which is extremely high by international standards. In the mean time, income inequality as measured by the Gini coefficient has risen from 0.31 in 1990 to 0.36 in 2001 in rural areas, and from 0.23 to 0.32 in urban areas over the same period (Li and Yue 2004).

This widening income disparity is the result of profound structural changes in the PRC's economy. The experience of the last decade suggests that trade liberalization might contribute to increased inequality (Kanbur and Zhang 2005). The PRC's WTO accession has further heightened concerns about the increasing rural-urban disparity, as most analyses suggest that accession will exacerbate inequalities by lowering barriers to grain imports and increasing opportunities for manufacturing exports as well as foreign investment in the urban-based services (Ianchovichina and Martin 2004). Hertel, Zhai, and Wang (2004) found that the poorest rural, agriculture-specialized households that have limited labor mobility out of farming might lose from WTO accession. How will these outcomes be affected by a potential Doha reform package? Do complementary reforms exist that might lessen the adverse impacts on the poor? This paper focuses on the potential for rural education reforms to enhance poverty outcomes under a potential Doha Development Agenda.

It is widely recognized that education plays a critical role in creating human capital, and subsequently, prompting economic development and reducing poverty. However, investment in education is often inadequate relative to other investments, due to the presence of associated externalities, labor market distortions that depress private returns to education, and generally low level of public support for education (Heckman 2002). Moreover, disparities in the funding of education have resulted in nonuniform access of education across regions and between urban and rural areas. In the PRC, education spending has been disproportionately directed toward urban areas at the expense of rural areas. In 2001, per capita spending on compulsory education in urban areas was 16% higher than for rural areas (Wang 2003).

In this paper, we utilize a household-disaggregated applied general equilibrium model to assess the differential effects of multilateral trade liberalization under Doha Round WTO negotiation and increasing rural education spending on each group of households. We explicitly model the linkages between education and labor productivity improvement as well as off-farm labor mobility, which we see as a critical vehicle for poverty reduction in rural PRC.

This paper is organized as follows: the next section describes the specification of the CGE model used in this study. We then elaborate how we model the educational expenditures and output in terms of the supply of labor force by skill and their associated efficiency. Section IV assesses the



impact of Doha Round trade liberalization, as well as increasing rural educational expenditures on rural–urban inequality. The final section offers conclusions.

## II. THE CGE MODEL

The CGE model used in this study is the latest in a long line of model developments based at the Development Research Center of the State Council in Beijing. The model has its intellectual roots in the group of single-country, applied general equilibrium models used over the past two decades that analyze the impact of trade policy reform (Dervis, de Melo, and Robinson 1982; Shoven and Whalley 1992). We focus on the main features of the model in this section.

### A. Household Behavior

In order to come to grips with the poverty question, it is critical that that we disaggregate households to the maximum extent possible, subject to the limitations posed by survey sampling, computational constraints, and human capacity for analysis. Following our previous work (Hertel, Zhai, and Wang 2004; Hertel and Zhai 2004), we disaggregated rural and urban households into 40 rural and 60 urban representative households according to their primary source of income and relative income level. Recent analysis of trade and poverty by Hertel et al. (2004) suggests the merit of distinguishing those households that are specialized (95% or more of their income from one source) in transfer payments, labor wages and salaries, or self-employment income. Using available survey data, we stratify rural households by agriculture-specialized and diversified (all other), and urban households by three strata: transfer-specialized, labor-specialized, and diversified. Within each stratum, we order households from poorest to richest, based on per capita income, and then group them into 20 vintiles, each containing 5% of the stratum population.

Household income derives from labor income, profits from family-owned agriculture and nonagriculture enterprises, property income, and transfers. Households consume goods and services according to a preference structure determined by the extended linear expenditure system (ELES). Through specification of a subsistence quantity of each good or service, this expenditure function generates nonhomothetic demands, whereby the larger the relative importance of subsistence consumption (e.g., it would be high for rice, and low for automobiles) the more income-inelastic the household's demand for that good.

The other important dimension of household behavior is the supply of labor to off-farm activities. In the PRC, the off-farm labor supply decision is complicated by institutional factors that have been built into the system in order to keep the agricultural population in place (Zhao 1999b). In earlier years, the PRC government sought to make it costly for individuals to leave the rural areas by tying incomes to daily participation in collective work. More recently, the absence of well-defined land tenure has raised the opportunity cost of leaving the farm (Yang 1997). Households that cease to farm the land may lose the rights to it, so they have a strong incentive to continue some level of agricultural activity, even when profitability is quite low (Zhao 1999a). With only modest growth in rural, nonfarm activities, this seriously limits the ability of households to obtain off-farm work (Zhao 1999b).<sup>1</sup>

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<sup>1</sup> However, as noted by Parish, Zhe, and Li (1995), the rural labor market is looking more like a market all the time.

We use a constant elasticity of transformation function to model the off-farm labor supply of rural households. The labor allocation between farm and off-farm jobs is determined by the ratio of the shadow value of labor in agriculture relative to the off-farm wage rate, and the elasticity of transformation<sup>2</sup> that reflects imperfect labor mobility. There are many reasons for this imperfect mobility of labor, including education, experience, and simple geography, which can serve to isolate farm households from the nonfarm labor market. Owing to the absence of an effectively functioning land market, the shadow value of labor in agriculture in this function takes into account the potential impact that reducing agricultural employment will have on the household's claim to farm land. This incremental factor is calculated as the marginal value product of land, multiplied by the rate at which decreased on-farm labor reduces the household's land endowment.<sup>3</sup>

## B. Rural–urban Migration

Despite the large income and poverty differential between rural and urban households, permanent migration in the PRC has been limited due to a combination of both direct and indirect measures. First and foremost, households must have an appropriate registration (*hukou*) in order to legally reside in an urban area. Without this registration, access to many of the urban amenities, including housing and education, is limited and quite expensive. In light of these barriers to moving the entire household to an urban area, rural–urban migration is largely a transitory phenomenon.

For our modeling exercise, it is important to obtain an estimate of the wage gap motivating the temporary migration of workers from the rural to the urban sector. Zhao (1999a) documents an average annual wage gap between rural and urban work of 2,387.6 yuan for unskilled rural workers of comparable background and ability in 1995 in Sichuan province. Much of the wage gap is due to social costs associated with migration including the disutility of being away from family, poor quality of housing, limited social services for migrants, and general uncertainty associated with being a nonregistered worker in an urban area (Zhao 1999a and 1999b). While these transactions costs are unobservable, they clearly represent a very significant burden on the migrants and their families.

If there were no barriers to the movement of labor between rural and urban areas, we would expect real wages to be equalized for an individual worker with given characteristics. Sicular and Zhao (2002) explore the question of rural–urban inequality in greater detail for nine different provinces using the China Health and Nutrition Survey (CHNS). The authors conclude that the apparent labor market distortion is about 42% of the rural–urban labor income differential and 48% of the hourly earnings differential.<sup>4</sup> When applied to the average wage differential, this amounts to an *ad valorem* rate of apparent transactions “tax” on rural wages of 81 percent.<sup>5</sup>

<sup>2</sup> See Hertel and Zhai (2004) for details of off-farm labor supply behavior in the model.

<sup>3</sup> In this model we assume that the elasticity of land with respect to on-farm labor is unitary.

<sup>4</sup> There are likely to be other unobserved factors inducing this rural–urban wage differential, in which case estimation of the labor market distortion via subtraction of known factors is biased in the direction of overstating the *hukou*-related distortion. Therefore, it is useful to also estimate the direct impact of household registration status on the observed wage difference among households. Shi (2002) takes this approach to the problem using the same CHNS data set. He finds that only 28% of the rural–urban wage difference can be explained directly via the coefficient on the *hukou* registration variable. This is quite a bit less than the 48% left unexplained via the subtraction approach of Shi, Sicular, and Zhao (2002).

<sup>5</sup> See Hertel and Zhai (2004) for a detailed description of how this *ad valorem* distortion is obtained.

We model these transaction costs as real costs that are assumed by the temporary migrants. Of course these migrants are heterogeneous and the extent of the burden varies widely. Those individuals who are single and live close to the urban area in which they are working are likely to experience minor inconvenience as a result of this temporary migration. We expect them to be the first to migrate (*ceteris paribus*) in response to higher urban wages. On the other hand, some migrants have large families and come from a great distance. Their urban living conditions are often very poor and it is not uncommon for them to be robbed on the train when returning home from work. For such individuals, the decision to migrate temporarily is likely to be a marginal one—and one they may not choose to repeat. With this heterogeneous population in mind, we postulate a transactions cost function that is increasing in the proportion of the rural population engaged in temporary work. This transactions cost function has a simple, constant elasticity functional form, which begins at the origin and reaches the observed wage gap (adjusted for transport and living costs) at the current level of temporary migration (about 70 million workers). We assume that further increases in temporary migration have only a modest impact on these transactions costs.<sup>6</sup>

### C. Production, Exports, and Imports

Since the 1990s, processing exports have grown rapidly as a result of their preferential treatment, which includes duty-free imports. This sector now accounts for more than half of the PRC's total exports. This is captured in our CGE model explicitly by incorporating two separate foreign trading regimes. One is the export processing regime, which receives duty-free imports and is therefore extremely open, with considerable foreign investment. Under this regime, firms process and assemble the imported goods, turning them into finished goods for export; these imported intermediate goods are exempted from tariffs and value-added taxes. Therefore, export processing firms more intensively use imports as intermediate inputs and their output is exported only. The other sector is the ordinary trade regime, which is carried out under traditional taxes and regulations. Firms under the ordinary trade regime sell products on the domestic market or export to the rest of the world, according to a constant elasticity of transformation (CET) function. Therefore, ordinary exports are treated as different products from those sold on the domestic market. We also assume the buyers from the rest of the world choose a mix between ordinary exports and processing exports to minimize their costs.

There are two types of imports in the model. The imports of duty-free processing goods are used by export processing firms as their intermediate inputs. The ordinary import is modeled using the Armington assumption, i.e., it is assumed to be differentiated from PRC products produced by ordinary firms. The small country assumption is assumed for imports and so world import prices are exogenous in terms of foreign currency. Exports are demanded according to constant-elasticity demand curves. Therefore the terms of trade for the PRC are endogenous in our simulation. The values of export demand elasticity and Armington elasticity, presented in Table 1, are based on the estimation by Hertel et al. (2003).

Production in each of the sectors of the economy is modeled using nested constant elasticity of substitution (CES) functions, and constant returns to scale is assumed. In the top level of the nest, value-added and a composite of intermediate inputs produce outputs. Then a further CES

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<sup>6</sup> We assume that a doubling of temporary migration would only increase the marginal cost of migration by 10 percent.

**TABLE 1**  
**ELASTICITY PARAMETERS FOR TRADE**

	ARMINGTON	CET	EXPORT DEMAND		ARMINGTON	CET	EXPORT DEMAND
Rice	5.1	3.6	10.1	Petroleum refining	2.1	3.8	4.2
Wheat	4.5	3.6	8.9	Chemicals	3.3	3.8	6.6
Corn	1.3	3.6	2.6	Medicine	3.3	3.8	6.6
Cotton	2.5	3.6	5.0	Chemical fibers	3.3	3.8	6.6
Other nongrain crops	2.5	3.6	4.9	Rubber and plastics	3.3	3.8	6.6
Forestry	2.5	3.6	5.0	Build materials	2.9	3.8	5.8
Wool	6.5	3.6	12.9	Primary iron and steel	3.0	4.6	5.9
Other livestock	1.5	3.6	3.1	Nonferrous metals	4.2	4.6	8.4
Fishing	1.3	3.6	2.5	Metal products	3.8	4.6	7.5
Other agriculture	2.5	3.6	5.0	Machinery	2.8	4.6	5.6
Coal mining	3.1	4.6	6.1	Special equipment	2.8	4.6	5.6
Crude oil and natural gas	7.4	4.6	14.9	Automobile	2.8	4.6	5.6
Ferrous ore mining	3.0	4.6	5.9	Other transport equipment	4.3	4.6	8.6
Nonferrous ore mining	4.2	4.6	8.4	Electric machinery	4.1	4.6	8.1
Other mining	0.9	4.6	1.8	Electronics	4.4	4.6	8.8
Vegetable oil	3.3	4.5	6.6	Instruments	4.1	4.6	8.1
Grain mill and forage	2.6	4.5	5.2	Other manufacturing	3.8	3.8	7.5
Sugar	2.7	4.7	5.4	Utilities	2.8	3.8	5.6
Processed food	2.8	4.5	5.6	Construction	1.9	3.8	3.8
Beverage	1.2	4.7	2.3	Transportation	1.9	2.8	3.8
Tobacco	1.2	4.7	2.3	Post and communications	1.9	2.8	3.8
Textile	3.8	5.4	7.5	Commerce	1.9	2.8	3.8
Apparel	3.7	5.8	7.4	Finance	1.9	2.8	3.8
Leather	4.1	4.6	8.1	Social services	1.9	2.8	3.8
Sawmills and furniture	3.4	4.6	6.8	Education and health	1.9	2.8	3.8
Paper and printing	3.0	4.6	5.9	Public administration	1.9	2.8	3.8
Social articles	3.8	5.6	7.5				

CET means constant elasticity of transformation.

function disaggregates the value-added into capital-labor composite and agricultural land. Capital-labor composite is further split into the capital-skilled labor composite and the aggregated less-skilled labor. The capital-skilled labor composite consists of capital and skilled labor, while aggregated less-skilled labor is composed of semi-skilled labor and unskilled labor. The values of substitution elasticities in production functions are listed in Table 2. A low substitution elasticity of 0.3 between capital and skilled labor is assumed here to introduce the capital-skill complementarity. The elasticity of substitution between semi-skilled labor and unskilled labor is set to 1.5, based on estimates for the United States by Katz and Murphy (1992) and Heckman and Lochner (1998).

Each type of labor comprises rural and urban labor that substitute imperfectly. This is an indirect means of building into the model a geographic flavor, since some sectors will be located largely in urban areas, while others will be predominantly in rural areas. By limiting the substitutability of rural and urban labor in each sector, we are able to proxy the economic effect of geographically distributed activity. Ideally we would model the geographic distribution of industrial activity, but unfortunately the data do not exist to support this split.

**TABLE 2**  
**SUBSTITUTION ELASTICITIES IN PRODUCTION**

SUBSTITUTIONS	AGRICULTURE	NONAGRICULTURE
VA – Aggregated intermediate Input	0.1	0.1
Capital-labor composite – Land	0.3	n.a.
Capital-skilled labor composite – Aggregate less-skill labor		
Old vintage	0.5	0.7
New vintage	1.0	1.1
Capital – Skilled labor	0.3	0.3
Unskilled labor – Semiskilled labor	1.5	1.5
Urban labor – Rural labor	2.2	2.2

VA means value-added.

n.a. means not available.

All commodity and nonlabor factor markets are assumed to clear through prices. With the exception of the farm/nonfarm labor supply decision, labor is assumed to be perfectly mobile across sectors. Capital is assumed to be partially mobile, reflecting differences in the marketability of capital goods across sectors.

#### **D. Recursive Dynamic and Comparative Static Steady State Closures**

The CGE model is benchmarked to the PRC's 1997 Social Accounting Matrix (SAM) and approximates the dynamics in two alternative ways. The recursive dynamic version of the model is used to update the SAM to 2005 and assess the impact of intervening events on the PRC's patterns of trade, production, and consumption. In this version of the model, the classical saving-investment mechanism determines the capital stock in the medium and long term. Dynamics originate from accumulation of productive factors and productivity changes. The steady-state, comparative static version is used to assess the impact of trade and educational reforms, so here, the longer-term accumulation effects are taken into account by introducing a different capital market closure following Harrison et al. (1997) and Francois et al. (1995). Here, the aggregate capital stock is allowed to adjust to its long-term equilibrium based on an exogenous capital rental rate (fixed at the benchmark level). The theoretical underpinnings of this closure are based on the concept of an invariant capital stock equilibrium as proposed by Hansen and Koopmans (1972).

### **III. MODELING EDUCATION**

Education affects the economy in several important ways. Education improves the skills of workers, thereby enhancing their productivity and garnering them a higher wage. In the context of rural PRC, education is also a key determinant of an individual's potential suitability for off-farm work (Yang 2004; Zhang, Huang, and Rozelle 2002). Since the farm-off-farm labor market linkage has proven key to the transmission of trade reform benefits to the rural poor, this mechanism will receive special attention here. This section describes the framework through which education

expenditure affects the production of human capital and its distribution among different household groups, as well as the linkage between schooling attainment and rural labor off-farm mobility.

### A. Supply of Educated Labor by Household

In the CGE model each household is endowed with 17 groups of workers, distinguished by their total years of schooling, ranging from 0 to 16. Based on this level of educational attainment, we infer the skill level of household members in the workforce. Unskilled labor refers to workers with 0 to 6 years of educational attainment; semi-skilled workers have 7 to 12 years of educational attainment; and skilled workers have an educational attainment from 12 to 16 years. For each household, the shares of 17 labor groups in each age cohort,  $Q_{zy}$  are determined by its age-specific school participation rates,  $p_y^s$ .

$$Q_{zy} = \begin{cases} (1 - p_{z+7}^s) / (1 - p_y^s), & z = 0 \\ (p_{z+6}^s - p_{z+7}^s) / (1 - p_y^s) & 0 < z < y - 6 \end{cases} \quad (1)$$

where  $z=0, \dots, 16$  denotes the schooling year and  $y$  denotes age. Each household's labor endowment by skill is calculated based on their labor force participation rate,  $p_y^l$ :

$$\begin{aligned} L_{usk} &= \sum_y Pop_y p_y^l \sum_{z=0}^6 Q_{zy} \\ L_{ssk} &= \sum_y Pop_y p_y^l \sum_{z=7}^{12} Q_{zy} \\ L_{sk} &= \sum_y Pop_y p_y^l \sum_{z>12} Q_{zy} \end{aligned} \quad (2)$$

where  $Pop_y$  is the population by age cohort of the household and  $p_y^l$  is the age-specific labor participation ratio of the household that is subject to the following constraint on the sum of participation rates in schooling and labor force:

$$p_y^l + p_y^s \leq 1 \quad (3)$$

### B. Labor Productivity and Off-farm Mobility

Education enhances labor productivity through two channels. First, as asserted in equations (1) and (2), more education improves the skill composition of labor stock, resulting in a greater supply of skilled labor and lesser supply of unskilled labor. Second, for each skill level, more education yields a higher level of average schooling attainment, thereby improving its average labor productivity. The second channel can be captured by the following equation:

$$h_l = h_l^0 + \eta_l S_l \quad (4)$$

where  $h_l$  is the efficiency factor of each skill level of labor and  $S_l$  is its average schooling attainment, which is calculated as:

$$\begin{aligned}
 S_{usk} &= \sum_y \left( Pop_y p_y^l \sum_{z=0}^6 Q_{zy} \cdot z \right) / \sum_y \left( Pop_y p_y^l \sum_{z=0}^6 Q_{zy} \right) \\
 S_{ssk} &= \sum_y \left( Pop_y p_y^l \sum_{z=7}^{12} Q_{zy} \cdot z \right) / \sum_y \left( Pop_y p_y^l \sum_{z=7}^{12} Q_{zy} \right) \\
 S_{sk} &= \sum_y \left( Pop_y p_y^l \sum_{z>12} Q_{zy} \cdot z \right) / \sum_y \left( Pop_y p_y^l \sum_{z>12} Q_{zy} \right)
 \end{aligned} \tag{5}$$

As noted above, we model the off-farm labor supply decision of rural households as a CET function of the ratio of the shadow value of labor in agriculture, relative to the off-farm wage rate. We assume that the elasticity of transformation  $\sigma_l$  is a linear increasing function of average years of schooling within the labor skill groups. This specification, which implies that rural households with higher educational attainment respond more effectively to farm/nonfarm wage gaps, is supported by recent empirical evidence (Zhang, Huang, and Rozelle 2002). It is formalized as follows:

$$\sigma_l = \sigma_l^0 + S_l \cdot \varepsilon_l \tag{6}$$

### C. Educational Expenditure and Its Financing

Assuming the education costs per pupil-year,  $c_y$ , are exogenously fixed for each level of schooling, the total educational expenditure,  $E$ , is simply the sum of schooling costs of all schooling levels, which is calculated as the schooling population multiplied by the education costs per pupil-year:

$$E = \sum_h \sum_y c_y Pop_{yh} p_{yh}^s \tag{7}$$

The education expenditure comprises private expenditure  $E_h^p$  and government expenditure  $E^g$ . We assume the two components are fully complementary, and also that the share of total expenditure covered by the government is fixed and equal to  $\alpha_y$ , we have:

$$E^g = \sum_y \sum_h \alpha_y c_y Pop_{yh} p_{yh}^s \tag{8}$$

$$E_h^p = \sum_y (1 - \alpha_y) c_y Pop_{yh} p_{yh}^s \tag{9}$$

$E^g$  and  $E_h^p$  enter the budget constraints of government and households, respectively.

## IV. MODEL CALIBRATION AND CHOICE OF PARAMETERS

Detailed data on the population and labor force is necessary to calibrate the education block of the model. By assuming stationary population growth, we calculate the age distribution of the rural and urban populations, respectively, according to their mortality tables from the 2000 national population census. The age distribution of 40 rural households is assumed to be the same, and so

are the 60 urban households. Age-specific labor participation rates by urban and rural classifications are also obtained from 2000 national population census. We scaled them up/down to the aggregated labor force participation rate of each representative household to obtain the age-specific labor participation rates by household.

National average school participation rates by age are calculated from official enrollment and drop-off rates for primary school, middle school, high school, and university or college. Then we estimate the age-specific school participation rates of each household by solving a quadratic program, which minimizes the difference between the school participation rates of each household and the national average school participation rates, subject to the constraints implied by the base year skill composition of each household's labor endowment.

The productivity increments associated with educational attainment enhancement are derived from the study by Shi, Sicular, and Zhao (2002). These authors estimate wage (and shadow wage) equations for agricultural and rural, nonfarm workers. These equations include educational attainment as an explanatory variable. Their estimates suggest that additional education has the greatest impact on rural nonfarm wages, with one additional year of schooling boosting hourly wages (and, we presume, productivity) by 15 percent. Additional schooling also has an impact on agricultural productivity, with an additional year of schooling boosting labor productivity on the farm by 2 percent. When adjusted for the share of labor in agricultural output, this translates into a 2.5% increase in labor productivity.

Specification of the values of the off-farm labor supply elasticity draws on the econometric work of Sicular and Zhao (2004) and Zhang, Huang, and Rozelle (2002). Sicular and Zhao report results from a household labor supply model estimated using labor survey data from the 1997 CHNS data set for nine central provinces. From their labor supply equations for self-employed agricultural labor, and self-employed nonagricultural labor, it is possible to calculate elasticities of labor transfer from farm to nonfarm activities. They report a variety of elasticities in their paper.<sup>7</sup> We adopt their estimate of 2.67 for this work as the overall farm/off-farm transformation elasticity for total rural labor force.

To obtain separate estimates of the farm/off-farm transformation elasticity for three skill levels of labor, we utilized the rate at which increased schooling attainment enhances the transformation elasticity,  $\varepsilon_l$ , based on the study by Zhang, Huang, and Rozelle (2002). These authors explored the labor supply behavior of a panel of 310 individuals in 109 families observed in four villages of Jiangsu province in 1988, 1992, and 1996. They found that for every additional year of education, farmers had a 14% greater chance of finding an off-farm job in 1996, *ceteris paribus*. Using the base year ratio of the shadow value of labor in agriculture relative to the off-farm wage rate, as well as the total farm and off-farm labor supplies, this increasing opportunity to access off-farm jobs associated

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<sup>7</sup> Due to the variety of labor supply elasticities in response to the three different wages in their model, the authors obtain a variety of labor transfer elasticities, depending on the "thought experiment" being conducted. These are asymmetric, with the response to a change in shadow wages differing from the response of labor supply to a change in the market wage. However, this response is treated as symmetric in our model. This makes it difficult to choose the correct parameter for our analysis. We focus on the transfer of labor from agriculture to market wage employment in response to a change in returns to agriculture, since this transfer accounts for the bulk of the labor flow in our analysis.



with more educational attainment translates into an increment of 0.58 in transformation elasticity for each additional year of schooling. This is used to calculate the farm/off-farm transformation elasticities by skill level, according to the average schooling year of each skill level of rural labor forces. The resulting values for this elasticity are 0.68 for unskilled labor, 4.01 for semi-skilled labor, and 7.49 for skilled labor.

## V. SIMULATIONS

### A. Simulation Design

The baseline scenario from 1998 to 2005 is constructed by utilizing the recursive dynamic version of the model. The baseline scenario establishes a plausible growth trajectory for the PRC economy, which takes into account events such as the PRC's WTO accession and its recent dramatic surge in exports, which have doubled in the last four years. We then utilize the predicted 2005 database as the new benchmark equilibrium from which we employ the comparative steady state model to conduct the policy simulations. A sequence of alternative scenarios is considered in order to explore the implications for poverty and income distribution of multilateral trade reforms under the WTO, as well as their relationship to educational reforms and rural-urban inequality. The first three scenarios that we consider relate to multilateral trade reforms, while the fourth scenario captures the added impact of rural education reform.

In the first scenario (*ROW*) we consider the impacts of global trade liberalization excluding the PRC. In particular, this entails elimination of all import tariffs in the rest of the world. In addition, agricultural export subsidies are eliminated, as are subsidies for domestic agricultural production in the Organisation for Economic Co-operation and Development. The second scenario (*Uni*) focuses on the PRC's unilateral liberalization. All import tariffs and nontariff barriers of the PRC are eliminated in this scenario. The third scenario (*Full-Lib*) considers the impact of global free trade by combining the first and second scenarios.

The fourth scenario is called *Doha-SDT*. Here, we examine the impact of a prospective Doha Round trade liberalization on the PRC. This scenario combines several elements of a potential agreement. First of all, agricultural market access is increased, particularly in the developed countries. This is done through a tiered reduction formula in which the percentage cuts in bound tariffs become larger as the tariff height rises. For low agricultural tariffs in industrial countries, the cut marginal rate of reduction is 45 percent. For medium-level tariffs, it is 70%, and for the highest tariffs, it is 75 percent. Developed countries face bound tariff cuts that are two thirds as deep, while the least developed countries are not required to reduce tariffs at all. Nonagricultural market access is governed by a 50% proportional cut for industrial countries, 33% for developing, and 0% for least developed. In addition, we assume that agricultural export subsidies, as reported to the WTO in 2001, are fully eliminated. Domestic support is assumed to be guided by a 60% reduction in the commitments on the Aggregate Measure of Support.

The fifth scenario (*Doha-All*) abolishes differential treatment of developing countries and requires that all countries face the same depth of bound tariff cuts as those faced by the industrial countries. Of course, given the differential degree of "binding overhang" in each country, just because they cut bound tariffs by the same amount does not mean that applied protection will

fall at the same rate. However, this is clearly a scenario that requires greater developing country participation in the WTO round. And for the least developed countries—which do not cut tariffs at all in the *Doha-SDT* scenario—this represents a dramatic departure from “business as usual.”

To reflect the impacts of multilateral trade liberalization in the single country model, we incorporate external market impacts into the CGE model through exogenous changes in import prices and export demands. The sizes of these exogenous trade shocks are obtained from global CGE simulations for each scenario, which were done using the Global Trade Analysis Project (GTAP) model of global trade. Tariff reduction in the PRC is excluded in this GTAP simulation but is included in the simulation of the single country model.

Table 3 lists the shocks imposed in scenarios 1 through 3. In the case of global trade liberalization, there are some enormous percentage increases in the PRC’s export volumes generated by the elimination of very high rates of protection elsewhere in Asia. Rice, corn, grain milling, and other food products all show very large proportionate increases. Of course the associated volume changes are often quite modest, as the PRC is not a large exporter of most of these products. Moreover, after the CGE model is solved with the shifts in demand and export price in place, the resulting equilibrium change in export volume is much smaller than that suggested by the GTAP simulations. In the cases of *Doha-SDT* and *Doha-All*, the export volume increases are on the order of 20–30% as large as global liberalization.

World food and agricultural prices also rise relative to nonfood prices, with the increases ranging from 4% to 12% in the case of full liberalization. These are reported for the three scenarios in the second and third sets of columns in Table 3. They are much smaller in the case of *Doha-SDT* and *Doha-All*.

The final set of columns in Table 3 report the percentage cut in the tariff rates in the PRC under each scenario. In the case of *Doha-SDT*, they are in the range of one quarter to one third, whereas in *Doha-All* they are closer to one half for nonagriculture products (the bound nonagricultural tariffs are cut by 50% in this scenario). In the case of full trade liberalization, the cuts are obviously 100 percent.

In the final scenario, we explore the potential impact of investing in rural education. In this scenario we equalize the urban–rural imbalance in per capita government spending on education by increasing the government spending on rural education by 16% in order to bring per capita rural spending in line with that in the urban areas.<sup>8</sup> Since we are interested in the impact of this reform in the context of multilateral trade liberalization, we treat it as a combined scenario, with the rural educational reforms *added to* the global liberalization scenario (*Full-Lib*). The shorthand for this combined scenario is *EduLib*.

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<sup>8</sup> A caveat should be mentioned here. In the scenario of education reform, we assume private education spending of rural households increases proportionally to public spending. This implies that the education demand in rural areas is constrained by supply-side factors. This seems reasonable, given the low level of rural education in the PRC, the potential benefits from education investment, and the long-term nature of the simulation.

**TABLE 3**  
**EXOGENOUS SHOCKS IN TRADE LIBERALIZATION SCENARIOS (PERCENT CHANGE)**

	EXPORT DEMAND			EXPORT PRICE			IMPORT PRICE			TARIFF		
	FULL-LIB	DOHA-SDT	DOHA-ALL	FULL-LIB	DOHA-SDT	DOHA-ALL	FULL-LIB	DOHA-SDT	DOHA-ALL	FULL-LIB	DOHA-SDT	DOHA-ALL
Rice	7574.5	454.4	452.5	12.2	2.1	2.1	12.2	1.3	1.2	-100	0	0
Wheat	43.2	7.6	6.8	5.4	1.4	1.4	5.4	1.3	1.3	-100	0	0
Corn	88.8	21.3	21.1	7.6	1.9	2.0	7.6	5.5	5.5	-100	-28	-28
Cotton	71.9	28.5	28.6	5.7	1.7	1.8	5.7	5.0	5.0	-100	-20	-25
Other crops	37.9	14.9	14.7	6.7	1.6	1.6	6.1	3.6	3.6	-100	-21	-20
Forestry	0.9	-1.4	-1.4	2.5	0.7	0.7	2.5	0.1	0.1	-100	-24	-29
Wool	3.0	-6.3	-7.1	7.7	2.2	2.2	7.7	2.4	2.3	-100	-2	-2
Other livestock	-3.1	-1.3	-1.3	7.1	1.8	1.8	7.1	0.7	0.7	-100	-23	-23
Fishing	9.8	2.8	2.9	5.0	1.2	1.2	5.0	0.2	0.2	-100	-29	-43
Other agriculture	71.9	28.5	28.6	5.7	1.7	1.8	5.7	5.0	5.0	-100	-20	-25
Coal mining	1.9	0.5	0.8	2.0	0.5	0.6	2.0	0.3	0.4	-100	-30	-46
Crude oil and gas	-1.9	-0.3	-0.5	1.0	0.1	0.1	0.7	0.1	0.1	-100	-	-
Ferrous ore mining	-2.4	-1.4	-1.3	2.4	0.7	0.8	2.4	0.2	0.2	-100	-30	-46
Nonferrous ore mining	-3.6	-1.8	-2.2	2.3	0.7	0.7	2.3	0.2	0.2	-100	-31	-47
Other mining	0.8	0.2	0.1	1.9	0.5	0.5	1.9	0.5	0.4	-100	-29	-45
Vegetable oil	-18.8	-9.2	-9.2	5.7	1.7	1.7	5.7	0.4	0.5	-100	-22	-23
Grain mill and forage	525.3	53.2	52.9	6.9	1.4	1.4	6.9	2.6	2.5	-100	0	0
Sugar	83.4	25.0	24.8	5.0	1.4	1.4	5.0	1.5	1.4	-100	-1	-1
Processed food	36.6	-0.5	-0.5	5.9	1.4	1.5	5.5	0.9	0.9	-100	-25	-30
Beverage	19.9	2.2	2.1	4.5	1.2	1.2	4.5	0.2	0.2	-100	-22	-23
Tobacco	19.9	2.2	2.1	4.5	1.2	1.2	4.5	0.2	0.2	-100	-22	-23
Textile	13.7	5.5	5.5	3.3	1.0	1.0	3.3	0.2	0.2	-100	-33	-50
Apparel	17.0	9.0	8.9	2.9	0.9	0.9	2.9	0.4	0.3	-100	-32	-49
Leather	15.2	7.0	7.2	3.7	1.1	1.1	3.7	-0.3	-0.4	-100	-32	-50
Sawmills and furniture	-4.7	-2.8	-2.8	2.8	0.8	0.8	2.8	0.2	0.2	-100	-32	-49
Paper and printing	-5.1	-3.1	-2.9	3.0	0.9	0.9	3.0	0.3	0.3	-100	-33	-50
Social articles	-4.3	-2.0	-2.2	2.9	0.9	0.9	2.9	0.0	-0.1	-100	-28	-46
Petroleum refining	3.8	-0.5	0.2	1.2	0.3	0.4	1.2	0.1	0.1	-100	-30	-46
Chemicals	0.6	-0.7	-0.1	2.5	0.7	0.8	2.5	0.1	0.0	-100	-28	-44
Medicine	0.6	-0.7	-0.1	2.5	0.7	0.8	2.5	0.1	0.0	-100	-28	-44
Chemical fibers	0.6	-0.7	-0.1	2.5	0.7	0.8	2.5	0.1	0.0	-100	-28	-44
Rubber and plastics	0.6	-0.7	-0.1	2.5	0.7	0.8	2.5	0.1	0.0	-100	-28	-44
Build materials	8.8	2.1	2.6	2.6	0.8	0.8	2.6	0.2	0.2	-100	-32	-49
Primary iron and steel	-2.4	-1.4	-1.3	2.4	0.7	0.8	2.4	0.2	0.2	-100	-30	-46
Nonferrous metals	-3.6	-1.8	-2.2	2.3	0.7	0.7	2.3	0.2	0.2	-100	-31	-47
Metal products	4.4	0.9	1.2	2.5	0.7	0.8	2.5	0.1	0.1	-100	-33	-50
Machinery	-18.3	-5.6	-6.8	2.3	0.7	0.7	2.3	0.0	0.0	-100	-33	-50
Special equipment	-18.3	-5.6	-6.8	2.3	0.7	0.7	2.3	0.0	0.0	-100	-33	-50
Automobile	-18.3	-5.6	-6.8	2.3	0.7	0.7	2.3	0.0	0.0	-100	-33	-50

(CONTINUED)

TABLE 3. (CONTINUED)

	EXPORT DEMAND			EXPORT PRICE			IMPORT PRICE			TARIFF		
	FULL-LIB	DOHA-SDT	DOHA-ALL	FULL-LIB	DOHA-SDT	DOHA-ALL	FULL-LIB	DOHA-SDT	DOHA-ALL	FULL-LIB	DOHA-SDT	DOHA-ALL
Other transport equipment	15.7	-1.3	-0.9	2.4	0.7	0.7	2.4	0.0	0.0	-100	-32	-49
Electric machinery	-4.1	-2.3	-2.1	2.4	0.7	0.7	2.4	0.0	0.0	-100	-33	-50
Electronics	-4.8	-2.8	-2.8	1.8	0.5	0.6	1.8	0.1	0.1	-100	-33	-49
Instruments	-4.1	-2.3	-2.1	2.4	0.7	0.7	2.4	0.0	0.0	-100	-33	-50
Other manufacturing	-4.3	-2.0	-2.2	2.9	0.9	0.9	2.9	0.0	-0.1	-100	-28	-46
Utilities	-2.4	-1.3	-1.4	2.4	0.7	0.7	2.4	0.0	0.0	0	0	-100
Construction	-6.3	-2.6	-2.6	2.7	0.8	0.8	2.7	-0.1	-0.1	0	0	-100
Transportation	-5.5	-2.3	-2.3	3.0	0.9	0.9	2.9	0.2	0.3	0	0	-100
Post and communications	-5.4	-2.2	-2.2	2.6	0.8	0.8	2.6	0.0	0.0	0	0	-100
Commerce	-5.6	-2.5	-2.5	3.1	0.9	0.9	3.1	0.3	0.3	0	0	-100
Finance	-5.6	-2.3	-2.3	2.7	0.8	0.8	2.7	-0.1	-0.1	0	0	-100
Social services	-6.2	-2.4	-2.4	2.8	0.8	0.9	2.8	-0.1	0.0	0	0	-100
Education and health	-6.5	-2.3	-2.4	2.8	0.8	0.9	2.8	0.0	0.0	0	0	-100
Public administration	-6.5	-2.3	-2.4	2.8	0.8	0.9	2.8	0.0	0.0	0	0	-100

Source: GTAP simulations.

## B. Economywide Impacts of Multilateral Trade Liberalization

The macroeconomic results from scenarios 1 through 5 are reported in the first five columns of Table 4. These are deviations from the baseline in 2005. The reduction in global trade barriers gives a substantial boost to trade in the PRC, with both exports and imports rising by about 2-3% in the Doha Round trade liberalization and 5-6% in the scenario of global free trade (*Full-Lib*). Aggregate welfare, measured by the summation of individual household equivalent variation (EV) and reported as percent of GDP, would increase by 0.4% in the Doha Round trade liberalization and 1.0% in the scenario of global free trade, due to improved terms of trade and reduced distortions between world prices and domestic prices. The PRC's welfare gain from global trade liberalization all comes from the liberalization of other countries. Actually, in the scenario of unilateral trade liberalization, the PRC experiences a welfare loss of 0.3% in its GDP, due to deterioration in its terms of trade. This reflects the PRC's relatively low import protection after its WTO accession and its growing influence in world export markets.

With fixed labor endowments, full employment, and no productivity changes, the PRC's GDP is little changed. The small increase under *Full-Lib* is driven by the effects on labor reallocation and capital accumulation. In the cases of Doha Round trade liberalization and global free trade, stronger export demand in agricultural products and larger cuts in tariff rates for manufacturing goods divert the labor force from high productivity, and manufacturing sectors to lower productivity and agricultural sectors, when compared to the baseline outcome. Although capital stocks rise slightly spurred by trade liberalization, the increased capital stock is largely offset by the productivity loss associated with more labor employed in the agriculture and rural sectors, resulting in minimal gains in real GDP. On the contrary, in the scenario of the PRC's unilateral liberalization, the

**TABLE 4**  
**AGGREGATED RESULTS (PERCENT CHANGE)**

	ROWLIB	UNI-LIB	FULL-LIB	DOHA-SDT	DOHA-ALL	EDULIB	
						INCREMENTAL	CUMULATIVE
<b>Macroeconomic Variables</b>							
Welfare(EV)	1.0	-0.3	0.8	0.4	0.4	1.2	2.0
GDP	0.1	-0.1	0.1	0.0	0.0	1.2	1.2
Exports	0.2	4.4	4.8	2.2	2.8	1.0	5.8
Imports	1.9	3.8	5.9	2.9	3.5	0.8	6.7
Terms of trade	1.4	-0.8	0.5	0.5	0.5	-0.3	0.3
CPI	4.6	-2.1	2.4	0.7	0.5	0.9	3.3
Capital stock	1.7	-0.6	1.1	0.3	0.2	1.1	2.2
<b>Factor Prices</b>							
Returns to agricultural land	23.2	-7.2	15.5	5.2	5.1	7.0	23.5
Unskilled wages							
Urban	5.2	-1.9	3.3	1.0	0.8	14.8	18.6
Rural nonagricultural	5.3	-1.9	3.3	1.0	0.8	16.7	20.6
Agricultural	6.1	-2.3	3.9	1.3	1.1	28.3	33.3
Semi-skilled wages							
Urban	5.4	-1.9	3.4	1.1	0.9	-4.0	-0.7
Rural nonagricultural	5.8	-2.0	3.7	1.2	1.0	-4.9	-1.4
Agricultural	5.2	-1.9	3.3	1.0	0.9	-4.2	-1.0
Skilled wages							
Urban	5.6	-1.7	3.8	1.2	0.9	-0.5	3.3
Rural nonagricultural	5.6	-1.7	3.8	1.2	0.9	-0.5	3.3
Agricultural	5.9	-1.8	4.0	1.2	1.0	-3.9	-0.1
<b>Labor Migration (millions)</b>							
Off-farm labor	-3.3	1.2	-2.2	-0.8	-0.8	4.9	2.8
Unskilled	-0.5	0.2	-0.4	-0.1	-0.1	-10.2	-10.6
Semi-skilled	-2.6	1.0	-1.7	-0.6	-0.6	13.3	11.6
Skilled	-0.2	0.1	-0.1	0.0	0.0	1.9	1.8
Rural–Urban	-2.4	0.9	-1.5	-0.6	-0.6	2.0	0.4
Unskilled	-0.3	0.1	-0.2	-0.1	-0.1	-10.4	-10.6
Semi-skill	-1.9	0.7	-1.2	-0.5	-0.5	10.5	9.2
Skilled	-0.2	0.1	-0.1	0.0	0.0	1.9	1.8
<b>Labor Migration (percent)</b>							
Off-farm labor	-2.5	0.9	-1.6	-0.6	-0.6	3.8	2.1
Unskilled	-0.9	0.3	-0.6	-0.2	-0.2	-18.4	-18.9
Semi-skilled	-3.8	1.4	-2.5	-0.9	-0.9	19.7	16.7
Skilled	-2.3	1.0	-1.4	-0.5	-0.5	27.9	26.1
Rural–Urban	-3.7	1.4	-2.3	-0.9	-0.9	3.1	0.7
Unskilled	-1.0	0.4	-0.7	-0.2	-0.2	-38.2	-38.6
Semi-skilled	-6.1	2.4	-3.9	-1.4	-1.4	34.2	29.0
Skilled	-3.0	1.2	-1.8	-0.7	-0.7	35.9	33.5

Source: Simulation results.

deterioration in terms of trade reduces the profits of exports, which consequently discourage capital accumulation, resulting in a lower level of steady-state capital stock. Although more agricultural labor forces are diverted from agricultural activities to nonagricultural activities, it hardly counterbalances the adverse effect of less capital stock. As a consequence, GDP slightly declines in the scenario of the PRC's unilateral liberalization.

Turning to the changes in factor prices, we see that the effects of global free trade and Doha Round trade liberalization on wages are largely neutral across skill levels and between rural and urban sectors. The increase in agricultural profitability, which is reflected in the rise of returns to agricultural land, would reduce off-farm labor supply by about 0.8 million in the Doha Round trade liberalization and 2.2 million in the scenario of global free trade, relative to baseline. Increased on-farm labor supply restrains wage growth in the agricultural sector. Urban and rural nonfarm wages are linked through the temporary migration of individuals to urban areas. In the multilateral trade liberalization scenarios, temporary migration from the rural to urban sectors is slowed, with about 1.5 million fewer migrants under *Full-Lib* than would be the case in the baseline.

Since poverty and income distribution are central to our paper, we provide several such measures for the PRC as a whole in Table 5. The urban–rural income ratio declines in all the three global trade liberalization scenarios, although the magnitude of this change is very small: 0.01 points in the case of global free trade. This is reflected in a small improvement in urban–rural inequality, as measured by the Gini coefficient, but no discernible changes in inequality within the urban and rural areas.

Using the \$2/day level of poverty line, Chen and Ravallion (2004) estimate that 45.2% of the rural population in the PRC and 4.1% of the urban population are in poverty. Applying these figures to our benchmark data for 2005, we obtain the poverty line of 4730 yuan (1997 prices) for urban and 3580 yuan (1997 prices) for rural households. By assuming a uniform distribution of the population within each of the vingtiles, we are able to estimate the poverty headcount changes in the wake of these reforms. This information is also reported in Table 5. In the *Full-Lib* scenario, the monetary poverty line increases by 2.4%, following the change in consumer price index (CPI) in Table 4. Nevertheless, higher factor earnings mean that the poverty headcount ratio declines for all household groups. Since all transfer incomes are assumed to be constant in real terms and are indexed by the CPI, the urban transfer-specialized household group experiences only a modest decline in its poverty headcount, reflecting a decline in nontransfer income. The aggregate urban poverty headcounts decreases by about 2.1 percent. Rural households enjoy a 2.7 percent reduction in poverty headcount, which amounts to about a 1.2 *percentage point* reduction in rural poverty (i.e., the proportion of the entire rural population in poverty falls by 1.2 percent). Given the large population base in rural PRC, this translates into a rural poverty reduction of 10.6 million. The two scenarios of Doha Round trade liberalization show similar patterns of poverty reduction across households, but with lesser absolute reductions. Overall, the impoverished share of the national population falls from 31.3 percent of the total population to 30.5 percent in the scenario of global free trade, and to 30.9 percent under the Doha Round scenarios.

### C. Sector Impacts

Figures 1 through 3 report a subset of the changes in sector output, in descending order, omitting the changes that are less than 2% for the scenario of global free trade and 0.7% in absolute

**TABLE 5**  
**EFFECTS ON INEQUALITY AND POVERTY**

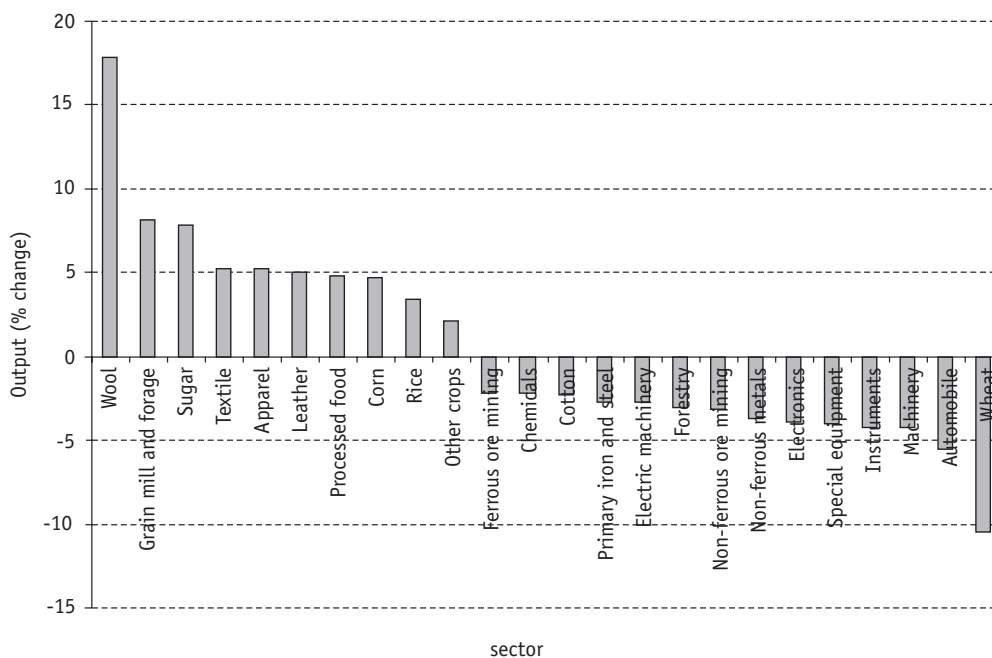
	BASE	FULL-LIB	DOHA-SDT	DOHA-ALL	EDULIB	
					INCREMENTAL	CUMULATIVE
<b>Inequality</b>						
Urban/rural income ratio	3.213	-0.012	-0.005	-0.006	-0.230	-0.242
Gini	0.438	-0.001	-0.001	-0.001	-0.015	-0.016
Urban	0.291	0.000	0.000	0.000	0.003	0.003
Rural	0.298	0.000	0.000	0.000	0.001	0.001
<b>Poverty Headcount</b>						
	(ratio,%)	Changes (percentage point)				
<u>Total</u>	31.3	-0.8	-0.4	-0.4	-3.3	-4.2
Urban	4.1	-0.1	0.0	0.0	0.3	0.2
Transfer-specialized	24.7	0.0	0.0	0.0	0.1	0.1
Labor-specialized	3.8	-0.1	-0.1	0.0	0.3	0.2
Diversified	2.5	-0.1	0.0	0.0	0.3	0.2
Rural	45.2	-1.2	-0.6	-0.6	-5.2	-6.4
Agriculture-specialized	54.3	-1.2	-0.5	-0.5	-4.7	-5.8
Diversified	44.1	-1.2	-0.6	-0.6	-5.3	-6.5
	(million persons)	(% change)				
<u>Total</u>	413.7	-2.7	-1.3	-1.2	-11.0	-13.4
Urban	18.2	-2.1	-1.2	-1.1	7.3	5.0
Transfer-specialized	5.3	-0.1	-0.1	-0.1	0.5	0.4
Labor-specialized	6.7	-2.5	-1.4	-1.3	8.5	5.8
Diversified	6.1	-3.5	-2.0	-1.8	12.0	8.1
Rural	395.5	-2.7	-1.3	-1.2	-11.8	-14.2
Agriculture-specialized	49.8	-2.1	-1.0	-0.9	-8.8	-10.7
Diversified	345.7	-2.8	-1.3	-1.3	-12.3	-14.7

Source: Simulation results.

value for the scenarios of Doha Round trade liberalization. In all the three scenarios, the largest increases in output are due to the expansion of textiles and apparel exports, as well as substantial increased production of synthetic fibers. Some agricultural sectors such as wool, corn, and grain milling and feedstuff could also enjoy a boost in output particularly under the *Full-Lib* scenario. At the other end of the spectrum, the most heavily protected sectors including automobiles, machinery, special equipment, nonferrous metal products, and vegetable oil, with their sizable trade exposure, experience declining output. In the case of global free trade, wheat production shows the largest reduction in output, due to the very large reduction in tariff under that scenario.

Trade volume changes associated with each of the trade reform experiments are reported in Table 6. With the exception of a few mining products and transport services for which there is no cut in protection, import volumes increase for all sectors in the economy in the scenarios of Doha Round trade liberalization. The largest increases are for automobiles, as well as textiles, apparel, and leather products where the demand for intermediate inputs increases strongly. Export volumes for most products also increase, especially for rice, corn, grain milling and feedstuff, and textile

**FIGURE 1**  
**CHANGE IN SECTOR OUTPUT—FULL-LIB**



**FIGURE 2**  
**CHANGE IN SECTOR OUTPUT—DOHA-SDT**

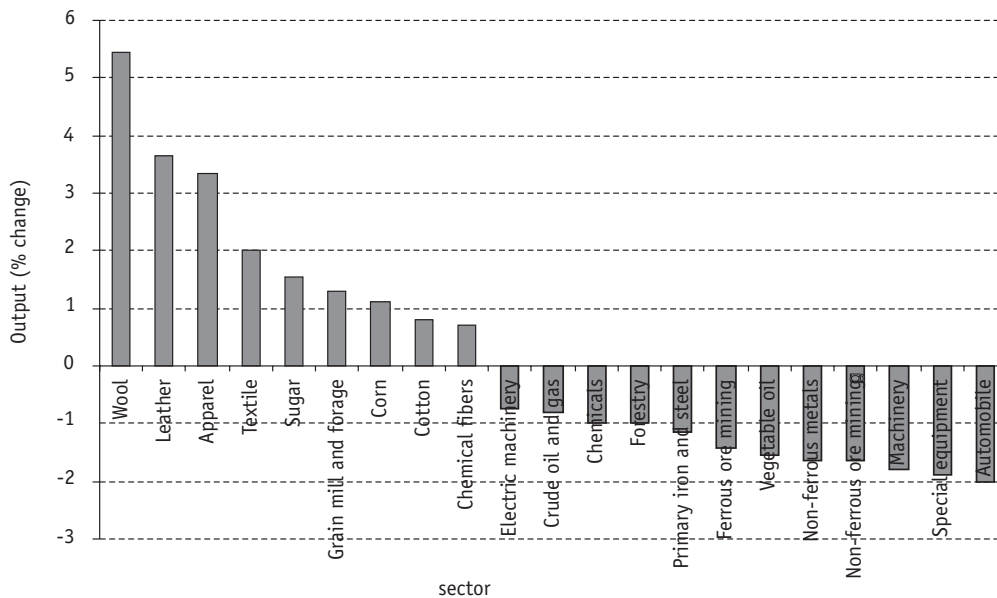
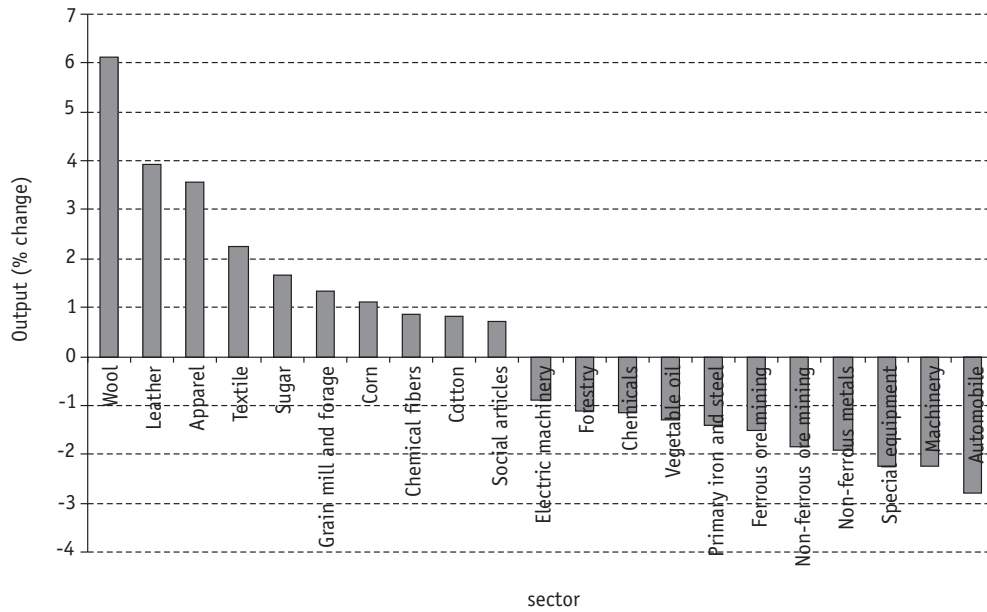




FIGURE 3  
 CHANGE IN SECTOR OUTPUT—DOHA-ALL



and apparel, fueled by increased demands in the global market. Those sectors with slight or negative increment in exogenous export demand, such as vegetable oil, nonferrous metals, some mining products, machinery, special equipment, and automobiles, experience reductions in export volumes in both scenarios of Doha Round trade liberalization.

In the case of global free trade, the changes in both imports and exports are much more significant. Despite relatively large increases in the world price of imports into the PRC, import volumes grow by 20–50% in most crops and food sectors, because of their large reduction in import protection. One exception is imports of rice, which would decline due to the low initial protection and large increment in import price. Similar to the cases of Doha Round trade liberalization, the rise of imports in automobile, textile, and apparel is also large. The sectors of agricultural and food, textile and apparel, as well as other transportation equipment are the major gainers in terms of export. However, there are also considerable manufacturing sectors that would experience losses in their exports.

The large expansion in the PRC's agricultural exports under the scenario of global free trade can be better understood against the backdrop of the significant cut in agricultural protection in Japan and Republic of Korea. Given its close geographic proximity to (and strong trade linkage with) these countries, the PRC would benefit from their strong agricultural import growth following global trade liberalization. However, as mentioned in the previous section, due to its small export volumes in most agricultural products, the PRC is still a small agricultural exporter in the world market. In the case of grain, our baseline scenario predicts that the PRC's exports of rice and corn will be 2.0 and 4.8 billion yuan (1997 prices), respectively, in 2005. Even under the scenario of

**TABLE 6**  
**SECTOR IMPACTS OF TRADE LIBERALIZATION: PERCENTAGE DEVIATION FROM BASELINE**

	FULL-LIB		DOHA-SDT		DOHA-ALL	
	IMPORT	EXPORT	IMPORT	EXPORT	IMPORT	EXPORT
Rice	-29.3	290.5	-0.6	60.7	-1.1	61.5
Wheat	83.7	-	0.6	-	0.1	-
Corn	55.2	54.4	6.6	13.4	7.3	13.7
Cotton	54.5	28.8	5.6	12.3	6.5	13.2
Other nongrain crops	33.6	22.1	2.9	7.0	3.4	7.5
Forestry	16.9	-2.5	5.2	-1.7	5.7	-1.3
Wool	2.7	27.9	2.9	5.8	3.3	6.7
Other livestock	2.2	4.3	3.1	0.3	3.1	0.7
Fishing	5.8	9.7	1.5	2.2	1.4	2.6
Other agriculture	17.3	34.9	2.5	13.5	3.7	14.0
Coal mining	15.2	-0.9	4.9	-0.6	6.4	0.3
Crude oil and natural gas	1.0	-1.8	0.1	-0.8	-0.3	-0.4
Ferrous ore mining	-2.5	-1.0	0.1	-1.0	-0.1	0.0
Nonferrous ore mining	-3.6	-3.1	0.0	-1.4	-0.5	-1.0
Other mining	1.6	0.1	0.6	0.0	0.8	0.3
Vegetable oil	29.0	20.1	5.2	-4.8	5.0	-3.7
Grain mill and forage	-2.2	247.4	-3.2	29.5	-3.6	30.1
Sugar	38.1	162.7	0.9	22.7	0.9	24.2
Processed food	18.1	32.8	7.7	1.7	8.4	2.3
Beverage	17.1	18.4	3.4	2.3	3.4	2.6
Tobacco	7.3	17.3	2.8	2.3	2.5	2.6
Textile	12.9	15.6	7.4	5.6	8.4	6.4
Apparel	15.2	13.0	7.1	8.5	8.8	9.2
Leather	13.1	12.9	9.8	9.5	11.1	10.5
Sawmills and furniture	4.5	-1.6	3.0	-0.5	3.7	0.1
Paper and printing	4.0	-1.7	2.6	-0.7	3.1	-0.1
Social articles	0.7	-1.6	2.7	1.1	2.7	1.6
Petroleum refining	7.9	1.8	2.5	-0.2	3.2	0.4
Chemicals	6.6	0.8	3.2	0.1	4.2	0.8
Medicine	12.3	1.4	5.1	0.2	6.4	1.0
Chemical fibers	10.5	1.9	5.6	2.0	6.3	3.1
Rubber and plastics	6.1	0.2	3.4	1.5	4.6	2.5
Build materials	11.7	5.0	4.9	1.6	6.9	2.3
Primary iron and steel	3.2	-1.7	2.0	0.6	2.5	1.0
Nonferrous metals	1.2	-3.4	1.6	-0.4	1.9	-0.2
Metal products	8.2	2.6	4.2	1.6	5.4	2.3
Machinery	7.1	-12.1	3.4	-3.0	4.4	-3.3
Special equipment	4.5	-12.0	2.4	-3.0	2.8	-3.3
Automobile	26.8	-11.1	9.4	-2.6	13.4	-2.9
Other transport equipment	6.9	11.5	3.8	1.9	4.3	2.8
Electric machinery	9.7	-3.3	4.9	0.8	6.5	1.5
Electronics	-1.6	-5.8	0.9	-0.2	1.2	0.3
Instruments	3.0	-3.7	1.9	0.6	2.5	1.3
Other manufacturing	5.9	-2.2	3.6	0.3	4.9	0.7
Utilities	-1.4	-0.2	1.1	-0.3	0.4	0.2
Construction	-0.8	-2.4	1.4	-1.0	1.0	-0.5
Transportation	-1.2	-1.1	0.7	-0.7	0.2	-0.3
Post and communications	-1.7	-0.7	0.8	-0.3	0.4	0.0
Commerce	-0.5	-1.5	1.0	-0.8	0.5	-0.5
Finance	-0.5	-1.8	1.4	-0.7	1.0	-0.4
Social services	-0.5	-1.6	1.4	-0.7	1.0	-0.3
Education and health	0.2	-2.7	1.7	-0.9	1.3	-0.6
Public administration	0.0	-2.8	1.6	-1.0	1.2	-0.6

Source: Simulation results.

global free trade, its exports of rice and corn are only 7.9 and 7.5 billion yuan (1997 prices). These changes are in line with recent annual fluctuations in exports of these commodities.<sup>9</sup>

## D. Household Impacts

Figures 4a to 4c report the household impacts of trade liberalization, by stratum, across the vintile spectrum. The first point to note from Figure 4a is that global trade liberalization benefits all households, except those reliant on transfers. Since the transfers are constant in real terms, and transfers comprise most of their income, the latter group is little affected by trade liberalization. Among the other urban households, the smallest welfare increases in Figure 4a are associated with urban diversified households. This contrasts with the relatively larger gains by the urban, labor-specialized households. The difference is attributable to the fact that the urban diversified households have significant income from capital earnings—particularly the wealthiest households. Since the increases in return rates of other factors are larger than the increases in capital stock, the highest-income, diversified households benefit proportionately less than the other, labor-specialized urban household groups. The largest increases in welfare following global trade liberalization accrue to the rural households, especially the wealthier, agriculture-specialized households. They benefit from the fact that returns to agricultural land increase relative to other factor prices. Real income rises less for rural diversified households due to the dominance of nonfarm wage earnings. Similar patterns of household incidence emerge from the Doha scenarios.

## E. Impact of Investing in Rural Education

As noted previously, one of the keys to enhancing the welfare of the rural poor—particularly those reliant on agriculture for their income—is to enhance their off-farm opportunities. Education has proven to be one of the key determinants of off-farm labor supply. Therefore, we now consider the impact of improved access to education for rural households, in conjunction with the experiment of global free trade implemented previously. The incremental aggregate effects of rural education reform are reported in the sixth column of Table 4. Real GDP and welfare rise by 1.3% and 1.2%, respectively, as a result of increasing rural education spending by 16 percent. Clearly from an economywide point of view, rural education is a favorable investment, given our assumptions about productivity differentials, education costs, and financing mechanisms.

Three factors contribute to the observed GDP growth following investment in rural education:

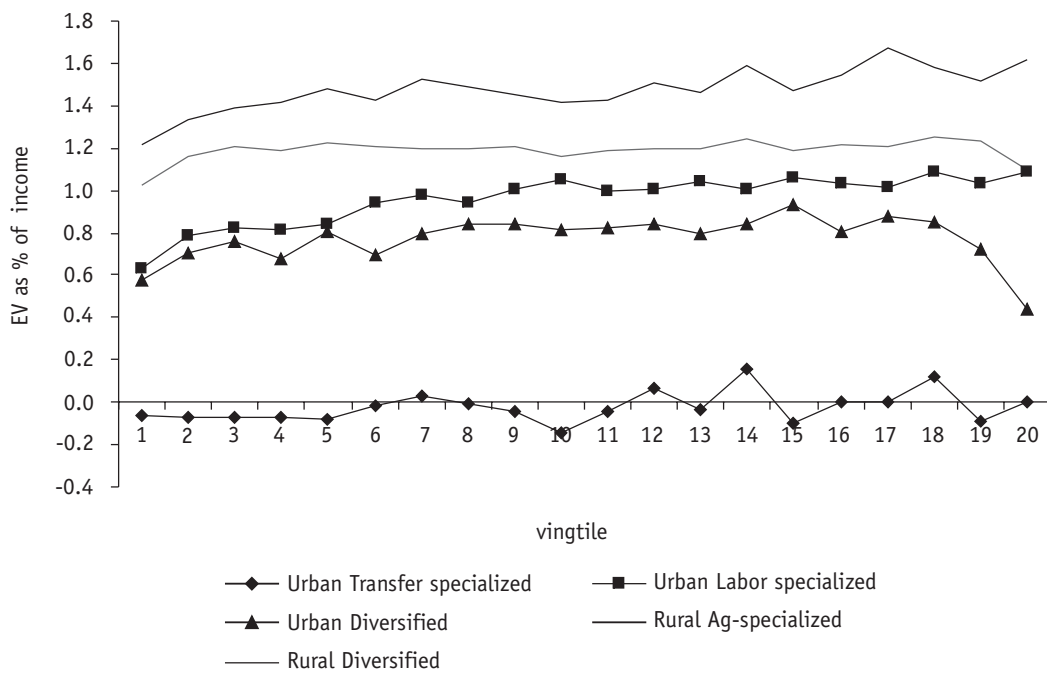
- (i) Due to improved access to education, average schooling attainment of unskilled rural labor increases by 1.7 years.<sup>10</sup> It results in higher productivity, which largely offsets the decline in the amount of unskilled labor supply.

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<sup>9</sup> In the case of rice exports, this increase is comparable in size to that observed between 1997 and 1998, where rice exports increased from about 2 billion yuan to nearly 9 billion yuan, after which it steadily declined, returning to about 2 billion yuan by 2004. In the case of maize, the projected change is smaller than recent annual export fluctuations.

<sup>10</sup> The model predicts that only the unskilled labor force will experience an increment in schooling attainment because we assume a proportional increase in the school participation rates across grades. Thus the increase in semi-skilled labor at the low end is offset by a reduction at the high end as more semi-skilled labor becomes skilled. However, at the low end, the increase in unskilled labor is fueled by a decline in the share of illiterate people in the unskilled labor force.

**FIGURE 4A**  
**IMPACTS ON HOUSEHOLDS—FULL-LIB**



**FIGURE 4B**  
**IMPACTS ON HOUSEHOLDS—DOHA-SDT**

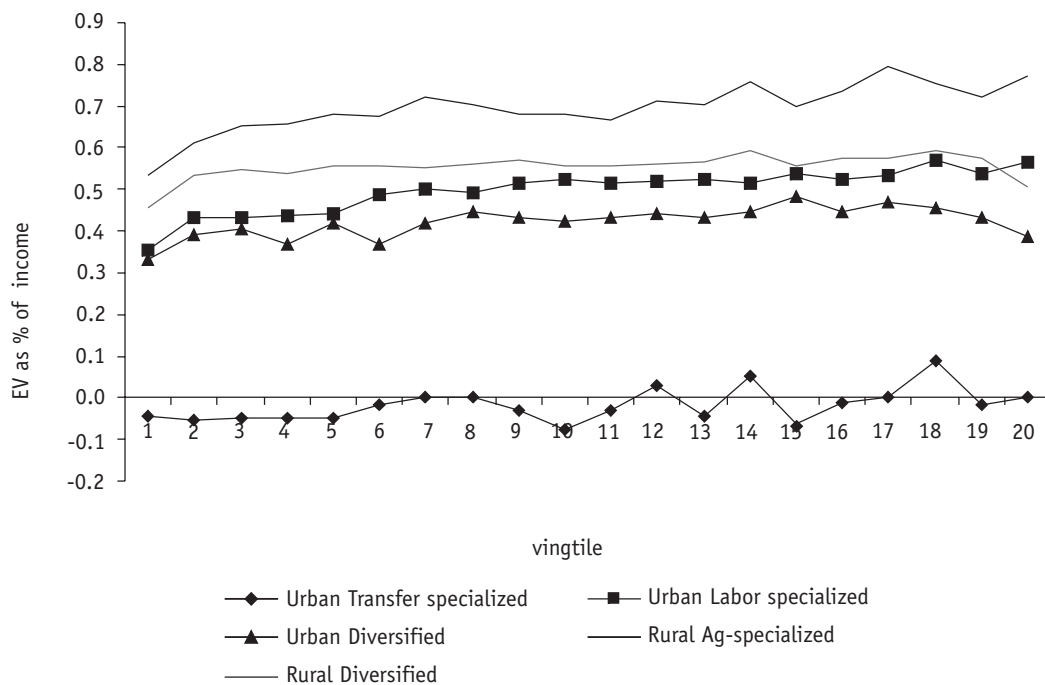
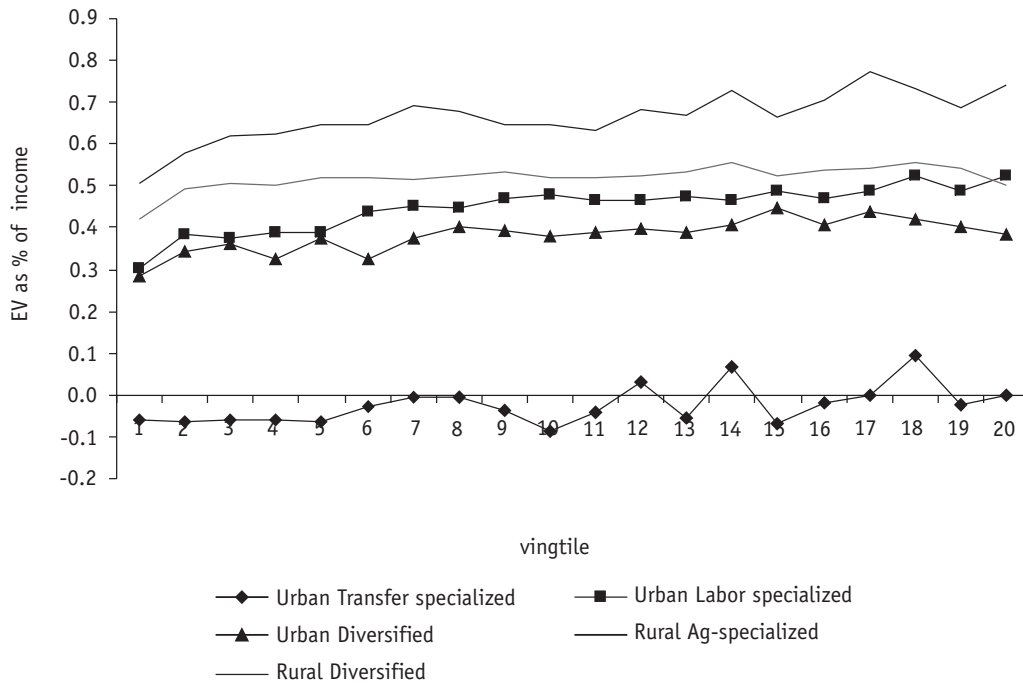


FIGURE 4C  
 IMPACTS ON HOUSEHOLDS—DOHA-ALL



- (ii) As a result of improved rural education, the supply of rural semi-skilled and skilled labor increases by 16% and unskilled labor declines by 23 percent. This favorable change in skill composition induces an economywide productivity gain. On the other hand, the foregone loss of working hours from higher school participation rates is quite modest, with the supply of aggregated rural labor force declining by only 0.29 percent.
- (iii) Higher educational attainment improves off-farm labor mobility. Due to improved rural education, 4.9 million additional workers leave agriculture and an additional 2.0 million temporal migrants move to urban areas. This movement of labor from relatively low-productivity sectors (agriculture and rural nonfarm employment), into higher-productivity activities (rural nonfarm work, and urban employment, respectively), also boosts overall productivity.

With a large increase in the pool of semi-skilled rural workers of 42.4 million, migration among this group out of agriculture increases by 13.3 million workers. Temporary migration of semi-skilled workers to urban areas also rises by 10.5 million workers, contributing to a decline in urban semi-skilled wage rates. Since we abstract from transitional costs associated with the rural–urban temporal migration of skilled labor, the bulk of the increased supply of rural skilled workers (around 1.9 million, or 82% of the supply increment) migrates to urban areas. However, its impact on the urban skilled wage is very limited, given the small size of temporary skilled migration compared to the stock of urban skilled workers. On the other hand, with the combination of a diminished supply and an enhanced schooling attainment of unskilled workers in the rural areas, wages for this group rise sharply. As a consequence, both off-farm employment and temporary migration of unskilled labor to urban areas actually decline.

The distributional impacts of improved rural education may be seen in Figure 5a, which reports the *incremental* welfare change of disaggregated household groups in urban and rural PRC. Most urban households lose under this scenario, as they face more intense competition from increasingly well-educated and mobile rural workers. Furthermore, given the closure rules used in our model, the additional government expenditure on rural education is financed via a direct tax on household income. Therefore, urban households pay part of the costs of rural education.<sup>11</sup> Lower-income households in the urban area experience bigger losses because they rely more heavily on semi-skilled labor income. As a consequence the urban Gini index rises by 0.003 (Table 5). On the other hand, rural household welfare rises for all households. The largest proportional increase in welfare is for the agriculture-specialized rural households that benefit from the strong increase in rural unskilled wages. Overall, the benefits from rural educational reform are spread relatively evenly across income levels, and the rural Gini index is hardly changed. The educational reform induces a 0.23 point decline in the urban-rural income ratio and a 0.015 decline in national Gini coefficient, indicating an important improvement in urban-rural income distribution in the PRC. Returning to Table 5, we see that the rural poverty headcount falls significantly, by 11.8%, following the investment in rural education. The largest fall is ascribed to diversified rural households. The poverty headcounts of urban labor-specialized, and diversified urban household groups increase by 8.5% and 12.0%, respectively. However, given the share of urban poverty in the overall population, the deterioration of urban poverty is more than offset by the alleviation of rural poverty, and national poverty headcount falls by 44.3 million.

The combined aggregate impact of both global free trade and improvement in rural education is reported in the final columns of Tables 4 and 5.<sup>12</sup> The results show that these reforms are potentially significant for the PRC economy. As a major indicator of overall efficiency, GDP increases by 1.2%, and aggregate welfare rises by 2.0 percent.

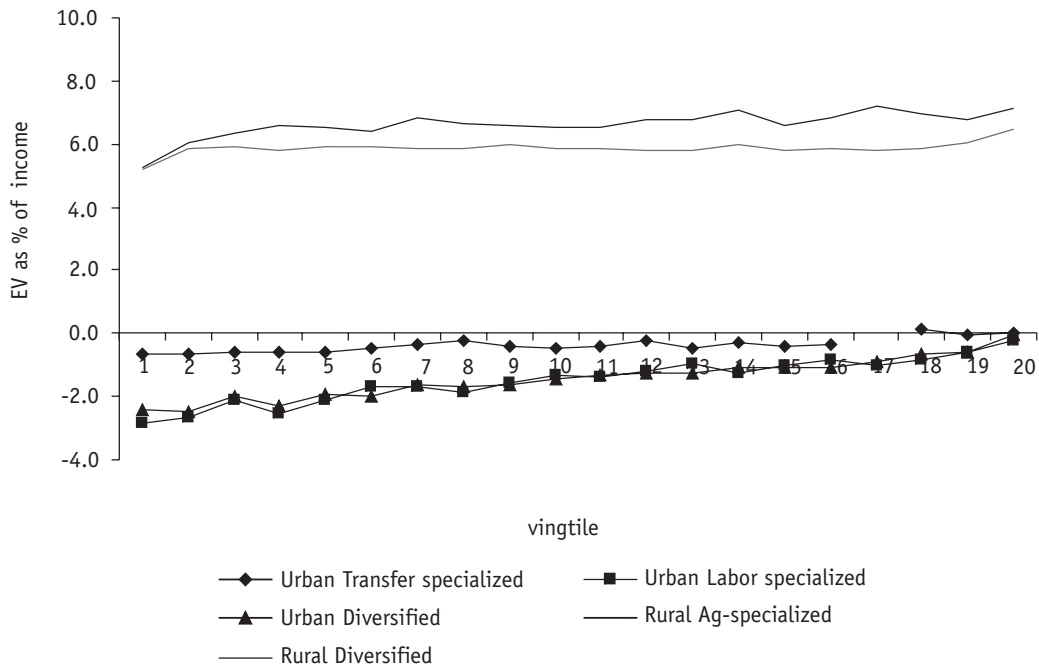
Figure 5b shows the cumulative effect of global free trade and educational reform on disaggregate urban and rural household welfare. Here, the potential urban-rural redistribution of welfare is striking. The equivalent variation for agriculture-specialized rural households is around 7–9% of initial income. Other rural households also benefit from these reforms. In contrast, urban household welfare falls by as much as 2% of initial income for the poorest urban households. Clearly the reforms aiming at global free trade and promoting rural education would boost rural household welfare; however, this does come at the expense of urban household welfare, particularly the lower-income groups. However, when viewed in an historical context, this redistribution is quite modest. It does little more than undo the worsening of the urban-rural income disparity that has arisen since 1998.

The combined education and trade reforms also contribute significantly to rural poverty reduction. The rural poverty headcount ratio declines by 14.2% from 45.2% in the base case to

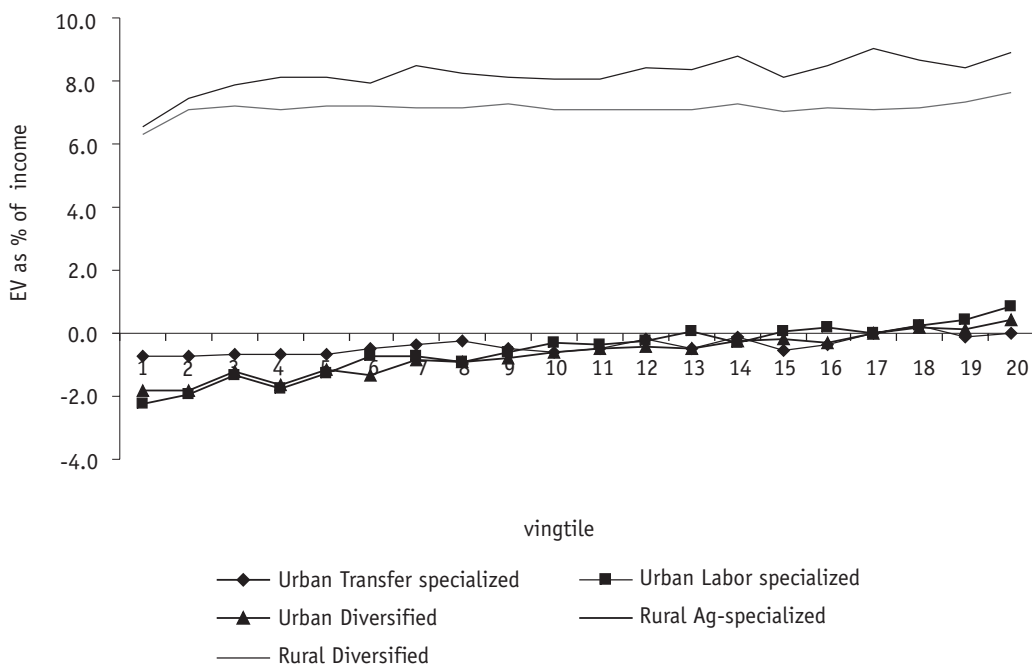
<sup>11</sup> As we assume that the income tax is levied on nontransfer incomes, urban transfer-specialized households do not bear the costs of additional rural education.

<sup>12</sup> In order to isolate the interaction between the rural education reforms and multilateral trade liberalization, we repeated the *Full-Lib* scenario using the database and parameters that result from implementation of the education reforms. The results of the *Full-Lib* experiment in the wake of education reform were nearly identical, suggesting that there is little interaction between the two policies. In other words, the cumulative impact of undertaking both sets of reforms is essentially the sum of the two individual impacts.

**FIGURE 5A**  
**INCREMENTAL IMPACTS ON HOUSEHOLDS—EDULIB**



**FIGURE 5B**  
**CUMULATIVE IMPACTS ON HOUSEHOLDS—EDULIB**



38.8% in the *EduLib* scenario, while the urban headcount ratio rises slightly from 4.07% to 4.27 percent. As a result, the national number of people in poverty nationwide declines by 55 million.

## VI. CONCLUSIONS AND POLICY IMPLICATIONS

The goal of this paper has been to assess the implications of multilateral trade reforms for poverty in the PRC. We do so by combining results from a global modeling exercise with a national CGE model that features disaggregated households in both the rural and urban sectors. We examine three different scenarios: one involving global trade liberalization, and two involving possible Doha Development Agenda reforms. Using the World Bank's \$2/day poverty line, we find that multilateral trade reforms do in fact reduce poverty in the PRC. The biggest reductions occur in the rural areas largely as a result of higher prices for farm products. Since this is where the bulk of the poor reside, this results in an overall reduction in poverty.

Urban poverty falls for two of the three household groups considered in this analysis, since the increased demand for PRC products in world markets boosts factor earnings sufficiently to offset the impact of higher food prices. For the remaining group, which is heavily dependent on transfer payments, we assume that indexation of these payments will largely offset the adverse consequences of higher prices. However, a decline in other income sources is sufficient to cause an increase in poverty, and this increase is large enough to boost the overall urban poverty headcount. However, the urban poor only represent 5% of the total poor in the PRC and thus the national poverty headcount falls.

We also explore the implications of complementary reforms in the PRC, in particular increased investments in rural education. These are aimed at increasing labor productivity, as well as enhancing the mobility of the rural labor force, thereby putting these workers in a better position to benefit from trade reforms. The specific scenario that we consider is one in which rural enrollment rises by 16 percent. Our analysis takes into account the cost of funding these additional students, as well as the reduction in the workforce that results from having more pupils in school. Nevertheless, these reforms generate very substantial gains for the PRC's economy. They also serve to boost rural incomes and reduce the incidence of rural poverty. Indeed, when combined with global trade liberalization, poverty in the PRC is estimated to drop by about 55 million people.

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