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STRUCTURAL CHANGE WITH PUBLIC EDUCATIONAL EXPENDITURE: EVIDENCE FROM THE PEOPLE'S REPUBLIC OF CHINA

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Abstract

This paper represents an early attempt to analyze the comprehensive relationship between public educational expenditure and structural change, which is often measured by labor transfer from agricultural sector to industrial sector in developing economies. I construct a two-sector general equilibrium model, showing that in the short term, public educational expenditure mainly crowds out industrial capital accumulation and thus temporarily hinders structural change, while there is an inverted-U relationship between them in the long run, as public educational expenditure helps reduce the educational cost of rural residents permanently. The People's Republic of China's (PRC) hukou system provides appropriate data to empirically identify this comprehensive relationship. The empirical evidence confirms the theoretical interpretations when I control for confounding factors, take the endogeneity of public educational expenditure into account, and investigate the mechanisms behind the relationship. The PRC's current level of public educational expenditure is still far from its optimal value, as indicated by the inverted-U relationship with structural change, suggesting that the PRC should increase spending on public education, especially for rural residents.

Keywords: public educational expenditure, structural change, crowding-out effect, human capital, People's Republic of China (PRC)

JEL Classification: I28, O11, O15

Contents

1. INTRODUCTION

There are two components of economic development: economic growth and structural change. At least since the work of Lucas (1988), human capital accumulation has been identified as a potential engine of growth. A natural question thus comes to mind: Is human capital accumulation also a potential engine of structural change? In fact, the story may be as simple as that of growth: Human capital accumulation, which provides the basic labor skills for modern economic activity, facilitates rural residents' transfer to the nonagricultural sector and promotes structural change. There is also considerable evidence to support a link between human capital accumulation and structural change, especially from the perspective of labor transfer. Examples include Sjaastad (1962), Shryock and Nam (1965), Greenwood (1969), Bowles (1970), Schultz (1982), Zhao (1999), and Lucas (2004).

To enhance human capital and thus promote structural change, the government must not only play a role in providing funds for schooling, but must also put more emphasis on rural educational expenditure, as in most developing countries, structural change takes place in the transition of workers from the agricultural sector to the industrial sector. Growth in the industrial sector requires large numbers of laborers, who mostly live in rural areas of origin where there is low labor productivity and thus little money to pay for education.

However, public educational expenditure will not always promote structural change. The direct effect (the reduction of educational cost) can be diminished or even negated when other inputs to human capital accumulation are negatively affected by general equilibrium adjustments. If the reaction is severe enough, these equilibrium adjustments may dominate. Such equilibrium adjustments may also explain the reason why governments in most developing countries fail to provide enough public educational expenditure, especially in rural areas. Even if the equilibrium adjustments do not dominate in the long run, the short-term effects are inevitable. Government officials who are faced with career pressures will choose to underprovide funds for education in order to stimulate short-term economic growth, but this choice results in the stagnation of long-term sustainable economic development.

Therefore, a comprehensive analysis of public educational expenditure and structural change is needed, as this issue has largely been overlooked in development research, at least from an analytical perspective. This paper represents an early attempt to analyze the comprehensive relationship between public educational expenditure and structural change. Numerous articles analyze the general equilibrium adjustments of public educational expenditure on growth and show that the impact is nonmonotonic. For example, Brauninger and Vidal (2000) show that educational expenditure crowds out physical capital and lowers economic growth temporarily, while it maximizes the long-term growth rate. Similar research includes Devarajan, Swaroop, and Zou (1996), Sylwester (2000), Blankenau and Simpson (2004), and Blankenau, Simpson, and Tomljanovich (2006). This research, although not directly related to public educational expenditure and structural change, provides some analytical foundations for this paper. There are other works that argue that public educational expenditure has an indirect growth effect by encouraging private investment. This theory is found in Zhang (1996), Milesi-Ferretti and Roubini (1998), and Hendricks (1999), for example.

This paper firstly develops a general equilibrium model of public educational expenditure and structural change. In the model, I show that there is a nonmonotonic relationship between public educational expenditure and structural change. In the short term, public educational expenditure crowds out industrial capital accumulation,

reduces the demand of nonagricultural sectors for rural laborers, and thus temporarily hinders structural change. This is also why most governments underprovide public educational services. In the long run, even if public educational expenditure lowers the educational cost of rural residents, there is no reason to expect a positive linear relationship between public educational expenditure and structural change, and the relation between them still depicts an inverted-U curve. Reasonable public educational expenditure can promote structural change. Otherwise, the crowding-out effect still dominates the educational cost reduction effect.

The People's Republic of China's (PRC)'s *hukou* system makes it possible to empirically identify the comprehensive relationship between public educational expenditure (see detailed description in Section 4) and structural change. The empirical evidence, when I control for confounding factors, take into account the endogeneity of public educational expenditure, and investigate the mechanisms behind the relation, confirms the theoretical interpretations. It is noteworthy that the findings of this paper do not diminish the relevance of structural change and public educational expenditure, but rather point to the importance of recognizing the complex and possibly nonmonotonic nature of the expenditure-structure relationship. Furthermore, this analysis highlights the importance of considering appropriate policies that can help turn government educational expenditure into a more efficient engine of sustainable economic development.

The current research is especially relevant in the context of the PRC today. The *hukou* system[1] in the PRC still hinders rural-to-urban migration in the PRC by discriminating against migrants in terms of educational, medical, and other welfare assistance. Therefore, public educational expenditure on rural residents serves as an important way to reduce the negative effect of the *hukou* system on structural change and rural-to-urban migration. Rural residents, due to their identities, stay in rural areas at least when they are children and cannot enjoy high-quality education due to urban-rural educational disparity, which further prevents them from migrating to cities and getting qualified jobs. Therefore, if one's rural *hukou* status cannot be altered due to administrative difficulties, one possible and very important way to alleviate the effect of the *hukou* system on structural change is to increase educational expenditure and improve the educational quality for rural residents, so that rural residents can overcome human capital disadvantages and migrate to the city to work. In fact, if the government itself wishes to remove the *hukou* system, what it can do is to also remove the discrimination on educational, medical, and other welfare assistance. Therefore, if any discrimination on educational, medical, and other welfare assistance is mitigated, the hurdle of the *hukou* system is also reduced, especially in the context that the PRC's level of public educational expenditure is still far from its optimal value, suggesting that the PRC should increase spending on public education, especially for rural residents.

The rest of the paper proceeds as follows. Section 2 develops a general equilibrium model of structural change with two sectors and discusses the short-term and long-term effect of public educational expenditure on structural change, as well as human capital. Section 3 provides the empirical specifications. In Section 4, I introduce

[1] *Hukou* is a household registration system that was introduced in 1958 to control rural-to-urban migration in the PRC. At that time, a Chinese citizen was given a rural or urban *hukou*. Newborn children inherit their *hukou* status from their mothers. The urban *hukou* is associated with certain privileges and entitlements (social security and public services) that the rural citizens cannot enjoy, even today. It has been very difficult to alter one's *hukou* status. Before the early 1990s, rural citizens could not migrate to cities and towns. More recently, migration has been allowed, but the *hukou* system still discriminates against migrants in terms of educational, medical, and other welfare assistance.

the data for empirical analysis. Sections 5 and 6 provide both empirical results and robustness checks. Section 7 concludes.

2. A MODEL OF STRUCTURAL CHANGE

The theoretical framework begins with a simple variant of the standard dynamic two-sector model of Lucas (2004). The modeled economy is a closed economy and consists of a rural or agricultural sector and an urban or industrial sector and is populated by overlapping generations of two-period-lived agents. Extending the model to an open economy does not alter the results. All agents are born in rural areas and only work for one period and retire in the second period. In the first period, they decide which sector to work in.

2.1 Production

Let *t* index time, 1 index rural sector, *Y* denote output, and *L* denote labor input. The production function of the agricultural sector includes land (*B*), the amount of which is fixed, and labor (L_1), and follows the diminishing marginal product of labor (Gollin, Parente, and Rogerson, 2002; Yang and Zhu 2013):

$$Y_{1t} = BL_{1t}^{\gamma} \tag{2.1}$$

where $0 < \gamma < 1$. As is conventionally assumed, agricultural goods cannot be stored and must be consumed in the same period of production.[2] Profit maximization requires:

$$w_{1t} = \gamma BL_{1t}^{\gamma-1} \tag{2.2}$$

where *w* is the nominal wage.

The industrial sector is characterized by the standard Cobb-Douglas production function:

$$Y_{2t} = K_t^{\alpha} L_{2t}^{1-\alpha} \tag{2.3}$$

where 2 indexes the urban sector, and *α* denotes the capital share. Capital stock, denoted by K_t, is assumed to be accumulated using industrial output Y_{2t} and fully depreciated within the first period. Here I assume the production function to be a constant return to scale for simplicity. The model results are robust under different assumptions of the production function, including the increasing return to scale as recently argued by studies on urban economics. Using $R_t$to denote the nominal return to capital:

$$R_t = p_t \alpha K_t^{\alpha-1} L_{2t}^{1-\alpha} \tag{2.4}$$

and

[2] The model could be easily extended to incorporate the effect of agricultural machinery, which will increase rural labor productivity and further promote urbanization and structural change, as Gollin, Parente, and Rogerson (2002) and Yang and Zhu (2013) argued. In this case, public educational expenditure will become more essential as it can remove the human capital barrier to working in urban areas. However, incorporating agricultural machinery results in no closed-form solution of the model. Therefore, I assume that the effect of agricultural machinery is constant over time in this paper.

$$w_{2t} = p_t(1-\alpha)K_t^{\alpha}L_{2t}^{-\alpha} \tag{2.5}$$

where p_t denotes the relative price of industrial output compared to agricultural good.

The total labor supply *L* is:

$$L_{1t} + L_{2t} = L. \tag{2.6}$$

The structure of the economy v_t is defined as the ratio of the labor force in the modern sector to the total labor force, that is, $v_t = L_{2t}/L$, which closely reflects the sector output share. Therefore, the increase of v_t is considered a structural change.

2.2 Preference

Agents are defined, with time-separable and nonhomothetic preferences, over the per capita consumption of agricultural goods, c_{1t}^t, and industrial goods, c_{2t}^t:

$$U_i^t = \mu ln\left(c_{i,1t}^t\right) + (1-\mu)ln\left(c_{i,2t}^t\right) + \beta\left[\mu ln\left(c_{i,1,t+1}^t\right) + (1-\mu)ln\left(c_{i,2,t+1}^t\right)\right], i = 1,2. \tag{2.7}$$

$c_{i,1,t+1}^t$ measures the per capita agricultural goods consumption at time *t+1* of the agents born at time *t*. β is the rate of time preference and μ stands for the preference weight between agricultural and industrial goods.

The budget constraints of agents are thus in a two-period form. At time t, agents consume two goods and save for their retirement at time t+1:

$$c_{i,1t}^t + p_t c_{i,2t}^t + p_t s_i^t = w_{it} \tag{2.8}$$

where s_i^t is the amount of savings for agents working in sector *i*. The savings are thus converted into capital stock at time *t+1*. Agents retire at time t+1 and consume the capital gain as well as the savings principal:

$$R_{t+1}s_i^t = c_{i,1,t+1}^t + p_{t+1}c_{i,2,t+1}^t. \tag{2.9}$$

Therefore, I obtain the combined budget constraint using (2.8) and (2.9):

$$\frac{c_{i,1t}^t}{p_t} + c_{i,2t}^t + \frac{1}{R_{t+1}}\left(c_{i,1,t+1}^t + p_{t+1}c_{i,2,t+1}^t\right) = \frac{w_{it}}{p_t}. \tag{2.10}$$

For agents working in the agricultural sector, $w_{it} = w_{1t}$; and for those in the industrial sector, $w_{it} = w_{2t}$.

The solutions of the utility maximization problem are given by

$$\begin{cases} c_{i,1t}^t = \frac{\mu}{1+\beta}w_{it} \\ c_{i,2t}^t = \frac{1-\mu}{1+\beta}\frac{w_{it}}{p_t} \\ c_{i,1,t+1}^t = \frac{\mu\beta R_{t+1}}{1+\beta}\frac{w_{it}}{p_t} \\ c_{i,2,t+1}^t = \frac{(1-\mu)\beta R_{t+1}}{(1+\beta)p_{t+1}}\frac{w_{it}}{p_t} \end{cases} \tag{2.11}$$

Therefore, the utility difference between agents working in the agricultural sector and the industrial sector is simply the wage difference between the two sectors.

Using (2.10) and (2.11), I can also calculate the agents' savings function (see (2.12)):

$$s_i^t = \frac{w_{it}}{p_t} - \frac{c_{i,1t}^t}{p_t} - c_{i,2t}^t = \frac{\beta}{1+\beta}\frac{w_{it}}{p_t} \tag{2.12}$$

2.3 Labor Transfer Decision

As indicated by Harris and Todaro (1970) and Chau (1997), labor transfer, and thus structural change, will continue as capital is accumulated. In the case of no labor market friction, labor transfer will occur as long as the wage difference between the industrial sector and the agricultural sector exists, that is, $w_{2t} > w_{1t}$. Let χ_t be the binary variable of the labor transfer decision. It equals 1 when an agent chooses to transfer to the industrial sector and 0 when he decides to stay in the agricultural sector. Clearly:

$$\chi_t = \begin{cases} 1 \; if \; w_{2t} \geq w_{1t} \\ 0 \; if \; w_{2t} < w_{1t} \end{cases} \tag{2.13}$$

Labor market equilibrium is achieved when $w_{2t} = w_{1t}$.

However, labor transfer is not friction-free. In developing economies, the lack of education may restrict rural laborers from transferring to the industrial sector, even if labor-intensive industries. Therefore, it is probable that even if there is a wage difference between the two sectors ($w_{2t} \geq w_{1t}$), labor transfer will still not happen ($\chi_t = 0$). In this case, structural change will be hindered by inadequate education and underinvestment of human capital in rural areas.

To illustrate this, let us consider a simple case in which the necessary amount of human capital investment in order to work in the industrial sector is constant at *E*. At time *t*, the agent observes the wage difference between the two sectors and decides whether to transfer to the industrial sector. If he decides to transfer, he should spend *E* on education. The assumption here is that education is only a signal of high-skill labor. The signal permits the laborers to work in the industrial sector. The model can also be extended to allow for human capital accumulation (Lucas 2004) without altering the model results.

It is thus clear that the decision of whether to become educated (human capital investment) and the decision of labor transfer both depend on whether the wage gap between the industrial and rural sectors is larger than *E*. Let ζ_t be the binary variable of education decision, then:

$$\zeta_t = \chi_t' = \begin{cases} 1 \; if \; w_{2t} - E \geq w_{1t} \\ 0 \; if \; w_{2t} - E < w_{1t} \end{cases} \tag{2.14}$$

In equilibrium, there should be no difference between working in either sector. Therefore, the industrial labor income subtracted from the amount of educational expenditure (*E*, or educational cost) should be equal to rural labor income:

$$w_{2t} = w_{1t} + E = \gamma B L_{1t}^{\gamma-1} + E \tag{2.15}$$

Clearly, (2.15) describes the labor market equilibrium with market friction.

It is noteworthy that the decisions to become educated and to transfer to the industrial sector are endogenous in the modeled economy. In fact, the development of the industrial sector, especially capital accumulation, will increase the capital per industrial

laborer, the labor income (w_{2t}), and thus the wage gap between the two sectors. Therefore, the incentives for education and labor transfer become higher. More rural agents will transfer to the industrial sector and drive down the industrial labor income to a new equilibrium. This can be illustrated by inserting (2.2) and (2.4) into (2.15) and achieving the relation between educational cost and labor transfer:

$$p_t(1-\alpha)K_t^{\alpha} = \left(\gamma B L_{1t}^{\gamma-1} + E\right)L_{2t}^{\alpha} \tag{2.16}$$

Obviously, given capital stock K_t, the higher the educational cost, the lower the number of industrial laborers there will be. In other words, educational cost reduction can stimulate labor transfer and promote structural change. (2.16) can be further rewritten using an economic structure and capital per capita (see (2.17)):

$$p_t(1-\alpha)k_t^{\alpha}v_t^{-\alpha} = \gamma B(1-v_t)^{\gamma-1}L^{\gamma-1} + E \tag{2.17}$$

where k_t is capital per capita.

2.4 Equilibrium and Steady State

The laissez-faire market equilibrium consists of labor market, product market, and capital market equilibria. Labor market equilibrium is characterized by (2.17). According to Walras' law, the rural product market and capital market equilibria are still needed.

As I have assumed that agricultural goods cannot be stored, they should be consumed by households that are born in the current and last period, as characterized by (2.18):

$$Y_{1t} = BL_{1t}^{\gamma} = c_{1,1t}^{t}L_{1t} + c_{2,1t}^{t}L_{2t} + c_{1,1t}^{t-1}L_{1,t-1} + c_{2,1t}^{t-1}L_{2,t-1} \tag{2.18}$$

Simplifying (2.18) using the per capita and economic structure notations, I achieve (2.19):

$$\begin{aligned} BL^{\gamma-1}(1-v_t)^{\gamma} = {} & \frac{\mu}{1+\beta}\left[\gamma B(1-v_t)^{\gamma-1}L^{\gamma-1} + Ev_t\right] + \\ & \frac{\mu\beta R_t}{1+\beta}\frac{1}{p_{t-1}}\left[\gamma B(1-v_{t-1})^{\gamma-1}L^{\gamma-1} + Ev_{t-1}\right] \end{aligned} \tag{2.19}$$

Therefore, rural product market equilibrium is characterized by (2.19).

Capital market equilibrium (or industrial product market equilibrium) is simply the capital accumulation function:

$$K_{t+1} = s_1^t L_{1t} + s_2^t L_{2t} \tag{2.20}$$

Rewrite (2.20) using k_{t+1}:

$$p_t k_{t+1} = \frac{\beta}{1+\beta}\left[\gamma B(1-v_t)^{\gamma-1}L^{\gamma-1} + Ev_t\right] \tag{2.21}$$

Definition 1 The general equilibrium of the modeled economy, $\{k_t, v_t, w_{1t}, w_{2t}, p_t, R_t\}$, is characterized by (2.2), (2.4), (2.5), (2.14), (2.17), (2.19), and (2.21).

The key factor of the general equilibrium in Definition 1 is the labor transfer and structural change driven by capital accumulation in the industrial sector. To characterize the relation between educational cost (*E*) and structural change, I solve the steady-state equilibrium thus:

$$\begin{cases} \frac{\bar{R}}{\bar{p}} = \alpha \bar{k}^{\alpha-1} \bar{v}^{1-\alpha} \\ \bar{p}(1-\alpha)\left(\frac{\bar{k}}{\bar{v}}\right)^{\alpha} = \gamma B(1-\bar{v})^{\gamma-1} L^{\gamma-1} + E \\ B(1-\bar{v})^{\gamma} L^{\gamma-1} = \frac{\mu}{1+\beta}\left(1+\frac{\beta \bar{R}}{\bar{p}}\right)\left[\gamma B(1-\bar{v})^{\gamma-1} L^{\gamma-1} + E\bar{v}\right] \\ \bar{p}\bar{k} = \frac{\beta}{1+\beta}\left[\gamma B(1-\bar{v})^{\gamma-1} L^{\gamma-1} + E\bar{v}\right] \end{cases} \quad (2.22)$$

When the marginal product of labor is constant (implying $\gamma = 1$), I can achieve the explicit solution of $\{\bar{k}(E), \bar{v}(E), \bar{p}(E), \bar{R}(E)\}$ based on the equation system in (2.22), in which:

$$\bar{v}(E) = \left[E + \frac{1+\beta}{\mu} B + \frac{\alpha}{1-\alpha}(1+\beta)(B+E)\right]^{-1} \left(\frac{1+\beta}{\mu} - 1\right) B \quad (2.23)$$

Obviously, I have $\bar{v}'(E) < 0$. The lower the educational cost, the larger the number of rural laborers transferring into the industrial sector, and the deeper the level of structural change will be. When there is diminishing marginal product of labor (implying $\gamma < 1$), we can also obtain the relationship between educational cost and structural change:

$$\left(\frac{1+\beta}{\mu} - \gamma\right) B L^{\gamma-1} - \frac{(1+\beta) B L^{\gamma-1}}{\mu}\left(1 + \frac{\alpha\gamma\mu}{1-\alpha}\right)\bar{v} = E\left[1 + \frac{\alpha}{1-\alpha}(1+\beta)\right]\bar{v}(1-\bar{v})^{1-\gamma} \quad (2.24)$$

Obviously, I also have $\bar{v}'(E) < 0$. Thus, I summarize the key finding in Proposition 1:

Proposition 1. *Educational cost is negatively correlated with structural change: The reduction of educational cost will stimulate the labor transfer from the rural sector to the industrial sector and thus promote structural change.*

Further, according to (2.24), if educational cost becomes infinite, then $\bar{v}(E = \infty) = 0$, indicating that all the laborers stay in the rural sector. In turn, if educational cost is negligible and labor market is friction-free, I have:

$$\bar{v}(E = 0) = \left[\frac{1+\beta}{\mu} + \frac{\alpha}{1-\alpha}(1+\beta)\gamma\right]^{-1} \left(\frac{1+\beta}{\mu} - \gamma\right) = \psi < 1 \quad (2.25)$$

The implication of (2.25) is that structural change will not result in the disappearance of the agricultural sector because physical capital is being accumulated in the process of structural change. A higher level of structural change requires larger savings and less consumption, which violates the golden rule as well as the utility maximization principle.

I summarize the findings above in Proposition 2.

Proposition 2. *The structure of the economy at steady state satisfies* $\bar{v} \in [0, \psi]$. *When labor market friction is large enough so that educational cost becomes infinite, all the laborers stay in the agricultural sector. When market friction is small, the economic structure is positive but still less than 1.*

2.5 Structural Change with Public Educational Expenditure

The above general equilibrium model confirms that the reduction of educational cost can increase the level of labor transfer and structural change. The implication of the model is that in order to promote structural change, government can increase the public educational expenditure in rural areas, which can directly reduce educational costs for rural residents.

However, public educational expenditure needs time to be effective so it can contribute to human capital enhancement and structural change. Moreover, public educational expenditure is not without cost. Specifically, it needs to be financed, either by government debt or tax revenue. According to the Ricardian equivalence, there is no difference between taxation and debt issuance in terms of their long-term effects. Moreover, either taxation or government debt will create distortions in agents' and firms' decision-making. In the modeled economy, government taxation on the industrial sector may crowd out physical capital accumulation, reduce the demand for transferred laborers, hinder the process of structural change, and result in deadweight loss.

Next I formally incorporate government into the model.[3] I assume that the modeled economy reaches the steady-state equilibrium as described in (2.22) at time *t-1*. At time *t*, the government announces the imposition of a tax on industrial laborers with tax rate *τ*, and uses the tax revenue to subsidize public educational expenditure, especially for rural residents. The expenditure could reduce the educational cost, but the cost reduction will not be effective until time *t+1*. At the end of each period, the government's budget is balanced. Therefore, the income-expenditure equation becomes:

$$\tau w_{2t} L_{2t} = \Delta E_{t+1} L_{2,t+1} \tag{2.26}$$

The left-hand side of (2.26) is the tax revenue, while the right-hand side is educational expenditure. ΔE_{t+1} is the public educational expenditure for each transferred laborer. It can also be seen as the reduction of educational cost (see (2.27)):

$$E_{t+1} = E - \Delta E_{t+1} \tag{2.27}$$

2.5.1 Short-term Effects

First, I consider the short-term effects of public educational expenditure. At time *t*, as can be seen from (2.28), the imposition of a tax encourages the decline of labor demand in the industrial sector:

$$w_{2t} = B + E = (1-\alpha)(1-\tau) p_t K_t^{\alpha} L_{2t}^{-\alpha} = (1-\alpha)(1-\tau) p_t \bar{k}^{\alpha} v_t^{-\alpha} \tag{2.28}$$

where capital stock K_t is determined by the steady-state total savings at time *t-1* and satisfies $K_t = \bar{k}L$. Combined with (2.5) and (2.19) and after some manipulation, I obtain the function of economic structure at time *t*:

$$v_t = \left[E + \frac{1+\beta}{\mu} B + \frac{\alpha}{1-\alpha} \frac{(1+\beta)(B+E)}{1-\tau}\right]^{-1} \left(\frac{1+\beta}{\mu} - 1\right) B \tag{2.29}$$

[3] To give a closed-form solution, I assume a constant marginal product of labor in the following section. Assuming a diminishing marginal product of labor does not alter the results.

Obviously, (2.29) reduces to (2.24) when the tax rate is 0. As the tax rate increases, the short-term labor demand from the industrial sector declines, as does the level of structural change ($\frac{dv_t}{d\tau} < 0$) and the industrial output per capita at time *t*:

$$y_{2t} = \bar{k}^{\alpha} v_t^{1-\alpha} \tag{2.30}.$$

Further, the physical capital stock is also reduced:

$$k_{t+1} = \bar{k}^{\alpha} \frac{\beta}{1+\beta} \frac{1-\alpha}{B+E} \frac{(1-\tau)(1+Ev_t)}{v_t^{\alpha}} \tag{2.31}$$

where $1 + Ev_t/v_t^{\alpha}$ is positively correlated with v_t. Therefore, as the tax rate increases, both $1 + Ev_t/v_t^{\alpha}$ and $(1 - \tau)$ decrease, and so does k_{t+1}.

The findings of the short-term effects of public educational expenditure are summarized in Proposition 3:

Proposition 3. *Public educational expenditure has a short-term crowding-out effect: It distorts firms' decision-making, slows down the development of the industrial sector, and hinders the process of labor transfer and structural change.*

2.5.2 Long-term Effects

Next I discuss the long-term effects of public educational expenditure. Equations (2.26) and (2.27) are used to obtain a new steady-state equilibrium:

$$\begin{cases} B(1-\bar{\bar{v}}) = \frac{\mu}{1+\beta}\left[B + \left(E - \overline{\overline{\Delta E}}\right)\bar{\bar{v}}\right]\left(1 + \alpha\beta\bar{\bar{k}}^{\alpha-1}\bar{\bar{v}}^{1-\alpha}\right) \\ \bar{\bar{k}}^{1-\alpha}\bar{\bar{v}}^{\alpha}\left(B + E - \overline{\overline{\Delta E}}\right) = \frac{\beta}{1+\beta}(1-\alpha)(1-\tau)\left[B + \left(E - \overline{\overline{\Delta E}}\right)\bar{\bar{v}}\right] \end{cases} \tag{2.32}$$

The steady-state level of structural change is:

$$\bar{\bar{v}} = I(\tau)^{-1}\left(\frac{1+\beta}{\mu} - 1\right)B \tag{2.33}$$

where

$$I(\tau) = \frac{E - B\tau}{1+\tau} + \frac{1+\beta}{\mu}B + \frac{\alpha(1+\beta)}{(1-\alpha)}\frac{B+E}{1-\tau^2} = \frac{E - B\tau}{1+\tau} + \frac{1+\beta}{\mu}B + \frac{(B+E)\Lambda}{1-\tau^2}$$

where

$$\Lambda = \frac{\alpha(1+\beta)}{(1-\alpha)} > 0.$$

Obviously,

$$I'(\tau)\begin{cases} < 0 \; if \; \tau < \Lambda + 1 - \sqrt{\Lambda^2 + 2\Lambda} = \Pi \\ > 0 \; if \; \tau > \Lambda + 1 - \sqrt{\Lambda^2 + 2\Lambda} = \Pi \end{cases} \tag{2.34}$$

where $\Pi \in (0,1)$.

Therefore, in the long run, in line with the Laffer curve, there is an inverted-U-shaped relation between the tax rate and structural change. When the tax rate is relatively low so that $I'(\tau) < 0$ and $\bar{\bar{v}}'(\tau) > 0$, increases in the tax rate and public educational expenditure will promote structural change. However, as the tax rate passes Π, the turning point of the inverted-U curve, further increases in public educational expenditure will decrease the level of structural change as the development of the industrial sector is limited, even if the educational cost is already low enough. The optimal tax rate to maximize the level of structural change (or equivalently, urbanization) is thus obtained:

$$\tau_{Optimal} = \Lambda + 1 - \sqrt{\Lambda^2 + 2\Lambda} \tag{2.35}$$

I summarize the relation among public educational expenditure, structural change, and human capital in Proposition 4:

Proposition 4. *There is an inverted-U-shaped relation between the tax rate and structural change: When the tax rate is on the left of the inverted-U curve, increases in public educational expenditure will promote structural change. However, as the tax rate passes the turning point of the inverted-U curve, a further increase in public educational expenditure will hinder structural change.*

Therefore, if a government's objective is to maximize long-term economic growth or structural change, it will choose the optimal tax rate and expend money on public education, regardless of its short-term crowding-out effect. However, most governments, especially local governments, are faced with periodic assessments of economic growth and can only focus on short-term economic indicators. According to (2.30) and (2.31), any public educational expenditure will bring down economic growth as well as capital accumulation. Therefore, governments with short-term objectives are discouraged from spending on public education, resulting in long-term economic stagnation.

In sum, the model characterizes the complete relation between public educational expenditure and structural change. In the short term, public educational expenditure has a crowding-out effect and hinders structural change temporarily. This is also the reason for "government myopia." In the long run, there is an inverted-U-shaped relation between the tax rate and structural change. Under reasonable circumstances, increases in public educational expenditure can encourage long-term structural change, which lays the foundation for sustainable economic growth.

3. EMPIRICAL SPECIFICATION

The main empirical implications that I draw from the theory are:

- *The short-term effect of public educational expenditure on structural change is negative.*
- *There is an inverse-U relationship between public educational expenditure and structural change in the long run.*
- *Given that most governments, especially local governments in developing countries, have little incentive for educational expenditure, I expect that the average long-term effect is positive empirically.*

The implications derived above explain a nonmonotonic relation between public educational expenditure and structural change. The central empirical relation that I want to explore is of the form:

$$Y = f(EDU, EDU_{-n}, X) \tag{3.1}$$

where Y is a measure of structural change. Human capital can also be considered a dependent variable whereby rural residents make a simultaneous decision on whether to get educated and whether to migrate to urban areas to work. A factor that encourages rural residents to get educated should also help them to migrate to urban areas to work. Therefore, the determinant function of structural change and human capital for rural residents should be identical.

EDU is the current public educational expenditure, indicating the short-term effect, EDU_{-n} is the past public educational expenditure (*n*-period lag), indicating the long-term effect, and X is a vector of further covariates. These covariates, particularly the effects triggered by income gaps, capital deepening, infrastructure, and trade (regional openness), may influence structural change and human capital in addition to public educational expenditure.

It is also noteworthy that the short-term effect of public educational expenditure on human capital is different from that on structural change. Human capital is accumulated through education and experience and does not decrease over time. Therefore, while we can investigate the short-run and long-run relationship between public educational expenditure and structural change, we mainly focus on the long-run effect of educational expenditure on human capital.

Following the theoretical framework, the measure of structural change (SC_{it}) is the degree of labor transfer (I will explain the reasons in Section 4); the measure of public educational expenditure (EDU_{it}) is on a per-student basis. To bring equation (3.1) to the data, I specify the relation between structural change and educational expenditure as:

$$SC_{it} = \alpha + \beta_1 ln(EDU_{it}) + \beta_2 ln\left(EDU_{i,t-n}\right) + X'_{i,t-1}\gamma + \mu_i + \varphi_t + \varepsilon_{it} \tag{3.2}$$

Also, the relation between human capital and educational expenditure is specified as:

$$ln(HC_{it}) = \rho + \delta_1 ln(EDU_{it}) + \delta_2 ln\left(EDU_{i,t-n}\right) + X'_{i,t-1}\zeta + \theta_i + \eta_t + \xi_{it} \tag{3.3}$$

where *i* indexes regions, and *t* indexes years. To avoid reversed causality, I lag all the controlled variables by one year. Lagged educational expenditure is directly used to measure the long-term effect. Moreover, I use the current year's educational expenditure to measure the short-term effect and instrument it with government consumption (net of educational expenditure) and government administrative expense per capita. In fact, both structural change and human capital have significantly positive impacts on economic growth and contribute to the government's tax revenue, which provides room for increases in public educational expenditure. Therefore, the OLS estimates of (3.2) and (3.3) are faced with simultaneous equation bias and may overestimate the effect of public educational expenditure and structural change. Including regional fixed effects and time effects is unlikely to be sufficient to address the endogeneity issue, since region-specific, time-varying changes of structural change and human capital should affect educational expenditure.

The preferred approach to control for endogeneity is indicated by the model above and uses government consumption (net of educational expenditure) and government administrative expense as instrumental variables (IVs). I argue that these two variables affect public educational expenditure across regions and time but, conditional on all other covariates in the empirical specification, do not affect structural change or human capital. According to the general equilibrium model, similarly to the crowding-out effect caused by public educational expenditure, other public expenditure will in turn crowd out educational expenditure. Therefore, the correlation between government consumption, or government administrative expense, and public educational expenditure is negative.

The potential caveat of existing IVs is that they may violate exclusion restriction. Therefore, I need to control for other channels through which the two IVs may affect structural change and human capital. One concern is that parts of government consumption and government administrative expense are used to pay the wage of government employees and thus may directly affect structural change measured by nonagricultural (including government) employment. However, although there are a few exceptions, it is still rare for residents with a rural *hukou* to be employed by the government sector in the PRC. There are various reasons for this. One prominent reason is that despite the rigid entrance examination, the PRC's government still prefers hiring candidates with *guanxi* (connections with some government officials, especially ones with political power), which in turn becomes an obstacle to entering the government sector for rural residents. Therefore, most rural residents can only transfer to the urban private sector and thus are not directly funded by government consumption or administrative expense. Therefore, the concern above is alleviated.

Other channels through which the two IVs may affect structural change can be divided into two categories. The first category covers the production factors of the agricultural sector, in which government consumption may be directed toward subsidizing the mechanization of agricultural production and thus contributing to agricultural labor productivity and structural change (Yang and Zhu 2013). I therefore control for the measure of agricultural labor productivity. The second category refers to the production factors of the industrial sector. The measure of capital deepening is included to control for the crowding-out effect that government expenditure may have on physical capital accumulation. Thus, I argue that neither government consumption nor administrative expense has an additional impact on structural change and rural residents' human capital, after I condition on these covariates. I test the overidentification assumptions and experiment with using only subsets of these instruments. In Section 5, the results are shown to be robust to these specification checks.

4. DATA

I use the PRC's provincial panel data for empirical analysis. As I will argue below, the PRC's *hukou* system, which strictly distinguishes people who originally come from rural areas from people from urban areas, offers a proper way to measure regional structural change. The sample period is 1998–2015, which was the main time frame for the PRC's structural change from agriculture to industry when there was a large-scale labor transfer from rural areas to urban areas. I combine the educational expenditure data from the Ministry of Education (China Educational Finance Statistical Yearbook) with the data on structural change and human capital, as well as other independent variables from the National Bureau of Statistics (NBS) of the PRC and the Statistics Bureau of each province.

4.1 Structural Change

There are various measures of structural change. The direct measure is the GDP or employment share of the nonagricultural sector. In the general equilibrium model, I use the population/employment share as a proxy for structural change. In the empirical analysis, however, I will argue that using either GDP or the population/employment share as a dependent variable will lead to an underestimation of the impact of educational expenditure on structural change.

In the model, I assume that there is only one region, with one rural area and one urban area, and therefore the direction of labor transfer, or labor transfer, is unique: from the only rural area to the only urban area. However, in the empirical specification, I use the within-country regional data, in which the directions of labor transfer can be multiple. Suppose that there are two regions in the country, A and B. Both regions have agricultural and industrial sectors and are in the process of structural change. If I regress GDP or employment share on educational expenditure, I assume that Region A's educational expenditure only affects Region A's labor transfer and structural change, which contrasts with the fact that the directions of labor transfer can be multiple if people have multiple choices of transferred regions: The rural laborers in Region A, once educated, can choose to transfer to the industrial sector in either Region A or Region B. Similarly, the rural laborers in Region B can also choose to transfer to the industrial sector in either region. Therefore, treating GDP or employment share as a dependent variable will underestimate the effect of educational expenditure, as it ignores the impact of education expenditure on cross-region labor transfer.

Based on the discussion above, it is clear that all variables that measure labor transfer into the region are faced with underestimation bias. In order to better identify the empirical analysis, the empirical question should be specified more accurately as:

- *Does educational expenditure in Region i help its rural laborers transfer out of the nonagricultural sector in Region i?*

In fact, the role of educational expenditure in developing economies helps rural people become better educated, have the ability to transfer to urban areas, and be involved in modern economic activities. Therefore, as long as the educational expenditure has an influence on people's "transferring out," no matter to which regions (including Region i), I can argue that educational expenditure has a significant effect on structural change.

Therefore, a more accurate and identifiable way to address the empirical question is to define a variable that can measure the transferring out of rural people. The PRC's situation and institutions offer a way to define such a variable. On the one hand, the PRC is now a developing country and its structural change is progressing. In fact, the PRC's urbanization rate rapidly increased from 26% in 1990 and exceeded 50% in 2011, a level that is still much lower than that of most developed economies. On the other hand, the PRC's *hukou* system strictly distinguishes people who originally lived in rural areas from people from urban areas. People with a rural *hukou* cannot change their identities to an urban *hukou* even if they transfer to an urban area and work in nonagricultural sectors. The Ministry of Agriculture in the PRC records the number of provincial laborers each year who have a rural *hukou* (*Xiangcun Congye Renyuan,* XCR); this covers all the laborers with a provincial rural *hukou*, regardless of where they work or whether they work in an agricultural or nonagricultural sector. Thus, it certainly includes laborers who have a rural *hukou* in the province but are currently working outside the province. I subtract the number of laborers employed in the agricultural sector from XCR, to achieve the number of laborers with a rural *hukou* that have transferred to nonagricultural sectors (*Nongmingong* in Chinese), no matter

whether they remained in their original province or transferred to other provinces. In other words, laborers with a rural *hukou*, working, but not engaged in the agricultural sector will be covered in my calculation of provincial transferred laborers (PTLs). It is also noteworthy that, by doing such a subtraction, I assume that rural people rarely transfer to the agricultural sector in other provinces, which is a relatively reasonable assumption. I check the credibility of my calculation by adding the number of provincial transferred laborers at the national level, which were 237, 245, and 255 million in 2008, 2009, and 2010, respectively. The numbers of *Nongmingong* (only at the national level) released by the NBS between 2008 and 2010 (the only three years that the NBS released the national *Nongmingong* data) were 225, 230, and 242 million, which are comparable to my calculation. I take the ratio of PTLs over XCR to measure the degree of labor transfer, or structural change. It is noteworthy that, in line with the theoretical model, the level of structural change I use here measures the stock of transferred laborers, rather than flows.

4.2 Human Capital

I use the average schooling years of provincial laborers with a rural *hukou*. Following the literature, I set the schooling years of laborers with a primary school educationto six, with a junior high school educationto nine, with a senior high school education to 12, and with a university degree to 16. Then I take the average schooling years over the provincial laborers each year to proxy the stock of rural human capital. I admit that work experience can enhance human capital. However, public educational expenditure encourages rural residents to get educated and migrate to urban areas to work, and in the process, human capital for rural residents increases as more residents in rural areas get educated. Therefore, using average schooling years as a proxy of human capital precisely captures the part of human capital to which public educational expenditure contributes.

4.3 Public Educational Expenditure

The core explanatory variable in the empirical specification is public educational expenditure. I select the rural primary school educational expenditure per student as the proxy for public educational expenditure. On the one hand, primary education is the most basic education and equips people with skills that are needed to work. On the other hand, the expenditure is directly spent on rural residents, since there are concerns that public educational expenditure is mainly directed toward urban residents and thus cannot contribute to labor transfer and structural change.

Moreover, I primarily set the long-run term of public educational expenditure to a 6-year lag, that is, n=6 since generally it takes 6 years to graduate from primary school in the PRC, while I will conduct a robustness check by altering the lagged phase in Section 6.

There are substantial cross-province subsidies in education funding, which are formally called “transfer payments,” suggesting that educational funding may be collected from other provinces, leaving a potential underestimation of the short-run effect of public educational expenditure. However, the majority of provincial governmental expenditure, including educational expenditure, still comes from tax revenue from local government and the duty drawback of tax revenue from central government that is still collected from the local government. Therefore, the linkage between provincial taxation and expenditure still exists and is strong enough. At least, if an underestimation exists while we still observe a significant and negative short-run effect, the true estimation of the effect may be even larger. Moreover, in the following section, I also conduct IV

regression to overcome a potential endogeneity problem, including measurement error, which may serve to mitigate the underestimation effect.

4.4 Control Variables

I also control the variables that are proved to affect labor transfer or structural change. Among them, the key variable is the urban-rural income gap. The larger the income gap, the more incentive rural residents have to transfer to nonagricultural sectors. Other controlled variables include capital deepening, agricultural labor productivity, infrastructure, and openness. Capital deepening increases physical capital per laborer and wages, thereby contributing to labor transfer and structural change. Increases in agricultural labor productivity reduce the demand for agricultural labor and thus help structural change (Yang and Zhu 2013). Infrastructure reduces migration cost by connecting rural and urban areas, and thus promotes structural change (Morten and Oliveira 2014). The more open the region, the more nonagricultural laborers it needs for modern economic activity. I also include GDP per capita to control for the effect of regional economic development on structural change. Table 1 tabulates the descriptive statistics.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min.	Max.
Structural Change	558	0.406	0.053	0.0841	0.914
Human Capital	557	8.350	1.221	2.279	11.691
ln(EDU)	558	7.353	1.156	5.561	10.48
Income Gap	530	3.071	0.238	1.304	4.086
Capital per capita	558	1.712	1.176	0.198	8.001
Agricultural Labor Productivity	558	17.674	5.197	5.812	82.76
ln(Road Density)	558	8.009	0.463	5.232	10.03
FDI/GDP	555	0.00243	0.0103	0	0.0134
ln(GDP per capita)	558	9.822	0.698	7.768	11.55
Capital Return	558	11.003	4.453	–1.733	32.73
Government Consumption per capita	555	0.315	0.195	0.0310	6.092
Administrative Expense per capita	552	1.449	1.212	0.00202	14.34

5. EMPIRICAL RESULTS

In this section, I conduct an empirical analysis to identify the complete relation between public educational expenditure and structural change, where I control for confounding factors and take the endogeneity of public educational expenditure into account. Then, I investigate the economic mechanism behind the relation. I also test the inverted-U-curve hypothesis of the model, which also helps identify whether the PRC's current public rural educational expenditure is adequate. I conclude by conducting robustness checks for different model specifications and considering the effect of educational funding reform in 2006.

5.1 Baseline Results

To start with, I analyze the average effect of public educational expenditure on structural change. All regressions in Table 2 include a full set of year and province fixed effects. Standard errors are clustered on the provincial level to avoid the impacts of serial correlation.

Table 2: Baseline Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)
Structural Change	**FE**	**FE**	**FE**	**FE**	**FE**	**FE**
ln(EDU)	0.0238**		–0.189**	–0.203**	–0.239**	–0.211*
	(0.0113)		(0.0910)	(0.0927)	(0.110)	(0.114)
L6.ln(EDU)		0.0358**	0.332***	0.301***	0.278***	0.294**
		(0.0173)	(0.0808)	(0.0689)	(0.0638)	(0.141)
L.Income Gap	0.0157***	0.0127***	0.0145**	0.00921*	0.00818*	0.00701*
	(0.00516)	(0.00403)	(0.00647)	(0.00501)	(0.00442)	(0.00369)
L.ln(Capital per capita)				0.00868*	0.00712*	0.00646*
				(0.00498)	(0.00409)	(0.00347)
L.Agricultural Labor Productivity				0.000450**	0.000422*	0.000377*
				(0.000209)	(0.000224)	(0.000211)
L.ln(Road Density)					0.0364***	0.0122**
					(0.00945)	(0.00552)
L.(FDI/GDP)					1.292	0.540
					(1.958)	(0.837)
L.ln(GDP per capita)					–0.0868	–0.00489
					(0.0628)	(0.0546)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	No	No	No	No	Yes
N	526	372	372	372	371	371
R^2	0.854	0.755	0.757	0.759	0.790	0.938

Note: 1) Robust standard errors in parentheses, clustered in province level.
2) *** p < 0.01, ** p < 0.05, * p < 0.1.

In column (1) I use a linear term of public educational expenditure (as defined in Section 4.3) in the current year with the control of the urban-rural income gap, which is the core determinant of structural change, and find a significant effect on structural change. The results in column (1) show that in general, public educational expenditure helps promote labor transfer and structural change. Column (1) also confirms the positive effect of the urban-rural income gap on structural change. In column (2) I show that the average effect of public educational expenditure is robust to using the lagged term.

In column (3), I include both current and lagged public educational expenditure to study the nonmonotonic effect. The sign of the lagged term remains significantly positive, while that of the current term is flipped to negative. This preliminary result shows that the short-term and long-term effects of public educational expenditure on structural change are different. In the short term, there is a crowding-out effect of educational expenditure, which results in the temporary decline of labor transfer and structural change. In the long run, public educational expenditure contributes to structural

change. The results are robust to controlling for confounding factors of structural change (see columns (4) and (5)), which confirms the model implications in Section 2.

Further, since all of the empirical estimations presented include both province and year fixed effects, the sources of variations used for identification are the differences in the changes over time in public educational expenditure across different provinces. Thus, a potential confounding factor is the coincidental relationship between the province-specific trend in contemporary/lagged education spending and the province-specific time trend in structural change. For example, if provinces with a positive time trend in lagged educational expenditure also experience a positive time trend in structural change, a spurious positive relationship will arise. To mitigate this concern, I further control for the province-specific linear time trend in column (6). The results, albeit with reduced significances, remain robust.

5.2 Endogeneity

Next, I address the endogeneity issues. As stated above, I expect that structural change will also have an influence on public educational expenditure, resulting in simultaneous equation bias in OLS estimates, and thus use the instrument variable approach to alleviate the endogeneity problem. The first-stage estimation results are shown in Table 3, where different columns correspond to different control variables. In column (1) I use an instrument variable on government consumption (net of educational expenditure) per capita. In columns (2)–(5) I further add government administration expense per capita as an instrument. The results indicate that both instrument variables are significantly and negatively correlated with public educational expenditure, as expected.

Table 3: First-Stage Estimation

	(1)	(2)	(3)	(4)	(5)
ln(EDU)	**FE**	**FE**	**FE**	**FE**	**FE**
ln(Government Consumption per capita)	–0.264***	–0.259***	–0.251***	–0.222***	–0.113**
	(0.0790)	(0.0777)	(0.0707)	(0.0807)	(0.0540)
ln(Administrative Expense per capita)		–0.0197**	–0.0292**	–0.0197**	–0.0353*
		(0.0961)	(0.0139)	(0.00960)	(0.0189)
L.Income Gap	0.125**	0.123**	0.106	0.103	0.0337
	(0.0578)	(0.0598)	(0.0656)	(0.0742)	(0.0862)
L.ln(Capital per capita)			0.158	0.0724	0.0518
			(0.0966)	(0.0900)	(0.0765)
L.Agricultural Labor Productivity			–0.00234	–0.00353	–0.00617**
			(0.00440)	(0.00411)	(0.00253)
L.ln(Road Density)				–0.00386	0.0314
				(0.0389)	(0.0385)
L.(FDI/GDP)				12.69	11.22*
				(14.16)	(6.503)
L.ln(GDP per capita)				0.230	0.340
				(0.288)	(0.221)
Province FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	No	No	No	Yes
N	526	526	526	525	525
R^2	0.976	0.976	0.977	0.978	0.993

Note: 1) Robust standard errors in parentheses, clustered in province level.

2) *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 4 reports the second-stage estimation results. Using critical values reported in Stock, Wright, and Yogo (2002), I can reject the hypothesis of a weak instrument in all cases. Also, I cannot reject the hypothesis of overidentifying restrictions, which further provides statistical support for the use of the instruments. In all regressions, the short-term and long-term effects of public educational expenditure are stable with respect to many changes of the model specification and the set of instruments. Moreover, though OLS results do indeed overestimate the coefficients of public educational expenditure, the coefficients still do not differ much from the OLS estimates, indicating that the measurement error may not be a serious issue in the current empirical analysis (though I will still conduct a robustness check in Section 6.1).

Table 4: IV Estimation

	(1)	(2)	(3)	(4)	(5)
Structural Change	**2SLS**	**2SLS**	**2SLS**	**2SLS**	**2SLS**
ln(EDU)	–0.171**	–0.162**	–0.178**	–0.203*	–0.189*
	(0.0713)	(0.0707)	(0.0824)	(0.107)	(0.101)
L6.ln(EDU)	0.332***	0.317**	0.283**	0.264**	0.282**
	(0.115)	(0.132)	(0.119)	(0.125)	(0.133)
L.Income Gap	0.0220**	0.0225**	0.0212**	0.0220**	0.0344*
	(0.0107)	(0.0110)	(0.0101)	(0.0111)	(0.0181)
L.ln(Capital per capita)			0.0123	0.0188	0.0230*
			(0.0186)	(0.0175)	(0.0124)
L.Agricultural Labor Productivity			0.000416*	0.000111*	0.000102
			(0.000224)	(0.0000594)	(0.0000812)
L.ln(Road Density)				0.0365***	0.0175**
				(0.00884)	(0.00841)
L.(FDI/GDP)				1.460	0.962
				(2.432)	(1.080)
L.ln(GDP per capita)				–0.0834	–0.0128
				(0.0654)	(0.0393)
Province FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	No	No	No	Yes
N	372	372	372	371	371
R^2	0.757	0.756	0.756	0.790	0.925
Kleibergen-Paap Weak IV	23.17	16.78	18.64	16.50	18.22
Hansen-p	/	0.408	0.385	0.429	0.501

Note: 1) Robust standard errors in parentheses, clustered in province level.

2) *** p < 0.01, ** p < 0.05, * p < 0.1.

The effects of controlled variables on structural change are also in line with expectations. The larger the urban-rural income gap, the more incentive rural residents have to transfer to nonagricultural sectors. Capital deepening increases both physical capital per laborer and wages and is thus positively correlated with labor transfer and structural change. Increases in agricultural labor productivity, as indicated by Yang and Zhu (2013), reduce the demand for agricultural labor and thus help structural change. Infrastructure reduces migration cost by connecting rural and urban areas, and thus promotes structural change.

In terms of economic magnitude, I also find a profound effect of public educational expenditure on structural change. According to Table 4, doubling the expenditure would increase the rate of labor transfer by 9.3% (18.9%-28.2%). The economic magnitude of educational expenditure is more significant in the context of the average rate of labor transfer, which is only 40.6%.

5.3 Crowding-Out Effect

The evidence shown above supports the idea that public educational expenditure has a crowding-out effect on industrial development and structural change, which is consistent with the theoretical interpretation. The mechanism of the crowding-out effect, as stated in the model, is through taxation. To further verify this argument, I use a mediation model and control for the indicator of taxation in the regression. Thus, I can compare the coefficients of current public educational expenditure before and after the control to see whether taxation is a mediation between public educational expenditure and structural change.

Table 5: Crowding-Out Effect

	(1)	(2)	(3)	(4)	(5)	(6)
Structural Change	**2SLS**	**2SLS**	**2SLS**	**2SLS**	**2SLS**	**2SLS**
ln(EDU)	–0.162**	–0.0569	–0.203*	–0.0581	–0.189*	–0.0593
	(0.0707)	(0.0864)	(0.107)	(0.0894)	(0.101)	(0.0902)
Net Taxes on Production/GDP		–0.329***		–0.361***		–0.368***
		(0.125)		(0.131)		(0.133)
L6.ln(EDU)	0.317**	0.321**	0.264**	0.273**	0.282*	0.291*
	(0.132)	(0.135)	(0.125)	(0.129)	(0.151)	((0.156)
L.Income Gap	0.0225**	0.0230**	0.0220**	0.0228**	0.0344*	0.0351*
	(0.0110)	(0.0112)	(0.0111)	(0.0113)	(0.0181)	(0.0187)
L.ln(Capital per capita)			0.0188	0.0195	0.0230*	0.0241*
			(0.0175)	(0.0178)	(0.0124)	(0.0129)
L.Agricultural Labor Productivity			0.000111*	0.000121*	0.000102	0.000151*
			(0.0000594)	(0.0000637)	(0.0000812)	(0.0000888)
L.ln(Road Density)			0.0365***	0.0457**	0.0175**	0.0198**
			(0.00884)	(0.0214)	(0.00841)	(0.00904)
L.(FDI/GDP)			1.460	1.981	0.962	1.257
			(2.432)	(1.710)	(1.080)	(1.301)
L.ln(GDP per capita)			–0.0834	–0.0701	–0.0128	–0.0119
			(0.0654)	(0.0836)	(0.0393)	(0.0133)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	No	No	No	Yes	Yes
N	372	372	371	371	371	371
R^2	0.756	0.786	0.790	0.812	0.925	0.948
Kleibergen-Paap Weak IV	16.78	15.11	16.50	14.97	18.22	17.85
Hansen-p	0.408	0.312	0.429	0.384	0.501	0.418

Note: 1) Robust standard errors in parentheses, clustered in province level.

2) *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 5 presents the estimated results, in which columns (1), (3), and (5) are the results of Table 4, and columns (2), (4), and (6) are the results after controlling for the indicator of taxation. The indicator of taxation is measured by the ratio of net taxes on production over GDP. The results confirm that taxation has a negative impact on structural change in the short term, and once the indicator of taxation is controlled, the coefficient of public educational expenditure becomes insignificant, suggesting that taxation is the direct reason why public educational expenditure hinders structural change in the short run.

5.4 Human Capital

I further explore the empirical relation between public educational expenditure and human capital. Since public educational expenditure can only have a positive impact on structural change in the long run, I expect it will result in human capital enhancement only in the long term.

Table 6: Human Capital

	(1)	(2)	(3)	(4)	(5)	(6)
ln(Human Capital)	**FE**	**FE**	**2SLS**	**2SLS**	**2SLS**	**2SLS**
ln(EDU)	–0.115*	–0.0860	–0.137*	–0.129*	–0.140*	–0.0581
	(0.0622)	(0.0558)	(0.0717)	(0.0701)	(0.0828)	(0.0390)
L6.ln(EDU)	0.161***	0.204**	0.193***	0.189***	0.181***	0.192**
	(0.0573)	(0.0887)	(0.0679)	(0.0707)	(0.0667)	(0.0838)
L.Income Gap		–0.125**		–0.130	–0.136	–0.382**
		(0.0488)		(0.117)	(0.120)	(0.179)
L.ln(Capital per capita)		0.117*		0.102	0.071	0.240*
		(0.0629)		(0.071)	(0.057)	(0.134)
L.Agricultural Labor Productivity		0.00167		0.00129	0.00120	0.00992
		(0.00254)		(0.00138)	(0.00189)	(0.00799)
L.ln(Road Density)		0.123*			0.152	0.254*
		(0.0664)			(0.126)	(0.134)
L.(FDI/GDP)		–10.71			8.560	–18.11
		(12.66)			(17.65)	(13.88)
L.ln(GDP per capita)		0.229			0.362	0.368
		(0.375)			(0.329)	(0.658)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	Yes	No	No	No	Yes
N	371	371	371	371	371	371
R^2	0.584	0.857	0.513	0.629	0.746	0.798
Kleibergen-Paap Weak IV	/	/	16.77	18.35	16.50	18.22
Hansen-p	/	/	0.286	0.237	0.482	0.531

Note: 1) Robust standard errors in parentheses, clustered in province level.

2) *** p < 0.01, ** p < 0.05, * p < 0.1.

In Table 6, I present estimates from IV models that take the endogeneity of public educational expenditure into account. In line with what I find in the structural change regressions, public educational expenditure has beneficial impacts on human capital in the long run, and once the provincial-specific time trend is controlled, the coefficient of current public educational expenditure is insignificant. As stated, human capital is accumulated through education and experience and does not decrease over time. Therefore, while we can investigate the short-run and long-run relationship between public educational expenditure and structural change, we mainly expect a long-run

effect of educational expenditure on human capital. Furthermore, the estimated effects of other factors are similar to the results for structural change models, thereby showing the robustness of the empirical analysis.

5.5 Physical Capital

Next, I investigate the economic mechanism behind the relation between public educational expenditure and structural change. The investigation is in fact based on the theoretical interpretation in Section 2. I will start with the mechanism of physical capital, which is followed by capital return in the next section. Finally, I will test the validity of the long-term inverted-U curve as indicated by Proposition 4.

To begin with, I replace the dependent variable with physical capital per capita in Table 7. According to (2.30), the short-term effect of public educational expenditure on physical capital per capita is negative, as educational expenditure crowds out capital accumulation. In the long run, with appropriate expenditure, capital accumulation will recover. Therefore, I can verify my results by exploring the mechanism of physical capital and expect that public educational expenditure also has a nonmonotonic effect on it.

Table 7: Physical Capital

	(1)	(2)	(3)	(4)	(5)	(6)
ln(Capital per capita)	**FE**	**FE**	**2SLS**	**2SLS**	**2SLS**	**2SLS**
ln(EDU)	–0.323**	–0.329	–0.337**	–0.341**	–0.381**	–0.333*
	(0.161)	(0.202)	(0.156)	(0.166)	(0.192)	(0.180)
L6.ln(EDU)	0.498**	0.414**	0.513**	0.517**	0.450**	0.426**
	(0.216)	(0.192)	(0.225)	(0.231)	(0.210)	(0.205)
L.Income Gap		–0.130*		–0.170	–0.260***	–0.154*
		(0.0729)		(0.105)	(0.0875)	(0.0905)
L.Agricultural Labor Productivity		0.00143		0.00243	0.000691	0.00221
		(0.00262)		(0.00333)	(0.00401)	(0.00264)
L.ln(Road Density)		0.398*			0.115***	0.290*
		(0.215)			(0.0444)	(0.155)
L.(FDI/GDP)		8.565*			18.60	7.957*
		(4.809)			(13.46)	(4.790)
L.ln(GDP per capita)		0.667*			1.271***	0.596*
		(0.378)			(0.328)	(0.325)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	Yes	No	No	No	Yes
N	372	371	372	372	371	371
R^2	0.935	0.990	0.933	0.937	0.949	0.990
Kleibergen-Paap Weak IV	/	/	16.78	18.11	16.18	16.64
Hansen-p	/	/	0.121	0.171	0.142	0.133

Note: 1) Robust standard errors in parentheses, clustered in province level.
2) *** p < 0.01, ** p < 0.05, * p < 0.1.

Note, however, that I include the factor of physical capital in the estimations above, which I will remove in the current mechanism exploration. The empirical results in Table 7 confirm that public educational expenditure has a short-term crowding-out effect on physical expenditure, as indicated by the significantly negative coefficient of current expenditure, while it has a significant long-term contributive impact on capital

deepening. In terms of economic magnitude, I find that doubling public educational expenditure results in about a 9.3% increase in capital stock per capita, which is very significant.

5.6 Capital Return

I could carry out a further mechanism investigation by exploring the relation between public educational expenditure and capital return. As I have demonstrated above, public educational expenditure has nonmonotonic impacts on capital deepening, which, in turn, will affect capital return as well. Therefore, it is also of interest to look at the impact of public educational expenditure on capital return. Given that capital deepening is negatively correlated with capital return, I expect that public education expenditure's crowding-out effect will increase capital return, while its positive impact on capital deepening will decrease capital return.

In Table 8, I replace the dependent variable with capital return. Following Tang, Xu, and Zhang (2017), capital return is calculated using the total profit of aggregated industrial firms over net fixed assets. The estimated results are straightforward: The current public educational expenditure is positively correlated with capital return, indicating the short-term crowding-out effect; and the lagged expenditure is negative, showing the long-term contributive effect on capital deepening and structural change. The estimated effects of other factors are similar to the results above.

Table 8: Capital Return

	(1)	(2)	(3)	(4)	(5)	(6)
Capital Return	**FE**	**FE**	**2SLS**	**2SLS**	**2SLS**	**2SLS**
ln(EDU)	2.739**	4.846*	2.033**	2.623*	3.736*	3.506*
	(1.196)	(2.707)	(0.912)	(1.388)	(2.009)	(1.992)
L6.ln(EDU)	–4.301*	–7.581	–6.936*	–5.837*	–7.241*	–8.134*
	(2.276)	(4.739)	(3.632)	(3.139)	(4.001)	(4.813)
L.Income Gap		–0.526		–5.981**	–4.659**	–2.315*
		(2.275)		(2.478)	(2.333)	(1.244)
L.ln(Capital per capita)		–0.201		2.767	0.733	–0.518
		(1.298)		(1.747)	(1.394)	(1.815)
L.Agricultural Labor Productivity		–0.144		–0.157	–0.179	–0.126
		(0.191)		(0.201)	(0.192)	(0.145)
L.ln(Road Density)		1.431			1.521	1.709
		(1.481)			(1.366)	(1.049)
L.(FDI/GDP)		22.8			37.6	37.0
		(27.0)			(37.7)	(41.7)
L.ln(GDP per capita)		8.615**			8.146	8.910*
		(3.829)			(5.786)	(4.816)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	Yes	No	No	No	Yes
N	372	371	372	372	371	371
R^2	0.278	0.614	0.240	0.314	0.359	0.611
Kleibergen-Paap Weak IV	/	/	16.78	18.64	16.50	18.22
Hansen-p	/	/	0.166	0.114	0.115	0.139

Note: 1) Robust standard errors in parentheses, clustered in province level.

2) *** p < 0.01, ** p < 0.05, * p < 0.1.

5.7 The Inverted-U Curve

The evidence shown above supports the idea that public educational expenditure spurs structural change in the long run, indicating that if there is indeed an inverted-U relation, the PRC's public education expenditure must lie on the left of the inverted-U curve. Next, I formally test the existence of the inverted-U relation, since if it exists, it can provide a more accurate comparison between current public education expenditure and its optimal value. Thus, the empirical specification is:

$$SC_{it} = \alpha + \beta_1 ln(EDU_{it}) + \beta_2 ln\left(EDU_{i,t-6}\right) + \beta_3 \left[ln\left(EDU_{i,t-6}\right)\right]^2 + X'_{i,t-1}\gamma + \mu_i + \varphi_t + \varepsilon_{it} \quad (5.1)$$

where β_1 still indicates the short-term effect and β_2 and β_3 measure the long-term inverted-U effect. According to the theoretical interpretation, I expect $\beta_2 > 0$ and $\beta_3 < 0$.

Table 9: Long-term Inverted-U Curve

	(1)	(2)	(3)	(4)	(5)	(6)
Structural Change	**FE**	**FE**	**2SLS**	**2SLS**	**2SLS**	**2SLS**
ln(EDU)	–0.148**	–0.161*	–0.133*	–0.156*	–0.181*	–0.168*
	(0.0725)	(0.0866)	(0.0719)	(0.0843)	(0.101)	(0.0976)
L6.ln(EDU)	0.328**	0.365*	0.453**	0.379**	0.351**	0.375**
	(0.163)	(0.197)	(0.198)	(0.169)	(0.160)	(0.182)
[L6.ln(EDU)]^2	–0.0143**	–0.0185***	–0.0161**	–0.0176***	–0.0179***	–0.0188***
	(0.00641)	(0.00708)	(0.00516)	(0.00573)	(0.00605)	(0.00686)
L.Income Gap	0.0158**	0.0102*	0.0229**	0.0218**	0.0235**	0.0361*
	(0.00738)	(0.00540)	(0.0101)	(0.00991)	(0.0118)	(0.0191)
L.ln(Capital per capita)		0.0107*		0.0163	0.0216*	0.0208*
		(0.00597)		(0.0219)	(0.0124)	(0.0116)
L.Agricultural Labor Productivity		0.000442*		0.000430*	0.000198*	0.000166
		(0.000238)		(0.000252)	(0.000112)	(0.000109)
L.ln(Road Density)		0.0131**			0.0417***	0.0303**
		(0.00585)			(0.00893)	(0.0137)
L.(FDI/GDP)		0.650			1.959	1.500
		(0.823)			(2.415)	(1.372)
L.ln(GDP per capita)		–0.00430			–0.0641	–0.0049
		(0.0569)			(0.0563)	(0.0452)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	Yes	No	No	No	Yes
N	372	371	372	372	371	371
R^2	0.769	0.949	0.764	0.766	0.810	0.937
Kleibergen-Paap Weak IV	/	/	19.41	21.21	18.35	14.88
Hansen-p	/	/	0.383	0.343	0.423	0.498

Note: 1) Robust standard errors in parentheses, clustered in province level.

2) *** p < 0.01, ** p < 0.05, * p < 0.1.

The results of Table 9, in which I present both the OLS and IV estimators, confirm the hypothesis of an inverted-U relation between public educational expenditure and structural change. The optimal value of public educational expenditure, which maximizes the degree of structural change, is approximately RMB21,400, which is much higher than its current level. Thus, the evidence above shows that, for the PRC today, in order to promote structural change, greater public educational expenditure is needed for long-term sustainable economic growth, regardless of its short-term crowding-out effect.

6. FURTHER DISCUSSION

So far, I have presented empirical results that support the findings of the theoretical interpretation of public educational expenditure and structural change set out in Section 2. I showed the robustness of the results to several changes and instrumentation strategies and to different mechanisms as well as consequences. In this section I explore the robustness of the results in three other directions. First, I consider potential influences of measurement error. Second, I relax the key assumption of static empirical specification and allow sticky structural change. Third, I consider the effect of educational funding reform in 2006.

6.1 Measurement Error

There are three forms of measurement error that concern me here: (i) measurement of dependent variables, (ii) measurement of public educational expenditure, and (iii) measurements of other controlled variables. I consider these in turn.

The common measurement of structural change is GDP or population/employment share. However, as I said in Section 4.1, using either GDP or population/employment share as a dependent variable will underestimate the impact of educational expenditure on structural change. Column (1) in Table 10 confirms my argument, in which I use the urbanization rate instead of the degree of labor transfer as a dependent variable. When using the alternative measure, I obtain the same but insignificant coefficients for both current and past public educational expenditure, which is indeed an underestimation of educational expenditure's effect on structural change.

Second, the replacement of other controlled variables does not alter my results. For instance, in column (2), I use capital per laborer, instead of capital per capita, for a robustness check. The results are found to hold as well.

My third concern is with the measurement of public educational expenditure. In Section 6, I used a 6-phase lag of public educational expenditure as the proxy for long-term effect. In columns (3)–(6), I show that the long-term effect remains robust when using the core explanatory variable, that is, public educational expenditure with a 5/7-phase lag. Furthermore, the estimated effects of other factors are similar to the results in Section 6.

Table 10: Measurement Error

	(1)	(2)	(3)	(4)	(5)	(6)
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Structural Change	Urbanization Rate	Capital per Laborer	L5.ln(EDU)		L7.ln(EDU)	
ln(EDU)	–0.171	–0.184*	–0.156**	–0.187*	–0.171*	–0.197*
	(0.114)	(0.101)	(0.0764)	(0.0974)	(0.0939)	(0.111)
L*i*.ln(EDU)	0.239	0.275*	0.239**	0.271*	0.226*	0.261*
	(0.402)	(0.147)	(0.111)	(0.142)	(0.119)	(0.144)
L.Income Gap	0.0617	0.0119*	0.0276**	0.0318*	0.0164*	0.00582
	(0.215)	(0.00640)	(0.0126)	(0.0170)	(0.00886)	(0.00373)
L.ln(Capital per capita)	0.00117**	0.0210**		0.0301*		0.0141*
	(0.000511)	(0.00950)		(0.0162)		(0.00801)
L.Agricultural Labor Productivity	0.000600	0.000220		0.000201*		0.000177
	(0.000716)	(0.00125)		(0.000114)		(0.000925)
L.ln(Road Density)	0.0182**	0.0141**		0.0180**		0.0176**
	(0.00834)	(0.00674)		(0.00873)		(0.00769)
L.(FDI/GDP)	1.767	1.191		0.0765		2.573
	(2.075)	(0.757)		(0.809)		(1.846)
L.ln(GDP per capita)	0.0930*	0.0784*		–0.0172		–0.0554
	(0.498)	(0.0418)		(0.0304)		(0.0469)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	Yes	No	No	No	Yes
N	368	346	403	402	341	340
R^2	0.806	0.954	0.807	0.947	0.694	0.859
Kleibergen-Paap Weak IV	18.69	13.49	17.57	18.28	21.64	13.89
Hansen-p	0.401	0.359	0.552	0.365	0.170	0.191

Note: 1) Robust standard errors in parentheses, clustered in province level.
2) *** p < 0.01, ** p < 0.05, * p < 0.1.

6.2 Model Specification

In the empirical analysis above I assumed an entirely static model with different instrumentation strategies. In this section, I want to clarify that my results remain robust even if I assume a dynamic process of structural change. In fact, it is possible that the behavior of labor transfer is sticky: All other things being equal, people who transferred to a nonagricultural sector in the past are more likely to stay in an urban area than people who choose to work in the agricultural sector. Thus, it is important to consider whether my results are robust to relaxing the model assumption. The specification is modified as:

$$SC_{it} = \alpha_0 + \alpha_1 SC_{i,t-1} + \beta_1 ln(EDU_{it}) + \beta_2 ln\left(EDU_{i,t-6}\right) + X'_{i,t-1}\gamma + \mu_i + \varphi_t + \varepsilon_{it} \quad (6.1)$$

There are two potential pitfalls in (6.1), which will bias the OLS estimates. First, the unobserved regional heterogeneities (μ_i) may be correlated with the other independent variables, resulting in an omitted variable bias. Second, as I stated above, reverse causality may also bias the estimates. Thus, I follow Blundell and Bond (1998) and use the system GMM method to estimate (6.1). In Table 11, I show that the results of both public educational expenditure and other factors remain robust with no specification error, as indicated by the autocorrelation test and overidentification test.

Table 11: Model Specification

	(1)	(2)	(3)	(4)
Structural Change	**Sys-GMM**	**Sys-GMM**	**Sys-GMM**	**Sys-GMM**
L.Structural Change	0.636***	0.591***	0.602***	0.653***
	(0.123)	(0.107)	(0.122)	(0.141)
ln(EDU)	–0.00633**	–0.00346**	–0.00321**	–0.00334*
	(0.00276)	(0.00172)	(0.00162)	(0.00176)
L6.ln(EDU)	0.0135**	0.0129***	0.0118***	0.0191***
	(0.00587)	(0.00490)	(0.00418)	(0.00667)
L.Income Gap	0.0225***	0.0216***	0.0207***	0.0147**
	(0.00551)	(0.00545)	(0.00551)	(0.00647)
L.Ln(Capital per capita)		0.0479**	0.0681**	0.0135*
		(0.0225)	(0.0301)	(0.00707)
L.Agricultural Labor Productivity		0.000601*	0.000612*	0.00119*
		(0.000324)	(0.000327)	(0.000676)
L.ln(Road Density)			0.0264*	0.0116*
			(0.0141)	(0.00640)
L.(FDI/GDP)			–0.590	1.949*
			(0.535)	(0.955)
L.ln(GDP per capita)			–0.00377	0.0108
			(0.00576)	(0.0197)
Year FE	Yes	Yes	Yes	Yes
Provincial Time Trend	No	No	No	Yes
AR(1)-p	0.0632	0.0608	0.0605	0.0454
AR(2)-p	0.465	0.408	0.355	0.271
Hansen-p	0.528	0.377	0.329	0.568
N	372	372	371	371

Note: 1) Robust standard errors in parentheses, clustered in province level.
2) *** p < 0.01, ** p < 0.05, * p < 0.1.

6.3 Educational Funding Reform in 2006

Finally, the Chinese central government implemented a reform in funding less developed provinces' education in 2006. The reform may have driven some of the estimated results above, as it will certainly promote labor transfer from less developed provinces to a larger degree. To consider such a policy change, I consider a dummy variable indicating the samples in western provinces of the PRC and after 2006, and interact it with the long-term variable of public educational expenditure. The interactive term is expected to be positively correlated with structural change if the reform is effective. The results in Table 12 confirm the expectation, and on average, the reform brings in an incremental 1.7% on structural change if the educational expenditure doubles, accounting for 23.0% of the baseline effect (7.4%).

Table 12: Educational Funding Reform in 2006

Structural Change	(1)	(2)	(3)	(4)	(5)	(6)
	FE	FE	2SLS	2SLS	2SLS	2SLS
ln(EDU)	–0.171**	–0.192*	–0.181**	–0.187**	–0.217*	–0.201*
	(0.0781)	(0.101)	(0.0874)	(0.0921)	(0.114)	(0.108)
L6.ln(EDU)	0.291***	0.266**	0.294**	0.276**	0.259**	0.275*
	(0.0927)	(0.115)	(0.134)	(0.135)	(0.130)	(0.145)
L6.[D*ln(EDU)]	0.0301*	0.0218*	0.0293*	0.0238*	0.0198*	0.0171*
	(0.0172)	(0.0122)	(0.0157)	(0.0135)	(0.0105)	(0.00977)
L.Income Gap	0.0139**	0.00612*	0.0170**	0.0157**	0.0180**	0.0196*
	(0.00640)	(0.00330)	(0.0833)	(0.0758)	(0.0904)	(0.0104)
L.ln(Capital per capita)		0.00542		0.0113	0.0176	0.0228*
		(0.00774)		(0.0175)	(0.0177)	(0.0125)
L.Agricultural Labor Productivity		0.000339*		0.000308*	0.000105	0.0000981
		(0.00183)		(0.000177)	(0.000998)	(0.00102)
L.ln(Road Density)		0.0115**			0.0363***	0.0159**
		(0.00547)			(0.0129)	(0.00757)
L.(FDI/GDP)		0.529			1.210	0.935
		(0.822)			(2.405)	(1.070)
L.ln(GDP per capita)		–0.00558			–0.0846	–0.0137
		(0.0562)			(0.0598)	(0.0404)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Time Trend	No	Yes	No	No	No	Yes
N	372	371	372	372	371	371
R^2	0.761	0.941	0.758	0.759	0.801	0.937
Kleibergen-Paap Weak IV	/	/	17.37	18.80	16.44	18.21
Hansen-p	/	/	0.406	0.363	0.413	0.491

Note: 1) Robust standard errors in parentheses, clustered in province level.

2) D is the dummy variable indicating the samples in western provinces of the PRC and after 2006.

3) *** p < 0.01, ** p < 0.05, * p < 0.1.

7. CONCLUDING REMARKS

Human capital has taken a central role in the theory of economic growth and structural change (Lucas 2004), with schooling often considered a primary conduit for human capital accumulation. Since government plays a role in financing educational expenditure in most countries, there is a potential link between public education expenditure and structural change. However, neither clear theoretical interpretation nor empirical validation of this link exists comprehensively.

One possible explanation is that public education expenditure crowds out other factors that contribute to structural change. In this paper, I consider this possibility in the context of a two-sector general equilibrium model. In the model, the educational cost for rural residents to transfer to urban areas is reduced in line with public educational expenditure, which provides incentives for them to be engaged in nonagricultural sectors. However, in the short term, the direct effect of increasing the share of output devoted to public education expenditure is the crowding out of physical capital accumulation, resulting in a decreased demand for transferred labor. This is the reason for "government myopia." In the long run, the effect of public educational expenditure and structural change is also nonmonotonic and depicts an inverted-U relation. I show

that under a reasonable choice of tax rate, the crowding-out effect can be fully offset by the contributive impact.

The PRC's *hukou* system makes it possible to empirically identify the comprehensive relationship between public educational expenditure and structural change. The empirical evidence, where I control for confounding factors and take the endogeneity of public educational expenditure into account, confirms the theoretical interpretations. The empirical evidence is quite robust and consistent with theory, as I explore the mechanisms, such as human capital, physical capital crowding out, and its impact on capital return, behind the relation between public educational expenditure and structural change. I also make a careful check of possible measurement errors and model specification problems. All the empirical results give strong support to this theoretical comprehensive relation.

One implication of the results is that the macro-level ambiguity of the expenditure-structure link need not be interpreted as evidence that public educational expenditure is unimportant for structural change. Rather, it may point to the importance of acknowledging the nonmonotonic nature of the relation. Appropriate policies can help turn government educational expenditure into a more efficient engine of sustainable economic development.

Another implication is for the largest developing economy, the PRC: Its level of public educational expenditure is still far from its optimal value, suggesting that the PRC should increase its spending on public education, especially rural education. However, as I point out in this paper, the short-term crowding out of public educational expenditure reduces the incentive of local governments to spend on public educational services, as they are usually faced with career pressures (Li and Zhou 2005). An incentive-compatibility policy for public educational expenditure is called for in order to achieve sustainable economic growth.

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