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Educational Investments in a Dual Economy

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We present a simple two-period, dual-economy model in which migration options may affect the informal financing of educational investments. When credit contracts are universally available and perfectly enforceable, spatially varied returns to human capital have no effect on educational investment patterns. But when financial markets are incomplete and informal mechanisms with imperfect contract enforcement must fill the breach, attributes that affect the returns to education will affect educational lending and, consequently, educational attainment. Migration options can increase the returns to education, but can also choke off the informal finance on which poorer rural households may depend for long-term, lumpy investments like children's education.

INTRODUCTION

The positive relationship between education and expected future income is well established (Schultz 1988; Psacharopoulos 1994; Strauss and Thomas 1995; Barro and Sala-i-Martin 1995). Yet, despite clear evidence of strong returns to education, many communities exhibit low rates of educational attainment, especially in rural areas of the developing world (Singh 1992; Psacharopoulos 1994). One reason for the apparent underinvestment in children's education is imperfect financial markets, which ration poorer households out of the formal market for long-term loans. As Loury (1981) showed, when formal financial markets fail, the logical consequence is not only underinvestment in education but also, derivatively, the propagation of poverty from one generation to the next. Credit market failures, coupled with costly education, limit the ability of the poor to purchase optimal levels of education. The relationship between education and income is thus reversed, generating a poverty trap whereby the poor attain low levels of education owing to financial constraints and consequently earn low incomes.

Why, though, do not informal financial markets spring up to fill the educational financing gap when formal markets fail? Elaborate informal credit and insurance mechanisms exist between households, providing finance not available through formal financial institutions (Udry 1993; Townsend 1994; Besley 1995; Morduch 1995). Given the high apparent returns to education and widespread anecdotal evidence of informal financing of others' education, one naturally wonders why informal financial transactions do not resolve the educational investment problem in rural areas of developing countries.

This paper offers an answer to that puzzle. We show that, in the presence of financial market imperfections associated with imperfect credit contract enforcement, spatial variation in the returns to education can induce migration decisions that rationally choke off the informal financing of education in relatively disadvantaged areas. When financial markets are complete and

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perfect, spatially varied returns to human capital have no effect on educational investment patterns. But when formal financial markets are incomplete and credit contracts must be self-enforcing, spatial inequality in infrastructure and other attributes that increase the returns to education create spatial differentials in educational lending and, consequently, increase geographic and wealth-based variation in educational attainment.

The important innovation of this paper is to link the literature on spatially varied productivity and migration with that on informal finance. The extensive literature on migration emphasizes how spatially varied infrastructure, law enforcement, access to lucrative markets and other attributes creates a gradient across space in real returns to education (Stark 1984; Williamson 1988; Todaro 1997; Banerjee and Newman 1998). Educated persons living in relatively disadvantaged rural areas with few opportunities for skilled employment find that migration is an especially attractive option (Barnum and Sabot 1975; Schultz 1988). A consistent finding in this literature is the positive relationship between educational attainment and rural–urban migration (Todaro 1997).

On the other hand, the literature on informal finance identifies the close-knit associations of traditional communities as the 'social capital' that allows for the informal provision of financial services (Stiglitz 1991; Besley *et al.* 1993). Lenders can access relatively cheap information on potential borrowers through the highly personalized intra-community relationships. They can also assure repayment by the credible threat of social sanctions: a borrower who is visibly able to pay but neglects his loan commitment will signal dishonesty, thereby eroding his stock of social capital within the community.

Contract enforcement, however, becomes more difficult the farther the contracting parties are from each other. Tracking down debtors becomes costly, and the threat of social sanctions loses some of its power as their interaction with the community is diminished. Prospective rural lenders would thus consider borrowers' migration options when deciding whether to extend educational loans. Put differently, informal financial market equilibria depend on migration incentives. As a consequence, an increase in the spatial differential in the returns to human capital may choke off informal financing of education in rural areas as lenders increasingly expect borrowers to migrate, making them greater risks for default. In this paper we develop a theoretical model that demonstrates this explanation of the apparent underinvestment in rural education.

The rest of the paper is structured as follows. Section I builds the general structure of a simple two-period, dual-economy model that parsimoniously captures the essence of the problem. In Section II we explore the implications of the model for patterns of educational investment and migration, and examine the inefficiencies resulting from credit conditions that deviate from the first-best world. Section III discusses the policy implications of our findings and concludes.

I. The Model

Consider a two-period dual economy. In period 1 the adult household head makes educational investments in the children in the community. (No one

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invests in children outside their own community). Then in period 2 the (now grown) children decide where to live and work, conditional on the human capital they accumulated in period 1.

The economy consists of two locations: a rural area with weak productive infrastructure, which represents a more traditional mode of production, and an urban area with better communications, power, transport and public services, which underpin modern industrial and service economies; as such, returns to education are higher in the urban area. We treat the differences in productive infrastructure across locations as exogenous and assume that human capital productivity is increasing in infrastructure. This spatial variation in the returns to education generates incentives to migrate and geographic variation in private investments in education, especially in the absence of perfect credit contract enforcement.[1]

Assume there are $j = 1, \ldots, N$ households in the rural village, each with one adult decision-maker and one child. Each adult decision-maker is endowed with wealth w_j, and each child is endowed with a random assignment of innate ability α_j, where $\alpha \in [0,1]$. We assume that the distribution of abilities across children in the village is common knowledge.[2] In period 1, adults choose whether to educate their own children, invest in the education of other children in the village at a given net interest rate r, or hold their wealth in the form of a composite, alternative asset that pays marginally less than r.[3] At the outset of period 2, each grown child decides where to live and work.

We are concerned mainly with demonstrating how migration induced by spatial differences in the returns to education leads to rural underinvestment in education, especially for children with high latent ability, by hindering informal finance mechanisms. Thus, we make some strong simplifying assumptions. Following Banerjee and Newman (1998), we assume that once individuals migrate they free themselves entirely of their obligations to non-kin in their original, rural community. This assumed distinction between kin and non-kin derives from an observed qualitative difference between taking advantage of distance and relative anonymity to default on informal loans provided by non-kin community members, and the breaking of ties or responsibility to family. In a comprehensive survey of the relevant literature, Remple and Lobdell (1978) find that a substantial majority of urban remittances go to the household of the migrant; village elders are the only non-kin that receive a significant share. We incorporate this distinction by modelling households as receiving benefits from their own child's income, whether or not the child migrates.[4]

(a) The child's migration decision

We follow the standard solution technique of backward recursion, solving the child's period 2 migration decision first, then solving the adults' first-period educational investment decision conditional on the child's subsequent best response.

Let $E_j \equiv [E_{1j}, \ldots E_{Nj}]$ be the vector of educational units provided to each child $i = [1, \ldots, N]$ in the community by household j, and $E^j \equiv [E_{j1}, \ldots E_{jN}]$ be the vector of all educational units received by child j from each household $i = [1, \ldots, N]$. Note that the first subscript indexes the recipient (child) and the second the financier (household).

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To simplify notation and make the model more analytically tractable, we do not attempt to analyse complex exchanges that allow any household to offer education loans to specific non-kin children in the community. Instead, we model a community fund financed by the contribution of households wishing to invest in the education of community children. Any child from the community can then apply for educational funds from this community pot.[5] We can now write $E_j \equiv [E_{jj} + E_{cj}]$ and $E^j \equiv [E_{jj} + E_{jc}]$, where E_{cj} denotes household j's contribution to the community pot and E_{jc} represents that portion of child j's education financed through community funding.

Let $h_j = \alpha_j E^j$ be the level of human capital attained by child j. The labour productivity of a child with human capital h_j is then given by the strictly concave, monotone and twice differentiable function $\rho(h_j)$. An individual whose productivity is $\rho(h)$ in the village has an increased productivity level $\lambda\rho(h)$ in the city, where $\lambda > 1$, reflecting the higher returns to human capital in urban areas.

In the event that a parent's wealth is insufficient to cover their optimal level of education, a child may seek educational loans in period 1 from the community. In the absence of credit markets with perfect, exogenous contract enforcement, children are able to renege on these loans in period 2. For the sake of simplicity, we assume that the child tries to renege on any loans received from the community if and only if he migrates to the city. The lenders can respond and, following Banerjee and Newman (1998), we model their retribution as the power to seize the full value of a migrated child's income if they are caught.[6] We denote as $1 - \pi$ the probability of catching a reneging child. Educated children will rationally migrate and renege on their educational loan contracts when there is significant spatial variation in the returns to education λ, the costs of migration c are low and enforcement of loan contracts is weak (i.e. π is high).

Suppose that in the second period a child with human capital h_j remains in the village. His net earnings will then be $\rho(h_j) - (1 + r)P_E E_{jc}$, where r is the net interest rate and P_E is the cost of a unit of education.[7] Should the child decide to migrate, his expected gross earnings will be $\pi\lambda\rho(h_j)$ and he will incur a migration cost, c.[8] The migration cost c incorporates both the financial costs of relocation and the social costs that result from a loss of social relationships, which may be intrinsically as well as instrumentally important. The child's second-period choice is thus quite simple:

$$\max(\rho(h_j) - (1 + r)P_E E_{jc}, \pi(E_{jc})\lambda\rho(h_j) - c), \tag{1}$$

where[9]

$$\pi(E_{jc}) = \begin{cases} \pi & \text{if } E_{jc} > 0 \\ 1 & \text{if } E_{jc} = 0. \end{cases}$$

Adults invest in their community's children with the full knowledge that their investment decisions will eventually affect the children's migration decisions.

(b) The adult's investment decision

All the adults in the village can observe each child's innate ability by the time they need to make educational investments.[10] In deciding how to allocate their

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education investment between their own child and other children in the community, an adult will consider the returns to each investment option, taking the children's migration decisions into consideration. The adult household head's first-period decision problem can then be characterized by

$$\max_{E_{jj},E_{cj}} w_j - P_E(E_{jj}+E_{cj}) + \delta(1+r)P_E E_{cj} + \delta\beta Y_j \quad \delta\in(0,1),\ \beta\in(0,1], \tag{2}$$

subject to

$$Y_j = \max(\rho(h_j) - (1+r)P_E E_{jc},\ \lambda\rho(h_j) - c) \tag{3}$$

$$P_E(E_{jj}+E_{cj}) \leqslant w_j \tag{4}$$

$$[\rho(h_i) - (1+r)P_E(E_{ic}) - \pi\lambda\rho(h_i) + c]E_{cj} \geqslant 0 \quad \forall i \neq j, \tag{5}$$

where δ is a discount factor reflecting current valuation of future earnings. Note that a household's expenditure on the education of its own child indirectly affects its wellbeing via the function $\delta\beta Y$. The household's utility increases in its child's future productivity given by equation (3). β captures the household's valuation of its child's future income.[11] The function $\delta\beta Y$ flexibly accounts for parental investments in their children's education made from any combination of material and nonmaterial (e.g. altruistic, status) purposes. Equation (4) is a budget constraint.

The optimal investments are intuitive. Households will invest in their own children as long as the increase in their wellbeing resulting from a marginal gain in their child's productivity exceeds the opportunity cost of investing in another child from the community. An adult will invest in a child from another household within the community only if it is thought that that child will repay the loan. This creates an incentive compatibility constraint (ICC), reflected in equation (5), such that children receiving educational loans will not be educated beyond the point at which they would rationally migrate to the city and subsequently default on the loan.

As we will show, the incentive-compatible level of education depends fundamentally on the spatial variation in returns to education λ, the cost of migration c, the child's intrinsic ability α and the enforcement of loan contracts, as reflected in the probability that it is possible to renege on contracts by moving, represented by π. The ICC for the optimization problem reflects the fact that, if household j does not provide any funding for the education of child $i \neq j$, then it will be indifferent to child i's decision to migrate. Households may want their own children to migrate after they are educated, but if they have invested in the education of others' children's they will not want those children to leave.

II. Analysis

We now analyse the factors that affect the educational outcomes of children and the educational investment decisions taken by adults. Specifically, we investigate how various educational financing schemes affect the optimal education levels in a dual economy setting, and how educational investments vary in response to changes in the model's parameters.

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To establish a basis for comparison, we first analyse the case in which children receive educational funding only from their own parents and characterize the conditions for migration and the optimal levels of education in each sector. We then allow children to receive informal loans from other households. We show that the presence of an informal credit market weakly increases the educational attainment of all children but its efficiency is decreasing in the rate of out-migration. Finally, we briefly consider the case of a first-best world, where children can borrow on their future productivity from a formal credit market to finance their education. These comparisons show how informal credit markets can break down in the presence of migratory pressures, leading to underinvestment in education, especially among high-ability children from poor households.

(a) Household-funded education

In this first scenario, a child's education can be funded only by his or her own household, so there is no education loan market.

The child's decision. We begin by studying the child's problem. The human capital of a child j, whose education is funded only by his own household j, is given by $h_j = \alpha_j E_{jj}$. From (1), we know that the child will migrate if his total level of human capital h_j implies

(6) $$\lambda\rho(h_j) - \rho(h_j) \geqslant c.$$

Let $\overline{h}(\lambda, c)$ denote the level of h_j that solves equation (6) with equality. This is the threshold level of human capital necessary to migrate. Given that $\rho(\cdot)$is strictly concave and monotonically increasing, we can apply the Inverse Function theorem to establish

(7) $$\partial(\bar{h})/\partial(\lambda) < 0$$

and

(8) $$\partial(\bar{h})/\partial(c) > 0.$$

Condition (7) says that, as the urban/rural infrastructure ratio increases, the human capital threshold level decreases and therefore more people are likely to migrate. Indeed, both within and across nations, actual migration patterns are overwhelmingly towards higher-productivity regions. Condition (8) simply indicates that, as the cost of migration increases, the level of human capital required to migrate also increases. This wedge creates some modest, but bounded, spatial differences in incentives to invest in education.

Furthermore, since $h = \alpha E$, the threshold level of education needed to induce migration, $\alpha\bar{E}(\alpha) = \bar{h}$, is decreasing in natural ability:

(9) $$\partial(\bar{E}(\alpha))/\partial(\alpha) < 0.$$

Thus, everything else equal, high-potential individuals are more likely to attain the threshold level and migrate, as reflected in the 'brain drain' literature (Stark 1984, 1991; Masson 2001, Commander *et al.* 2003).

The household head's decision. We now analyse the adult or household head's first-period decision. We first characterize the conditions under which an adult will spend all of her wealth on the education of her own child.

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Suppose child j migrates in period 2; i.e. the household invests at least $\bar{E}_j$ in period 1. Then it must have been the case in period 1 that

$$(10) \qquad P_E \bar{E}_j \leqslant w_j$$

and

$$(11) \qquad \delta\beta\lambda\rho'(\alpha_j E_{jj})\alpha_j \geqslant \delta(1+r)P_E \quad \text{for } E_{jj} \geqslant \bar{E}_j.$$

Put differently, a child will migrate if and only if his parents were both able and willing to provide the child with a level of education that meets or exceeds the threshold level required for migration. Equations (10) and (11) reflect these conditions. Equation (10) sets down the minimum household wealth necessary to make such an investment feasible. Furthermore, as specified in (11), an adult will continue to invest in her migrating child's education as long as the marginal benefit to the household is larger or equal to the opportunity cost. We define $\overset{u}{E}_j$ as the value that solves (11) with equality.[12] $\overset{u}{E}_j$ is thus household j's optimal level of educational investment in its child, *conditional* on anticipating (correctly) that the child will migrate. $\overset{u}{E}_j \geqslant \bar{E}_j$ is a necessary condition for migration to occur.

If instead the child does not migrate in period 2, then it must have been the case in period 1 that either $w_j \leqslant \bar{w}_j$ or $\overset{u}{E}_j < \bar{E}_j$, or both. If either condition holds, the adult head will continue to spend on her child so long as E_{jj} satisfies

$$(12) \qquad \delta\beta\rho'(\alpha_j E_{jj})\alpha_j \geqslant \delta(1+r)P_E, \quad \text{where } E_{jj} < \bar{E}_j.$$

This condition ensures that, at the level of education that exhausts the household's wealth, the marginal benefit to the household from an increase in the non-migrating child's education is greater than the opportunity cost of investing in alternative options.

Let $\overset{r}{E}_j$ solve (12) with equality, representing household j's optimal level of education, given that child j is unable to migrate in the subsequent period.[13] It

TABLE 1
GLOSSARY OF KEY MODEL VARIABLES

Variable	Definition
E_{jj}	Amount of a child j's education funded purely by his parents (household j)
E_{cj}	Amount of educational units that household j invests in non-kin community children
E_{jc}	Amount of child j's education financed by community funds
E^j	$\equiv E_{jj} + E_{jc}$, the total education attained by child j
E_j	$\equiv E_{jj} + E_{cj}$, the total amount of education financed by household j
$\bar{E}_j$	Threshold level of education needed to make migration rational for child j
$\overset{u}{E}_j$	Level of education demanded for a child j who will migrate to the urban area
$\overset{r}{E}_j$	Level of education demanded for a child j who will remain in the rural area
$\overset{s}{E}_{jc}$	Maximum amount of education that the community will finance for a child j
$\overset{d}{E}_{cj}$	Amount of education for which a child j requires community funding

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is now a simple task to classify the set of children who will migrate if they have no recourse to extra-household education loans to finance their education. Given the set of community-specific parameters λ, r and c, a child's migration decision depends entirely on his innate ability and the level of his household's wealth. Intra-community variation in migration and education patterns thus arises owing to cross-sectional variation in initial endowments. The strict concavity of $\rho(\cdot)$ makes the LHS of equation (12) decreasing in E. Because the threshold level of education, $\bar{E}$, is decreasing in α, per equation (9), at low levels of innate ability α, $\bar{E}$ exceeds the optimal level of education for children who will migrate, $\overset{u}{E}$.

Let α^M establish the ability threshold that determines which children migrate irrespective of household wealth; i.e., $\bar{E}(\alpha^M) = \overset{u}{E}$. Figure 1 graphs the combination of parental educational investments and innate abilities that jointly determine a child's educational attainment and subsequent locational choice in the second period, conditional on λ and c. Consider first the $\overset{r}{E}$ schedule obtained from equation (12). It represents the maximum educational level an adult will 'invest' in her child if he stays in the rural area. The $\overset{u}{E}$ schedule, implied by (11), has a similar interpretation, but for children who migrate. As returns to education are higher in the city, this schedule strictly dominates the former. Both schedules represent the upper limits of potential education. Which schedule is relevant depends on household wealth and the child's ability. Children whose parents can afford to provide them with a level of education above the threshold (given by the curve $\bar{E}$ corresponding to equation (6)), migrate; the others stay home. For a child with $\alpha < \alpha^M$, the threshold level of education needed to make migration rational exceeds the maximum investment his parent would be willing to make in his education, irrespective of her wealth. These children are ability-constrained and will never migrate. Children with $\alpha \geqslant \alpha^M$ will migrate only if their parents can afford the threshold level of education, i.e. $w \geqslant P_E\bar{E}(\alpha)$. The shaded area in Figure 1 thus

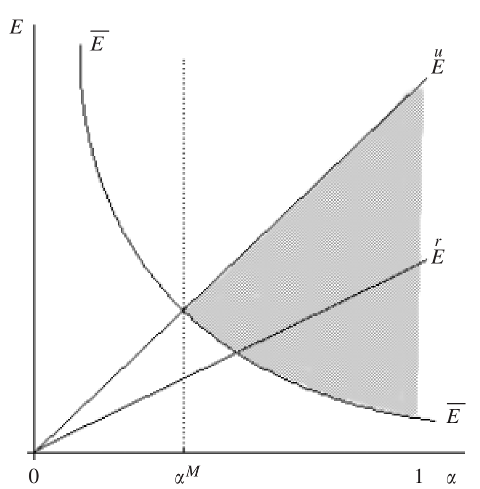

FIGURE 1. Educational outcomes and migration level conditioned on child intelligence and household wealth.

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represents the space of children who meet the conditions for migration. Assuming that the distribution of innate ability is independent of household wealth, there will be some children with high ability who fall far short of their optimal level of education because of low household wealth. Conversely, wealthy households will educate their low-ability children up to the optimal level. Without access to extra-household educational financing, therefore, poverty gives rise to lower levels of educational attainment and inefficiencies in the allocation of education across children of heterogeneous ability.

The effect of spatial variation in productivity on education levels. Suppose the urban sector underwent a period of heavy investment in its infrastructure, resulting in a relative increase in urban labour productivity. From equation (11), an increase in λ raises the marginal benefit of human capital, thereby resulting in higher $\overset{u}{E}$ for all levels of α. Consequently, the threshold level of $\bar{h}$ drops and, for any given α, so does $\bar{E}$ and therefore $\bar{w}$. Since $\alpha^M \bar{E} = \overset{u}{E}$, a decrease in $\bar{h}$ and an increase in $\overset{u}{E}$ imply a decrease in α^M. Thus, $\forall \alpha > 0$,

$$(13) \qquad \partial(\overset{u}{E})/\partial(\lambda) > 0$$

and

$$(14) \qquad \partial(\bar{E})/\partial(\lambda) < 0.$$

Figure 2 graphically depicts the effect of increasing urban productivity on educational outcomes and migration rates. As (13) and (14) indicate, an increase in λ pivots $O\overset{u}{E}$ counter-clockwise and shifts $\bar{E}$ down, causing α^M to fall from α_0^M to α_1^M. The result is an increase in migration if there exists at least one household j such that

$$(15) \qquad w_j < \alpha_j \bar{E}_0 \quad \text{and} \quad w_j > \alpha_j \bar{E}_1.$$

Condition (15) corresponds to the shaded area in Figure 2. It represents all those children for whom an increase in λ lifted wealth and/or ability constraints

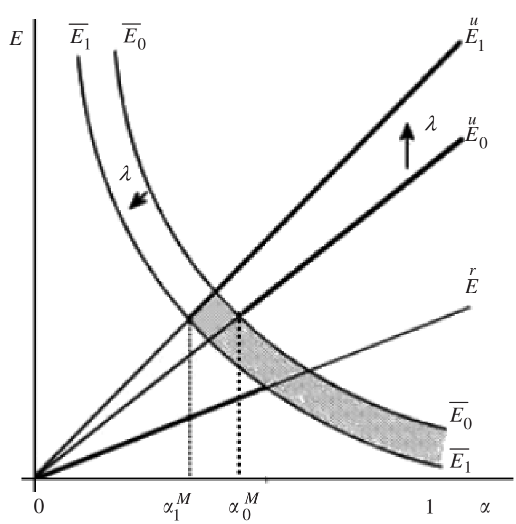

FIGURE 2. Effect of increasing urban productivity on educational outcome and migration rate.

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sufficiently to make migration attractive. Note that, even though their level of education remains the same, they now migrate, and thereby earn higher wages for any given level of human capital. There will, however, still be those children whose ability and/or household wealth endowment is too low for them to migrate. Household poverty can result in large differences between a child's optimal level of education and the actual amount of education received. The extent of this disparity, which increases with increasing spatial differences in labour productivity, is bound by the range $[0, \overset{u}{E_j}]$. This range collapses towards $\overset{u}{E_j}$ (towards $\overset{r}{E_j}$ for $\alpha_j < \alpha^M$) as household wealth increases, and, as is clear in Figure 2, is increasing in α. Moreover, as λ increases, the difference in optimal educational level between a child who chooses to stay in the rural area and one who migrates (for any given level of α) increases; that is, $\partial(\overset{u}{E} - \overset{r}{E})/\partial(\lambda) > 0$. Conversely, a decrease in λ, arising from improvements in rural infrastructure that increase its relative productivity, will reduce the educational investment gap. This reflects the well known phenomenon that, as urban centres develop more quickly than outlying rural areas, the socioeconomic disparity between urban elites and rural elites grows. This is reflected here in terms of higher incentives to educational attainment for rural children who expect to migrate. This does not mean that all, or even most of the urban immigrants achieve this level of education—indeed, increased relative productivity in the urban area increases the rate of migration by loosening the lower boundaries on the ability and wealth constraints. As a result, the urban area begins to attract both relatively more skill-poor individuals and those coming from low-wealth households. It is therefore safe to conjecture that such a dynamic not only increases the urban–rural polarization but also results in increasing inequality within the urban sector. In a growth model characterized by ability-biased technological transition, Galor and Moav (2000) show that increases in the rate of technological progress result in increasing wage inequality both between and within groups of skilled and unskilled workers. Assuming an urban bias in growth processes, it should be feasible to replicate similar results in a dynamic version of our model. We leave this topic for future extensions of the model.

(b) Informal credit market

Thus far we have restricted our attention to the case in which a child's education is financed solely by its own household. This establishes a benchmark against which we now explore the relationship between spatial variation in the returns to human capital and the financing of educational investments. We start by analysing the household's decision to invest in other children.

The supply of community-funded education. We first characterize the conditions under which educational loans can be be provided to children outside of the lender's household. In order for the community to invest in child j, i.e. $E_{jc} > 0$, it must be the case that

$$(16) \qquad \pi\lambda\rho[\alpha_j(E_{jj} + E_{jc})] - \rho[\alpha_j(E_{jj} + E_{jc})] \leqslant c - (1 + r)P_E E_{jc}.$$

This condition assures the lending household(s) that the recipient child will not migrate and thus renege on his loan. Let $\overset{s}{E_{jc}}$ solve (16) with equality. $\overset{s}{E_{jc}}$ then

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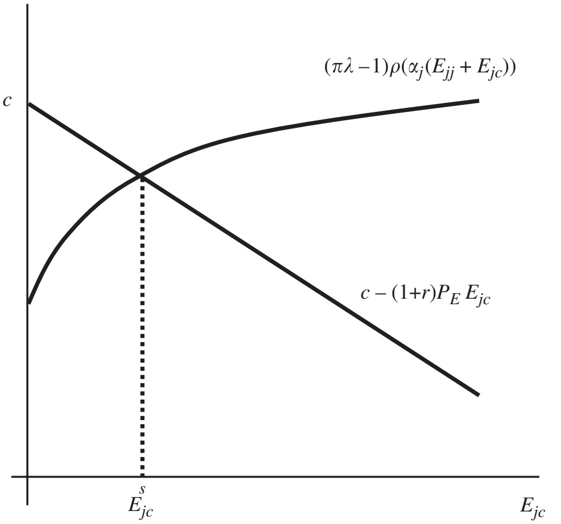

FIGURE 3. Determinants of maximum level of community financed education.

represents the maximum amount of educational loans the community will supply child j.[14] The allowance of educational loans shifts the migration threshold, since migration effectively generates windfall earnings in the form of loan non-repayments. With less risk of being caught and larger loans, the community lending constraint will be tighter as lenders adjust for the increased attractiveness of migration.

To provide a clear picture of the determinants of $\overset{s}{E}_{jc}$, we graph condition (16) in Figure 3 and analyse the comparative statics with respect to a shift in the model's parameters. Recall that the right-hand side of condition (16) captures the net cost of migration. When $E_{jc} = 0$ the net cost is constant, as in the model without any educational loans. As a child takes out educational loans, i.e. as E_{jc} increases, the net cost of migration decreases at the rate $(1 + r)P_E$, as migrating now induces windfall gains from default on the loans. The left-hand side of (16) crosses the vertical axis below c.[15] Since both functions are strictly concave, and therefore their difference is also strictly concave, then, for any given E_{jj}, $(\pi\lambda - 1)\rho(\alpha_j E^j)$ is increasing in $E_{jc} \cdot \overset{s}{E}_{jc}$ reflects the loan value for which the child is indifferent between staying and repaying his loans or migrating and defaulting, and thus represents the maximal supply of community-financed education.

Recall that π denotes the probability that a child escapes attempts by the community to punish him for defaulting on his loans. For large π, migrants find it relatively easy to avoid punishment. A rural household with surplus investible resources will rationally seek to protect itself from potentially bad investments. As Figure 4 shows, because an increase in π shifts up the expected gain of migrating, it lowers $\overset{s}{E}_{jc}$, reducing the supply of informal educational loans available to child j.

Figure 4 similarly shows the decrease in $\overset{s}{E}_{jc}$ resulting from an increase in λ. Again, this is merely the rational response of adults protecting their investments in the face of an increased incentive for educated children to

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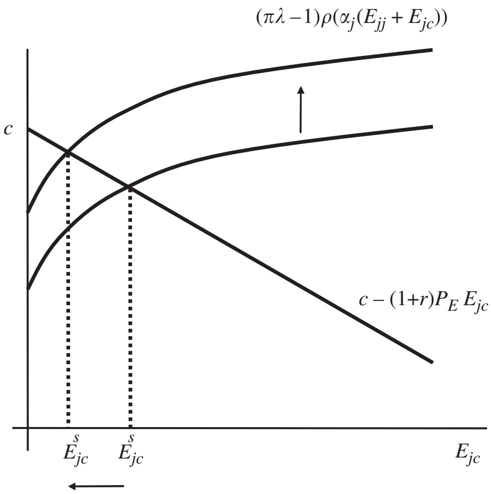

FIGURE 4. Response of community financed education to increases in urban productivity and ease of default.

migrate. On the other hand, in a community with strong social networks, and in which personal welfare is inextricably linked to social status, the resulting increase in the cost of moving is likely to relax this constraint of loan provision. These outcomes highlight our central result. As the expected benefit of migration increases for an educated child, the supply of community-financed educational loans decreases. That is,

$$\partial(\overset{s}{E}_{jc})/\partial(\lambda) < 0, \quad \partial(\overset{s}{E}_{jc})/\partial(\pi) < 0, \quad \partial(\overset{s}{E}_{jc})/\partial(c) > 0$$

Thus, the more attractive the migration option, the more the initial wealth of the child's household conditions its educational attainment.

The return on educational investment is given by $(1 + r)$. One would expect increases in investment returns to increase $\overset{s}{E}_{jc}$. However, a higher return to investment implies a larger debt burden per unit of education financed for the child, which increases his incentive to migrate and default. As such, increases in the net return on educational investment, r, actually decrease $\overset{s}{E}_{jc}$, the maximum level of education the community is willing to invest in any child j. That is, $\partial(\overset{s}{E}_{jc})/\partial(r) < 0$. Figure 5 shows this result. An increase in r represents a steeper slope on the net cost to migration curve, which then intersects the expected net gain to migration curve at a lower $\overset{s}{E}_{jc}$.

The demand for community funded education. As a result of the fixed rate of repayment $(1 + r)$ that an investor receives per unit of education financed, the investor may be willing to invest in a child beyond the level that optimizes the child's productivity. However, the child (or his parent, acting on his behalf) will reject all loans whose repayment cost exceeds the resulting productivity increase.

Recall that $\overset{r}{E}_j$ was child j's optimal level of education if he stayed in the rural area and only his parent financed his education. We now establish the

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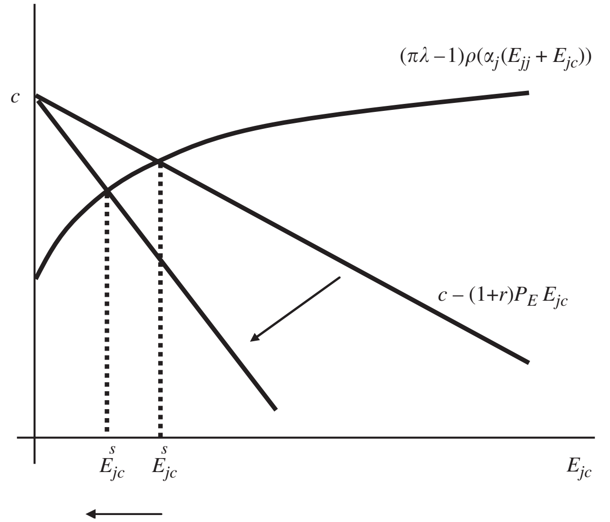

FIGURE 5. Response of community funded education to decreases in costs of migration.

child's demand for community-provided educational loans to supplement parental financing. Given the level of education provided by his own household, E_{jj}, child j will accept any level of community-funded educational units E_{jc} that satisfies

$$(17) \qquad \rho'(\alpha_j(E_{jj} + E_{jc}))\alpha_j \geqslant (1 + r)P_E.$$

Let $\overset{d}{E}_{jc}$ solve (17) with equality, denoting child j's optimal demand for education loans. If community willingness to lend to child j is at least as large as the child's demand for education, i.e. $\overset{s}{E}_{jc} \geqslant \overset{d}{E}_{jc}$, then child j's total educational attainment will be $E_{jj} + \overset{d}{E}_{jc}$ and will not be constrained by the contractual demands of the informal credit market structure. If, on the other hand, $\overset{s}{E}_{jc} < \overset{d}{E}_{jc}$, then the child will receive a total education of $E_{jj} + \overset{s}{E}_{jc}$, the amount funded by his household and community loans. Note that from (12) and (17) we have that

$$(18) \qquad \beta\rho'(\alpha_j \overset{r}{E}_j)\alpha_j = (1 + r)P_E$$

and

$$(19) \qquad \rho'(\alpha_j(E_{jj} + \overset{d}{E}_{jc}))\alpha_j = (1 + r)P_E;$$

therefore it follows that

$$(20) \qquad \overset{r}{E}_j \leqslant E_{jj} + \overset{d}{E}_{jc}\,.$$

Thus, for any child j who does not migrate, $\overset{d}{E}_{jc} \geqslant 0$ and he demands a weakly positive level of community-funded education (strictly positive $\forall \beta < 1$).[16] This is true because, while a child absorbs the full return from increased

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productivity resulting from additional education, the ensuing indirect increase in the household's utility is discounted by β. Whether a child's educational attainment is constrained by the community supply of education loans or by the child's demand for education loans depends on the child's ability and his household's wealth. Any child who seeks an education level that would make migration a rational second-period decision will be constrained by the limited community education loans available to him. Unlike the household-only funding scenario, in which any child with $\alpha \leqslant \alpha^M$ would never migrate, that threshold falls to zero in the presence of lending, because for large enough loan values the benefit of migrating and defaulting becomes irresistible. Migration becomes more inviting as the probability of getting caught $(1-\pi)$ decreases, the marginal cost of education $(1+r)P_E$ increases and the personal return to education α increases. $\overset{s}{E}_{jc}$ is thus decreasing in α_j, though even with $\alpha_j = 1$ a child j will always have access to a positive supply of community loans.[17] Meanwhile, a child's demand for education, and thus for educational loans, is monotonically increasing in α.

Figure 6 depicts the demand and supply of community education as a function of α. The bold sections of the demand and supply schedules represent the education loans that child j receives in equilibrium. All those children with $\alpha \leqslant \alpha^*$ will receive their optimal level of education, while children with $\alpha > \alpha^*$ will be constrained by the amount of loan the community is willing to finance.[18] The striking implication is that, with imperfectly enforceable credit contracts and migration options, children are implicitly punished for being born intelligent. High innate ability increases the benefits to migration, inducing rational investors to limit loans as a defence against default. This also results in an inefficient allocation of educational opportunities. *Ceteris paribus,* low-ability children who generate less productivity from a given level of education receive more funding and thus more education.

Moreover, since education loans are decreasing in child innate ability beyond some point α^*, high-ability children will depend disproportionately on their parents' wealth to finance their education. For wealthy households, the imperfect enforceability of informal lending contracts will not constrain the child's educational attainment and adult earning prospects (see Figure 1); but

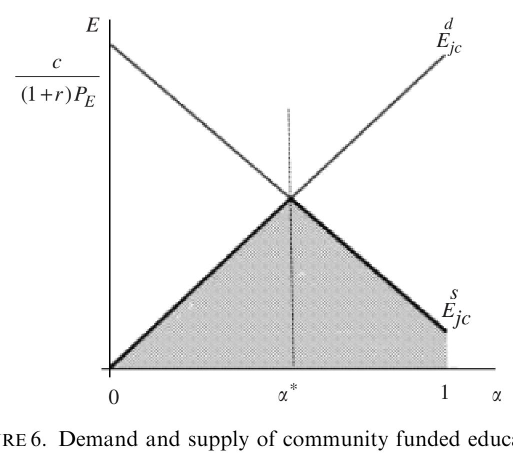

FIGURE 6. Demand and supply of community funded education.

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for poor households the constrained supply of educational loans limits opportunities.

We modelled an unconstrained community education lending fund, one that is always capable of meeting the demand for loans, i.e.

$$\sum_{j=i}^{N} E_{cj} \geqslant \sum_{j=1}^{N} \overset{d}{E}_{jc},$$

subject only to the incentive compatibility constraint. Whether this condition is met depends on the distribution and aggregate level of wealth across households and the distribution of abilities across children in the community. A community poorly endowed with wealth but richly endowed with intelligence is likely to be unable to provide the optimal levels of education for many children. This simple model none the less captures the key elements of our story: that informal financing weakly dominates the household-only provision of education under any distribution of α and w, that spatial disparities in returns to human capital reduce the available supply of educational loans, and that this financial market imperfection will most adversely affect high-ability children from poor households.

(c) The first-best world

While we have shown that informal credit is better than no credit, the incentive compatibility constraint results in inefficiencies and inequities in lending patterns. For completeness, we investigate the extent of these inefficiencies when compared with a complete, competitive credit market with perfect contract enforcement.[19]

In the first-best world of perfect credit markets, all children receive their ability-specific optimal level of education financing, regardless of whether they migrate or not. Moreover, for those children whose parents discount the utility they receive from their children's wellbeing (i.e. where $\beta < 1$), the first-best optimal level of education strictly dominates the purely household-funded optimal level of education for all but the lowest-ability children, who would remain in the rural village regardless. Perfectly enforceable credit contracts make the migration decision independent of the education financing problem. This lowers the threshold level of innate ability needed to migrate and in equilibrium increases educational lending and attainment, especially by high-ability children. Absent first-best credit markets, informal credit increases the funding available for children's education and thus increases educational attainment. But informal credit fails to fulfil the demand by higher-ability children from poorer households, creating important inefficiencies and inequities.

III. Discussion and Policy Implications

The central results of our model highlight three key points. First, spatially varied returns to education tighten the incentive compatibility constraints inherent in imperfectly enforceable credit markets, and thereby limit the usefulness of informal educational loans.

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Second, our model underscores the importance of effective credit contract enforcement mechanisms for optimal investment in children's education, especially for children of relatively high innate ability. Perfectly enforceable education loans afford children the opportunity to realize their full potential and to break free of poverty traps caused by low initial household wealth endowments. But when migration options constrain informal community financing, poor children's prospects may be severely limited by their parents' poverty, as in Loury (1981).

Third, increasing spatial inequality in productive infrastructure without any significant improvements in loan contract enforcement mechanisms increases incentives for rural-to-urban migration. But children from relatively wealthy homes are disproportionately able to capitalize on these opportunities, as informal education loans become increasingly supply-constrained when urban–rural productivity differences grow. Thus, as the urban–rural poverty gap increases, poor children of high innate ability become increasingly consigned to a low-education poverty trap of the sort first posited by Loury (1981).

If increasing educational attainment in less-favoured rural communities, especially among high-ability children, is an objective for policy-makers, then our analysis suggests a means by which public investment might 'crowd in' private educational investment. Governments and donors might improve rural infrastructure in ways that encourage private business investment that stimulates skilled employment and thereby raises the expected returns to human capital. This might include programmes of rural electrification, improvements in rural communication infrastructure, road improvement and maintenance and provision of police protection. Improving rural infrastructure reduces incentives to migrate out of rural villages, making informal loan contract enforcement easier and thereby increasing the provision of private, informal finance.

Though such a policy would indeed relax the incentive constraints on the informal financial market and weakly improve access to education loans, its aggregate impact depends on the availability of local funds for educational investment. It would also depend on whether the returns to investment in the education of non-kin children provided higher returns than other investments. Recall that our model abstracted away from aggregate wealth constraints. Where this assumption does not hold, the informal credit market will be further limited by a binding loan availability constraint. Moreover, as relative returns to productive infrastructure increase in the rural area, alternative, non-educational investment opportunities may become increasingly attractive. Together, these factors may decrease the share of community funds available for long-term investments in education.

If development processes such as growing urban–rural labour productivity gaps unleash forces that undermine the effectiveness of informal credit markets, it becomes crucial to develop universally accessible formal financial markets. Towards this end, governments and donors should invest in credit contract enforcement, perhaps through credit reporting bureaus or improved judicial processes, in order to stimulate the supply of education loans.

It would be instructive to expand this model to allow for dynamics to explore the potential divergence of rural and urban livelihoods and the

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prospective intergenerational reproduction of poverty. Indeed, as poorer and less skilled individuals tend to remain in the rural area, we would expect that spatial mobility combined with imperfect credit markets would yield over time a rural population with a distribution of innate abilities and wealth that results in a decreased rate of migration and a low steady-state level of rural educational attainment and productivity. The simple two-period model we have developed none the less provides a credible answer to the puzzle of underinvestment in education in rural areas based on the twin empirical regularities of spatially varied returns to human capital and imperfect loan contract enforcement in rural credit markets.

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NOTES

1. We focus on the rural economy and use the urban area only as a magnet for migrant labourers from the village. In our framework it would never be rational for an urban dweller to migrate to the rural area, given the decreased return on their human capital that would result.
2. By this assumption, we evoke a rural village with low informational asymmetries arising from the high degree of socialization common in traditional communities. Similar assumptions are standard in the large literature on rural traditional economies; see Platteau (2000) for an excellent review.
3. This composite alternative asset serves just as a benchmark against which educational investments are measured. Setting the returns to this asset at marginally less than r is a simplifying assumption allowing us to focus on a household's educational investments. The implication that the returns to education dominate the returns to other available investment options does not undermine our model. Rather, it simply underscores the puzzle this paper investigates: given empirical evidence of high returns to education (Psacharoupoulos 1994), what explains the apparent underinvestment in education that often characterizes rural communities?
4. Non-family community members can ensure returns to their investment by tracking down emigrants in urban areas and demanding repayment or reciprocity, such as using their home as a base for developing their own ties in the urban area. While emigrants might default on their loan commitment, it is more difficult for them to completely escape traditional norms that call for hospitality and the provision of food and shelter to natal community members who request it. In this way, emigrants can act as 'beachheads' for the rural community, establishing a foundation that facilitates greater rural–urban interaction. By utilizing emigrants for this purpose, natal community lenders can recoup some of their otherwise lost investment. But, while lenders can tap into the benefits emigrants provide to recover part of their loans, the 'beachhead' effect alone does not alter a potential lender's loan decision *ex ante*, because community norms generally require the emigrant to oblige any natal community member who requires assistance in the city, not just those who have extended him credit in the past. So long as emigrants cannot exclude any community members from assistance, then each potential lender in the rural community has an incentive to free-ride on the 'beachhead' opportunity sponsored by some other lender, since the service is non-exclusive. In the interests of simplicity, therefore, we assume away 'beachhead' effects in our model, as they do not affect the qualitative results.

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5. As the return on educational investments is set at $(1 + r)$, and thus is independent of the child, and as children are similarly indifferent as to who in the community provides the loans, our qualitative results are robust to this simplifying abstraction.
6. By driving a defaulter's income to zero, no lender would ever fund a migrating child, so informal finance flows only to non-migrating children. Our main aim—to show that migration options reduce the loan pool for education—is robust to this simplifying assumption.
7. A child does not have explicitly to repay education financed by his parents. This allows for adults' decisions on their children's education to involve additional considerations beyond merely material investment returns.
8. Note that, in equating productivity with wages, we implicitly assume a competitive labour market where firms hire labour up to the point where the marginal product of labour equals the wage rate.
9. Defining $\pi(E_{jc})$ in this manner captures the fact that the probability of being caught and punished is relevant only when the child received a positive amount of education loans from the community pot on which he can renege.
10. As primary education is often free or subsidized, the need for educational investments arises mainly at the secondary level and beyond, making this a tenable assumption.
11. The Rotten Kid Theorem (Becker 1974), which states that in the presence of parental transfers even a selfish child will choose actions that maximize the income of the family, suggests setting $\beta = 1$. However, as transfers are made in the first stage and the parent does not have control of the child's second-period earnings (as they do under the assumptions of the Rotten Kid Theorem), we opt to set $\beta \in (0,1]$, allowing for the utility that parents derive from their children's earnings to vary.
12. For ease of reference, Table 1 contains the definitions for key model variables.
13. A child j will not migrate if his parents are wealth constrained $(w_j < \bar{w}_j)$, if he is ability constrained $(\overset{u}{E}_j < \bar{E}_j)$, or both.
14. Note that the supply of loans $\overset{s}{E}_{jc}$ for a child j is calculated after household j decides how much to invest in its child's education, E_{jj}, independently from lending or borrowing options. Then, starting from the optimal educational expenses provided by the household, informal (or formal) lending may take place.
15. We know that $E_{jc} > 0$ implies that $E_{jj} < \bar{E}_j$. Thus, since $\bar{E}_j$ is such that $(\lambda - 1)\rho(\alpha_j \bar{E}_j) = c$, then, for $E_{jc} = 0$ and $\pi \in (0,1)$, it follows that $(\lambda\pi - 1)\rho(\alpha_j(E_{jj} + E_{jc})) < c$.
16. One can prove this as follows. $\forall \beta < 1$, (18) and (19) imply that $E_j < E_{jj} + \overset{d}{E}_{jc}$. Suppose $\overset{d}{E}_{jc} = 0$. Equation (20) then implies that $\overset{r}{E}_j < E_{jj}$. This is a contradiction, since, given that the optimal level of household funded rural education is $\overset{r}{E}_j$, it must be that $E_{jj} \leqslant \overset{r}{E}_j$. It follows that $\overset{d}{E}_{jc} > 0$. For $\beta = 1$, $\overset{d}{E}_{jc} = 0$ iff $w_j \geqslant P_E \overset{r}{E}_j$.
17. This result follows from the definition of $\bar{E}_j$ and $\overset{s}{E}_{jc} \cdot \bar{E}_j$ is such that $(\lambda - 1)\rho(\alpha_j \bar{E}_j) = c$ and $\overset{s}{E}_{jc}$ solve $(\lambda\pi - 1)\rho(\alpha_j(\bar{E}_j + \overset{s}{E}_{jc})) = c - (1 + r)P_E \overset{s}{E}_{jc}$. Let $\alpha_j = 1$ and $\pi \in (0,1)$. Suppose $\overset{s}{E}_{jc} = 0$; this implies that $(\lambda - 1)\rho(\alpha_j \bar{E}_j) = c$, and $(\lambda\pi - 1)\rho(\alpha_j \bar{E}_j) = c$. This is a contradiction, and thus $\overset{s}{E}_{jc} > 0$.
18. The low-density exception are children of households whose wealth and resulting investment choices bring the child nearly to the migration threshold, but where a single unit of community-financed education would provide sufficient education to make it worth the child's while to migrate.
19. As the results of the first-best counterfactual are similar to most analyses of competitive markets, we limit ourselves here to a brief presentation of the key results. A complete analysis with detailed derivations is available in the working paper version, available from the authors upon request.

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