Credit Constraints and Voting on Human Capital Policies*

Braz Camargo[†] Guilherme Stein[‡]

June 23, 2014

Abstract

We develop a model of voting behavior to show how credit constraints can affect a society's demand for government spending on *human capital policies*, that is, public policies that increase the returns to human capital accumulation. We show that credit constraints can lead poorer societies to prefer less government spending on human capital policies than richer societies, and that a reduction in credit market frictions can increase government spending on such policies, with the increase greater in poorer societies. We also provide some evidence in support of our results about the impact of credit market frictions on policy preferences.

Key Words: Credit Constraints, Human Capital, Majority Voting.
JEL Codes: D72, H40, I00, J24.

*We thank Tiago Cavalcanti, Bernardo Guimarães, and Mauro Rodrigues for comments and suggestions. Braz Camargo gratefully acknowledges financial support from CNPq.

[†]Corresponding Author. Sao Paulo School of Economics - FGV. Address: Rua Itapeva 474, São Paulo, SP 01332-000, Brazil. E-mail: braz.camargo@fgv.br.

[‡]Sao Paulo School of Economics - FGV.

1 Introduction

It is well-known that credit market imperfections affect human capital investment decisions.[1] Credit constraints reduce the ability of agents to smooth consumption, which in turn reduces the benefits from the accumulation of human capital. A natural conjecture, then, is that credit constraints affect preferences for government spending on *human capital policies*, that is, public policies that increase the returns to human capital accumulation. Note that human capital policies are not limited to expenditures on public education. For example, expenditures on public health have an impact on the returns to human capital accumulation by increasing life expectancy and decreasing morbidity.[2] Some forms of public infrastructure spending can also be regarded as human capital policies. For instance, access to potable water and sanitation has an (indirect) impact on the returns to the accumulation of human capital by increasing health outcomes.[3] Also, better transportation infrastructure can help increase access to schools and health care.[4]

In this paper, we develop a model of voting behavior to understand how credit constraints affect preferences for government spending on human capital policies. We obtain two results. First, that credit market frictions can lead poorer societies to prefer less government spending on human capital policies than richer societies. Second, that a reduction in credit market frictions can increase a society's demand for government spending on human capital policies, with this increase greater in poorer societies. We also provide some evidence in support of our results about the impact of credit market frictions on government spending on human capital policies.

The environment we consider is as follows. There is a continuum of mass one of agents who live for two periods and differ only in terms of their wealth (or period-one income). In the first period, the agents decide how much to borrow or save and how much human capital to accumulate. An agent's income in the second period depends on his investment in human capital. The govern-

[1] See Lochner and Monge-Naranjo (2012) and the references therein for evidence of the impact of credit constraints on the accumulation of human capital in children and young adults.

[2] Jayachandran and Lleras-Muney (2009) and Oster et al. (2012) provide evidence that increases in life expectancy have a positive impact on human capital investments. There is also evidence that improvements in child health care increase school attendance, see, e.g., Bleakley (2007), Bobonis et al. (2006), and Miguel and Kremer (2004).

[3] See Behrman and Wolfe (1987), Lavy et al. (1996), and Lee et al. (1997) for some evidence.

[4] See Gertler and Glewwe (1990) and Lavy (1996) for evidence on the impact of transportation infrastructure on school attendance.

ment has a budget that it can either spend on human capital policies or on direct cash transfers. The returns to human capital accumulation increase with the per capita spending on human capital policies. The government policy is chosen by majority voting.

We first analyze the benchmark case in which credit markets are perfect. We show that policy preferences are independent of wealth in this case, so that the per capita government spending on human capital policies does not depend on the distribution of wealth in society. In order to understand this result, notice that a higher per capita government spending on human capital policies increases the gains to human capital accumulation, and thus income in period two, but decreases disposable income in period one. An agent benefits from this to the extent that he can transform part of his higher period two income into period one consumption. Hence, when agents can smooth consumption perfectly, they all favor the same per capita government spending on human capital policies, namely, the spending that maximizes their net gain from accumulating human capital.

We then analyze the main case in which credit markets are not perfect. We capture credit constraints by assuming that only a fraction of the agents' income in period two can be collateralized.[5] We first show that the median voter theorem holds in our setting, that is, that the policy chosen by the government is the policy most preferred by the agent with median wealth. We then use the median voter theorem to establish the following two comparative statics results: (*i*) that the per capita government spending on human capital policies increases with the median wealth in society; and (*ii*) that a reduction in credit market frictions increases the per capita government spending on human capital policies, with the increase greater in poorer societies.

The result that per capita government expenditures on human capital policies increase with median wealth is intuitive. Indeed, in the presence of credit constraints, the ability of agents to smooth consumption, and thus benefit from human capital policies, is increasing in their wealth.

The result that a reduction in credit market frictions increases the per capita government spending on human capital policies, and that this increase is greater in poorer societies, is also intuitive. Indeed, a higher borrowing limit allows better consumption smoothing. However, for a given borrowing limit, an agent is not credit constrained if he is wealthy enough, in which case relaxing

[5] We model credit constraints as in Lochner and Monge-Naranjo (2011). Andolfatto and Gervais (2008), Chatterjee et al. (2007), and Livshits et al. (2007) model credit constraints in a similar way.

borrowing constraints does not increase the agent's gain from accumulating human capital. Thus, a reduction in credit market imperfections has no impact on government spending on human capital policies if the median voter is wealthy enough. More generally, by continuity, reducing credit market frictions has a greater impact on government spending on human capital policies in a society where the median voter is poor than in a society where the median voter is rich.

We make two assumptions in our model, namely, that agents have no access to private education and that the size of the government is given, that deserve some discussion. The assumption that private education is not available is reasonable given that private education is costly, and so unlikely to be affordable by the median voter in most countries.[6] The reason for abstracting from the determination of the government's size is that this allows us to focus on the question of interest, which is how credit constraints affect preferences for the composition of government expenditures.

Our model also assumes that the agents themselves are responsible for their investments in human capital. This assumption, which we do for ease of exposition, is unrealistic when considering the decision of whether to attend primary or secondary school. In the Appendix (Appendix B not for publication), we show that a two-generation version of our model in which the (altruistic) first generation invests in the human capital of the second generation (their offspring) and votes on the government policy has the same implications as the model in the main text.

We conclude our analysis by providing some evidence in support of our results about the impact of credit market frictions on policy preferences. In order to do so, we construct a panel of 214 countries from 2004 to 2010 containing three different measures of government spending on human capital policies and a measure of (the absence of) credit constraints. Our measure of credit constraints is an index measuring the amount of collateral protection against default afforded to lenders, which matches well with the way we model credit constraints.[7]

[6] For instance, in OECD countries (excluding Canada, Holland, and Turkey), on average only 11.29% of the students enrolled in primary schools are enrolled in private schools. In a larger sample of 111 countries, on average only 15.8% of the students enrolled in primary schools are enrolled in private schools. Epple and Romano (1996a, 1996b), Glomm and Ravimukar (1998), and Bearse et al. (2005) study the provision of public services when (costly) private alternatives exist and provide conditions under which majority voting equilibria exist.

[7] Our measures of government spending on human capital policies are: (*i*) expenditure per student in public elementary schools (% GDP per capita); (*ii*) student-to-teacher ratio in public elementary schools; and (*iii*) per capita government spending on public health (constant 2005 international US Dollars).

We find that a reduction in credit constraints is associated with an increase in government spending on human capital policies even after controlling for government size (and other variables that could affect preferences for government spending on human capital policies). We also find that there is no statistically significant relationship between credit constraints and military expenditures, a type of public policy that does not affect the returns to human capital accumulation. This provides further evidence that credit constraints affect the composition of government expenditures.

Furthermore, we split our sample based on GDP per capita and look at the relationship between credit constraints and government spending on human capital policies for countries in the first (lowest) and fourth (highest) quartile of the distribution of GDP per capita. Consistently with our model, we find that a reduction in credit constraints is associated with a greater increase in government spending on human capital policies for countries in the first quartile as compared to countries in the fourth quartile.

The rest of the paper is organized as follows. The remainder of this section discusses the related literature. Section 2 introduces the environment. Section 3 analyzes the benchmark case in which credit markets are perfect. Section 4 analyzes the main case in which credit markets are not perfect. Section 5 discusses our empirical evidence. Section 6 concludes and the Appendix contains omitted proofs and details.

Related Literature There are a number of papers that study the political economy of public education provision. Glomm and Ravikumar (1992) and Saint-Paul and Verdier (1993) study endogenous growth models where education is the determinant of growth and expenditures on public education, which act as redistributive policy, are determined by majority voting. Gradstein and Kaganovich (2004) and Levy (2005) study models where demography affects the provision of public education, which acts as a transfer from the old to the young. Credit constraints do not play a role in the analysis of these papers.

Credit constraints play a role in Fernandez and Rogerson (1995, 1996) and Soares (2003). Fernandez and Rogerson (1995) study a model of public provision of higher education in which credit constraints imply that government expenditures on higher education can act as a transfer from low-income individuals to high-income individuals. Fernandez and Rogerson (1996) study a multicommunity model in which individuals differ in their income, education is publicy provided at the community level, and individuals are free to move across communities. Credit constraints imply that the policy preferences of individuals depend on their income and on the income of their communities. Soares (2003) shows that in the presence of credit constraints, a society consisting of non-altruistic individuals can vote for positive spending on public education if public education increases the return on capital. Our paper differs from these other papers in that it studies how (changes in) credit constraints affect preferences for the composition of government expenditures.

A closely related paper is Bursztyn (2013), which provides evidence that lower-income voters tend to prefer the government to spend resources on direct cash transfers instead of spending resources on public education. Bursztyn (2013) also develops a simple model of voting behavior to show how credit constraints can help explain his findings. Bursztyn's model differs from our model in two important dimensions. First, Bursztyn's model assumes that the investment in human capital is exogenously given. Second, as in the papers discussed in the previous paragraph, Bursztyn's model assumes that credit constraints are fixed (agents cannot borrow), so that one cannot analyze the impact of changes in credit market imperfections on voters' preferences.

Finally, a number of papers document a causal relationship between credit market imperfections and lower economic growth (see, e.g., Levine et al. (2000), Calderón and Liu (2003), and Christopoulos and Tsionas (2004)). The literature on economic growth emphasizes that credit constraints reduce economic growth by preventing individuals from accumulating human capital, which is an input to production (see, e.g., Galor and Zeira (1993) and Benabou (2002)). Our results suggest an additional channel through which credit constraints can lower economic growth: credit constraints reduce preferences for government spending on public policies that increase the returns to human capital accumulation.

2 Environment

Society is populated by a continuum of mass one of agents who for live two periods and differ only in terms of their wealth w. Wealth is distributed according to a continuous cumulative density function F with support $[\underline{w}, \overline{w}]$, where $0 < \underline{w} < \overline{w}$. Agents invest in human capital in the first period and work in the second period. The agents' utility function over consumption streams is $u(c_1) + \beta u(c_2)$, where c_t is consumption in period t, $u : \mathbb{R}_+ \to \mathbb{R}$ is the per-period utility function, and $\beta \in (0, 1)$ is the agents' discount factor. The function u is twice continuously differentiable, strictly increasing, and strictly concave, with $\lim_{c \downarrow 0} u'(c) = \infty$ and $\lim_{c \to \infty} u'(c) = 0$.

The timing of events is as follows. In the first period, agents receive a direct (per capita) transfer τ from the government, and decide how much to invest in human capital, h, and how much to borrow or save, d. We adopt the convention that $d > 0$ if an agent borrows. The investment in human capital is in units of consumption and the gross interest rate is $R > 1$. We interpret the cost of accumulating human capital as forgone income. An agent's (labor) income ω in the second period is a function of both h and the government's (per capita) expenditure ε on human capital policies. Monotonicity of preferences implies that $c_1 = w + \tau - h + d$ and $c_2 = \omega(h, \varepsilon) - Rd$.

The function ω is twice continuously differentiable, with: (*i*) $\omega(0, \varepsilon) = \omega(h, 0) = \underline{\omega} > 0$ for all $(h, \varepsilon) \in \mathbb{R}^2_+$; (*ii*) $\partial\omega(h, \varepsilon)/\partial h > 0$, $\partial\omega(h, \varepsilon)/\partial\varepsilon > 0$, $\partial^2\omega(h, \varepsilon)/\partial h^2 < 0$, and $\partial^2\omega(h, \varepsilon)/\partial\varepsilon^2 < 0$ for all $(h, \varepsilon) \in \mathbb{R}^2_{++}$; (*iii*) $\lim_{h \downarrow 0} \partial\omega(h, \varepsilon)/\partial h = \infty$ and $\lim_{h \to \infty} \partial\omega(h, \varepsilon)/\partial h = 0$ for all $\varepsilon > 0$; and (*iv*) $\lim_{\varepsilon \downarrow 0} \partial\omega(h, \varepsilon)/\partial\varepsilon = \infty$ and $\lim_{\varepsilon \to \infty} \partial\omega(h, \varepsilon)/\partial\varepsilon = 0$ for all $h > 0$. Hence, $\omega(h, \varepsilon)$ is strictly increasing and strictly concave in h for all $\varepsilon > 0$ and strictly increasing and strictly concave in ε for all $h > 0$. Note that an agent's income in period two is always positive no matter his investment in human capital and the government's expenditure on human capital policies.

We also assume that:

(A1) $\dfrac{\partial^2\omega(h, \varepsilon)}{\partial h \partial\varepsilon} > 0$ for all $(h, \varepsilon) \in \mathbb{R}^2_{++}$.

Assumption (A1) implies that there is a complementarity between investments in human capital and expenditures on human capital policies. Moreover, we make the following two technical assumptions:

(A2) $\dfrac{\partial^2\omega(h, \varepsilon)}{\partial h^2}\dfrac{\partial^2\omega(h, \varepsilon)}{\partial\varepsilon^2} > \left(\dfrac{\partial^2\omega(h, \varepsilon)}{\partial h \partial\varepsilon}\right)^2$ for all $(h, \varepsilon) \in \mathbb{R}^2_{++}$;

(A3) $\lim_{\varepsilon \downarrow 0} \dfrac{\partial\omega(\varepsilon, \varepsilon)}{\partial h} > R$ and $\lim_{\varepsilon \downarrow 0} \dfrac{\partial\omega(\varepsilon, \varepsilon)}{\partial\varepsilon} > R$.

We show in the next section that (A2) and (A3) imply, respectively, that in the absence of credit constraints, the choice of ε that maximizes society's welfare and is unique and positive.

The policy pair (ε, τ) is determined through majority voting and the government's (per capita) budget constraint is $\varepsilon + \tau = B$, with $B > 0$.[8] Our equilibrium notion is standard.

Definition. *An equilibrium is a policy $\varepsilon^* \in [0, B]$ with the property that the policy pair $(\varepsilon^*, B - \varepsilon^*)$ is preferred to any other policy pair $(\varepsilon, B - \varepsilon)$ by a majority of the population.*

3 Voting in the Absence of Credit Constraints

In order to understand how the presence of credit constraints affects preferences for government spending on human capital policies, we begin our analysis with the benchmark case in which there are no borrowing constraints. We show that when credit markets are perfect, policy preferences are independent of wealth and the unique equilibrium is the policy in which the government maximizes the agents' net benefit of accumulating human capital.

In the absence of credit constraints, the consumption-saving-investment problem (C) for an agent with wealth w is

$$\begin{aligned} \max \quad & u(c_1) + \beta u(c_2) \\ \text{s.t.} \quad & c_1 + \frac{c_2}{R} = w + \tau + \frac{\omega(h, \varepsilon)}{R} - h \\ & h, c_1, c_2 \geq 0 \end{aligned}$$

when the policy pair is (ε, τ). We solve (C) by first finding the investment in human capital h^* that maximizes the present value of net lifetime income $\ell(h, \varepsilon) = -h + \omega(h, \varepsilon)/R$, and then determining the optimal choices of consumption in periods one and two when $h = h^*$. Let c_1^* and c_2^* be these choices of consumption. Since $\lim_{c \downarrow 0} u'(c) = \infty$, c_1^* and c_2^* are interior and satisfy the Euler equation

$$u'(c_1^*) = \beta R u'(c_2^*). \tag{1}$$

For each $\varepsilon \geq 0$, let $h^U(\varepsilon)$ denote the solution to $\max_{h \geq 0} \ell(h, \varepsilon)$. Notice that $h^U(0) = 0$ since $\omega(h, 0)$ is constant in h. Let then $\varepsilon > 0$. Given that $\lim_{h \downarrow 0} \partial \omega(0, \varepsilon)/\partial h = \infty$, it follows that $h^U(\varepsilon)$

[8]Monotonicity of preferences implies that a pair (τ, ε) with $\tau + \varepsilon < B$ is never chosen by majority voting.

is the unique and positive solution to

$$\frac{\partial \omega(h,\varepsilon)}{\partial h} = R. \tag{2}$$

Thus, regardless of ε, the optimal investment in human capital is independent of wealth. The first-order condition (2) has a straightforward interpretation: $h^U(\varepsilon)$ equates the marginal return of human capital accumulation with the marginal cost of borrowing when ε is positive. The complementarity between investments in human capital and government spending on human capital policies implies that $h^U(\varepsilon)$ is strictly increasing in ε.

Now define $d^U(w,\varepsilon,\tau)$ to be the unique value of d such that

$$u'(w+\tau-h^U(\varepsilon)+d) = \beta R u'(\omega(h^U(\varepsilon),\varepsilon)-Rd). \tag{3}$$

By construction, if the policy pair is (ε,τ), then $d^U(w,\varepsilon,\tau)$ is the amount an agent with wealth w who invests optimally in human capital needs to borrow (or save) in period one in order for his choice of consumption in periods one and two to satisfy the Euler equation (1). It is easy to see that $d^U(w,\varepsilon,\tau)$ is strictly decreasing in both w and τ and strictly increasing in ε. Intuitively, the greater an agent's wealth or the government's transfer in period one, the less the agent needs to borrow in order to optimally smooth his consumption. Likewise, given that $h^U(\varepsilon)$ is strictly increasing in ε, an increase in the government's expenditure on human capital policies implies that all agents need to borrow more in order to optimally smooth their consumption. A standard argument also shows that $d^U(w,\varepsilon,\tau)$ is continuous in w.

In order to determine the equilibria in the absence of credit constraints, for each $w \in [\underline{w},\overline{w}]$ and $G \in [0,B]$, let

$$V^U(G,w) = \max\{u(c_1)+\beta u(c_2) | c_1,c_2 \geq 0 \text{ and } c_1 + c_2/R = w+G\}$$

be the lifetime payoff to an agent with wealth w when there are no borrowing constraints and the net (lifetime) wealth transfer by the government to the agent is G. Note that G depends on both the policy pair (ε,τ) and the agent's investment in human capital h. Moreover, in a slight abuse of notation, let $G:[0,B]\to\mathbb{R}$ be such that

$$G(\varepsilon) = B-\varepsilon+\ell(h^U(\varepsilon),\varepsilon) = B-\varepsilon+\frac{\omega(h^U(\varepsilon),\varepsilon)}{R} - h^U(\varepsilon).$$

By construction, $G(\varepsilon)$ is the effective net wealth transfer by the government to the agents when the policy pair is $(\varepsilon, B-\varepsilon)$. In Lemma 8 in Appendix A, we show that (A2) implies that $G(\varepsilon)$ is strictly concave in ε and that (A3) implies that $G'(0) > 0$. Hence, there is a unique choice $\varepsilon_{\max}$ of ε that maximizes $G(\varepsilon)$, and this choice is positive.

It is straightforward to see that $V^U(G, w)$ is strictly increasing in G. Thus, regardless of his wealth, an agent prefers the policy pair $(\varepsilon_1, B-\varepsilon_1)$ to the policy pair $(\varepsilon_2, B-\varepsilon_2)$ if, and only if, $G(\varepsilon_1) > G(\varepsilon_2)$. Therefore, policy preferences are independent of wealth and $(\varepsilon_{\max}, B-\varepsilon_{\max})$ is the policy pair that maximizes society's welfare. Proposition 1 follows immediately.

Proposition 1. *Suppose there are no borrowing limits. Then $\varepsilon^* = \varepsilon_{\max}$ is the unique equilibrium in the absence of borrowing limits regardless of the distribution of wealth in society.*

The intuition for Proposition 1 is as follows. If access to credit markets is perfect, then no matter the government's expenditure on human capital policies, all agents in society can accumulate the human capital that maximizes the present value of their net lifetime income and borrow enough in the first period to optimally smooth their consumption. So, all agents in society favor the same policy, namely, the policy that maximizes the net benefit of optimally investing in human capital.

4 Voting in the Presence of Credit Constraints

We now consider the main case in which agents are constrained in how much they can borrow in the first period. We capture credit constraints by assuming that only a fraction $\widetilde{\kappa} \in [0,1)$ of an agent's income in period two can be collateralized. Hence, an agent who in the first period borrows d and invests h in human capital repays his debt in the second period if, and only if, $Rd \leq \widetilde{\kappa}\omega(\varepsilon, h)$.[9] Thus, credit to agents is restricted to a fraction $\kappa = R^{-1}\widetilde{\kappa} \in [0, R^{-1})$ of period two income:

$$d \leq \kappa\omega(h, \varepsilon). \tag{4}$$

The remainder of this section is organized as follows. First, we study the agents' consumption-saving-investment problem with credit constraints. Then, we show that the equilibria consist of the

[9] We implicitly assume that an agent commits to his investment in human capital before making a borrowing decision. Relaxing this assumption would complicate the analysis without bringing any insights.

preferred policies for the agent with median wealth. Finally, we establish the comparative statics results on how changes in the median wealth and the borrowing limit κ affect equilibria.

The Consumption-Saving-Investment Problem

When the policy pair is (ε, τ) and the borrowing limit is κ, the consumption-saving-investment problem (C) for an agent with wealth w is

$$\begin{array}{ll} \max_{h,d} & U(h, d, w, \varepsilon, \tau) \\ \text{s.t.} & w + \tau - h + d \geq 0 \\ & \kappa\omega(h, \varepsilon) - d \geq 0 \\ & h \geq 0 \end{array},$$

where $U(h, d, w, \varepsilon, \tau) = u(w+\tau-h+d)+\beta u(\omega(h, \varepsilon)-Rd)$.[10] A straightforward argument shows that U is strictly concave in (h, d) and the constraint set of (C) is compact and convex. Thus, (C) has a unique solution (h^*, d^*). Let $c_1^* = w + \tau - h^* + d^*$ and $c_2^* = \omega(h^*, \varepsilon) - Rd^*$. The necessary and sufficient Kuhn-Tucker conditions for (C) are

$$-u'(c_1^*) + \beta \frac{\partial \omega(h^*, \varepsilon)}{\partial h} u'(c_2^*) + \mu\kappa \frac{\partial \omega(h^*, \varepsilon)}{\partial h} + \lambda = 0, \tag{5}$$

$$u'(c_1^*) - \beta R u'(c_2^*) - \mu = 0, \tag{6}$$

$$\mu[\kappa\omega(h^*, \varepsilon) - d^*] = 0, \tag{7}$$

$$\lambda h^* = 0, \tag{8}$$

where $\mu \geq 0$ and $\lambda \geq 0$ are the multipliers associated with the borrowing constraint and the non-negativity constraint on h, respectively.[11]

It follows from the Kuhn-Tucker conditions to (C) that: (*i*) $\lambda = 0$ when $\varepsilon > 0$; (*ii*) $h^* \leq h^U(\varepsilon)$ for all $\varepsilon \geq 0$, and (*iii*) $\partial\omega(h^*, \varepsilon)/\partial h > R$, and thus $h^* < h^U(\varepsilon)$, when $\varepsilon > 0$ and the credit constraint binds.[12] The intuition for (*iii*) is simple. When the expenditure on human capital policies is positive, it is beneficial to increase the investment in human capital if the marginal return of

[10]Note that (4) implies that $Rd \leq \omega(h, \varepsilon)$, and so consumption in period two is necessarily non-negative.

[11]Since $\lim_{c \downarrow 0} u'(c) = \infty$, the non-negativity constraint on c_1 does not bind at the optimal solution to (C).

[12]It is immediate to see that $h^* = 0$ if $\varepsilon = 0$. When $\varepsilon > 0$, the desired result follows from summing conditions (5) and (6); see the proof of Lemma 3 in Appendix A for a complete argument.

human capital accumulation is greater than the marginal cost of borrowing. So, $\partial\omega(h^*, \varepsilon)/\partial h > R$ when the credit constraint binds and prevents a greater accumulation of human capital.

Now note that if the policy pair is (ε, τ), then an agent with wealth w who invests $h^U(\varepsilon)$ in human capital in the first period can optimally smooth his consumption if, and only if,

$$d^U(w, \varepsilon, \tau) \leq \kappa\omega(h^U(\varepsilon), \varepsilon). \tag{9}$$

So, condition (9) is necessary for the solution to (C) to coincide with its solution in the absence of credit constraints. Lemma 1 below, see Appendix A for a proof, shows that (9) is also sufficient for the solution to (C) to coincide with its solution without credit constraints, and that the credit constraint binds at the solution to (C) when (9) does not hold.

Lemma 1. *The pair* $(h^U(\varepsilon), d^U(w, \varepsilon, \tau))$ *is the solution to* (C) *if, and only if,* $d^U(w, \varepsilon, \tau) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$. *The credit constraint binds at the solution to* (C) *if* $d^U(w, \varepsilon, \tau) > \kappa\omega(h^U(\varepsilon), \varepsilon)$.

Let $V_\kappa(\varepsilon, \tau, w) = U(h^*, d^*, \varepsilon, \tau, w)$ be the lifetime payoff to an agent with wealth w when the policy pair is (ε, τ) and the borrowing limit is κ. Moreover, let $V_\kappa^*(\varepsilon, w) = V_\kappa(\varepsilon, B - \varepsilon, w)$. The function $V_\kappa^*(\varepsilon, w)$ describes the policy preferences of an agent with wealth w when the borrowing limit is κ. A straightforward application of the Theorem of the Maximum shows that $V_\kappa^*(\varepsilon, w)$ is jointly continuous in (ε, w). The next result is an immediate consequence of Lemma 1 and the definition of $V_\kappa^*(\varepsilon, w)$.

Corollary 1. $V_\kappa^*(\varepsilon, w) \leq V^U(G(\varepsilon), w)$ *for all* $\varepsilon \in [0, B]$ *and* $\kappa \in [0, R^{-1})$. *Moreover,* $V_\kappa^*(\varepsilon, w) = V^U(G(\varepsilon), w)$ *if, and only if,* $d^U(w, \varepsilon, B - \varepsilon) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$.

Fix the borrowing limit. By Lemma 1, an agent with wealth w is not credit constrained when the policy pair is (ε, τ) if $d^U(w, \varepsilon, \tau) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$. Moreover, since $d^U(w, \varepsilon, \tau)$ is strictly decreasing in w, if an agent with wealth w is not credit constrained for a given choice of policy pair, then any wealthier agent is also not credit constrained for the same choice of policy pair. The following result is then an immediate consequence of Corollary 1.

Lemma 2. $\varepsilon^* = \varepsilon_{\max}$ *is the only equilibrium if* $d^U(\underline{w}, \varepsilon_{\max}, B - \varepsilon_{\max}) \leq \kappa\omega(h^U(\varepsilon_{\max}), \varepsilon_{\max})$.

In light of Lemma 2, we assume that an agent with wealth $\underline{w}$ is credit constrained when the policy pair is $(\varepsilon_{\max}, B - \varepsilon_{\max})$:

(A4) $d^U(\underline{w}, \varepsilon_{\max}, B - \varepsilon_{\max}) > \kappa\omega(h^U(\varepsilon_{\max}), \varepsilon_{\max})$.

Otherwise, credit constraints do not matter for the choice of government policy. A necessary condition for (A4) is that $h^U(\varepsilon_{\max}) > \underline{w}$. Note that $h^U(\varepsilon_{\max}) > \underline{w}$ is trivially satisfied if $\underline{w}$ is small enough. Also note that (A4) holds when κ is close enough to zero if $h^U(\varepsilon_{\max}) > \underline{w}$.

We also assume that no agent is credit constrained when the government spends its entire budget on transfers, and that the wealthiest agent in society is not credit constrained when the government expenditure on human capital policies is $\varepsilon_{\max}$:

(A5) $d^U(\underline{w}, 0, B) < 0$;

(A6) $d^U(\overline{w}, \varepsilon_{\max}, B - \varepsilon_{\max}) < 0$.

Assumption (A5) holds if $\underline{\omega} \equiv \omega(h, 0)$ is small enough. Assumption (A6) is natural. It follows from (3) and the fact that $\lim_{c\to\infty} u'(c) = 0$ if we take $\overline{w}$ to be large enough. Assumption (A5), which we can dispense with, simplifies the exposition by implying that $\varepsilon = 0$ is never an equilibrium; we prove this last fact in the next subsection.

To finish the analysis of the consumption-saving-investment problem, note that for each policy pair (ε, τ), the Kuhn-Tucker conditions to (C) define the optimal investment in human capital implicitly as a function of an agent's wealth and the borrowing limit, that is, $h^* = h^*(w, \kappa)$. Since $\omega(h, 0)$ is constant in h, it is easy to see that $h^* \equiv 0$ when $\varepsilon = 0$. The next result we establish describes the effect of changes in w and κ on h^* when $\varepsilon > 0$; see Appendix A for a proof.

Lemma 3. *Suppose that $\varepsilon > 0$. Then: (i) $h^*(w, \kappa)$ is nondecreasing in w and strictly increasing in w as long as the borrowing constraint binds; and (ii) $h^*(w, \kappa)$ is nondecreasing in κ and strictly increasing in κ as long as the borrowing constraint binds.*

Lemma 3 is important for our median voter theorem and comparative statics results. The intuition for Lemma 3 is as follows. When the credit constraint does not bind, the optimal investment in human capital only depends on ε. Since the marginal return of human capital accumulation is greater than the marginal cost of borrowing when the credit constraint binds, an increase in the borrowing limit allows for a greater investment in human capital. Likewise, when the credit constraint binds, an increase in wealth reduces the need to borrow in the first period, which also allows for a greater investment in human capital.

Median Voter Theorem

We now establish that the median voter theorem holds in our setting. First, we show in Lemma 9 in Appendix A that $\varepsilon = 0$ is not an equilibrium regardless of the borrowing limit. Intuitively, (A5) implies that for all $\kappa \in [0, R^{-1})$, the credit constraint does not bind for the agents when ε is small enough. Hence, for ε in a neighborhood of zero, policy preferences are as when credit markets are perfect, in which case all agents prefer positive spending on human capital policies.

Now, for each $\varepsilon > 0$, $\tau \geq 0$, and $\kappa \in [0, R^{-1})$, let

$$\sigma_\kappa(\varepsilon, \tau, w) = \frac{\partial V_\kappa(\varepsilon, \tau, w)/\partial \varepsilon}{\partial V_\kappa(\varepsilon, \tau, w)/\partial \tau}$$

be the marginal rate of substitution between ε and τ as a function of the wealth w when the borrowing limit is κ.[13] Moreover, let $\mathcal{L}(h, d, \varepsilon, \tau, w) = U(h, d, \varepsilon, \tau, w) + \mu[\kappa\omega(h, \varepsilon) - d] + \lambda h$. Given that the solution to (C) is unique, Corollary 5 in Milgrom and Segal (2002) implies that

$$\frac{\partial V_\kappa(\varepsilon, \tau, w)}{\partial \varepsilon} = \frac{\partial \mathcal{L}(h^*, d^*, \varepsilon, \tau, w)}{\partial \varepsilon} = \beta \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon} u'(c_2^*) + \mu\kappa \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon}$$

for all $\varepsilon > 0$, and that

$$\frac{\partial V_\kappa(\varepsilon, \tau, w)}{\partial \tau} = \frac{\partial \mathcal{L}(h^*, d^*, \varepsilon, \tau, w)}{\partial \tau} = u'(c_1^*)$$

for all $\tau \geq 0$. Hence, by (5),

$$\sigma_\kappa(\varepsilon, \tau, w) = \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon} \frac{\beta u'(c_2^*) + \mu\kappa}{u'(c_1^*)} = \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon} \left(\frac{\partial \omega(h^*, \varepsilon)}{\partial h} \right)^{-1}.$$

Since $\partial\omega(h, \varepsilon)/\partial\varepsilon$ is strictly increasing in h by the complementarity assumption (A1) and $\partial\omega(h, \varepsilon)/\partial h$ is strictly decreasing in h, $\sigma_\kappa(\varepsilon, \tau, w)$ is strictly increasing in h^*. Lemma 4 below is then an immediate consequence of Lemma 3.

Lemma 4. *Fix $\varepsilon > 0$ and $\tau \geq 0$. Then: (i) $\sigma_\kappa(\varepsilon, \tau, w)$ is nondecreasing in w and strictly increasing in w as long as the borrowing constraint binds; and (ii) $\sigma_\kappa(\varepsilon, \tau, w)$ is nondecreasing in κ and strictly increasing in κ as long as the borrowing constraint binds.*

[13] Since $\underline{w} > 0$, the problem (C) is well-defined for τ in a neighborhood of zero.

Lemma 4, together with Theorem 3 in Milgrom and Shannon (1994), implies that for each $\kappa \in [0, R^{-1})$, the indirect utility function $V^*_\kappa(\varepsilon, w)$ satisfies the single-crossing property in (ε, w) for all $\varepsilon \in [0, B]$ and $w \in [\underline{w}, \overline{w}]$.[14] Let $\mathcal{E}_\kappa(w) = \text{argmax}_{\varepsilon \in [0,B]} V^*_\kappa(\varepsilon, w)$ and w_{med} be the median wealth. Since $V^*_\kappa(\varepsilon, w)$ is jointly continuous in ε and w, the set $\mathcal{E}_\kappa(w)$ is non-empty for all $w \in [\underline{w}, \overline{w}]$ regardless of κ. We can now adapt the arguments in Gans and Smart (1996) to show that the policies chosen by the government are the policies most preferred by the agents with median wealth. The details are in Appendix A.

Proposition 2. *For all $\kappa \in [0, R^{-1})$, the equilibrium set is $\mathcal{E}_\kappa(w_{\text{med}})$.*

Comparative Statics

We now use Proposition 2 to study how changes in the median wealth and the borrowing limit affect the equilibrium set. We start with some auxiliary results. Let $\eta_\kappa(\varepsilon, w) = \sigma_\kappa(\varepsilon, B - \varepsilon, w)$. First note that since $\sigma_\kappa(\varepsilon, \tau, w)$ is strictly increasing in h^* and $h^* \leq h^U(\varepsilon)$, we have that

$$\eta_\kappa(\varepsilon, w) \leq \frac{\partial \omega(h^U(\varepsilon), \varepsilon)}{\partial \varepsilon} \left(\frac{\partial \omega(h^U(\varepsilon), \varepsilon)}{\partial h} \right)^{-1} = G'(\varepsilon) + 1 \tag{10}$$

for all $\varepsilon \in [0, B]$ and $\kappa \in [0, R^{-1})$; the equality in (10) follows from (2) and the definition of $G(\varepsilon)$. Hence, $\eta_\kappa(\varepsilon, w) < 1$ for all $\varepsilon > \varepsilon_{\max}$. Given that

$$\frac{\partial V^*_\kappa(\varepsilon, w)}{\partial \varepsilon} = \frac{\partial V_\kappa(\varepsilon, B - \varepsilon, w)}{\partial \varepsilon} - \frac{\partial V_\kappa(\varepsilon, B - \varepsilon, w)}{\partial \tau} = u'(c_1^*)[\eta_\kappa(\varepsilon, w) - 1] \tag{11}$$

for all $\varepsilon > 0$, a policy pair $(\varepsilon, B - \varepsilon)$ with $\varepsilon > \varepsilon_{\max}$ is suboptimal for all agents no matter their wealth and the borrowing limit. Hence, any equilibrium is bounded above by $\varepsilon_{\max}$.

Lemma 5. *All equilibria are bounded above by $\varepsilon_{\max}$.*

The fact that $\eta_\kappa(\varepsilon, w) < 1$ for all $\varepsilon > \varepsilon_{\max}$ suggests that $\eta_\kappa(\varepsilon_{\max}, w)$ is bounded above by one; we show that this is the case in Lemma 10 in Appendix A. Now observe that if the borrowing limit is κ, then (11) implies that $\varepsilon_{\max}$ is not an equilibrium if $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$. It turns out that $\varepsilon_{\max}$ is not an equilibrium only if $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$; see Appendix A for a proof.

[14] We can apply Theorem 3 in Milgrom and Shannon (1994) since $\partial V_\kappa(\varepsilon, \tau, w)/\partial \varepsilon > 0$ and $\partial V_\kappa(\varepsilon, \tau, w)/\partial \tau > 0$ for all $\varepsilon > 0$ and $\tau \geq 0$, so that if $(\varepsilon', \tau') \neq (0, \tau)$ are two policy pairs in the same indifference curve, then $\varepsilon' > 0$.

Lemma 6. $\varepsilon_{\max}$ *is an equilibrium if, and only if,* $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) = 1$.

Assumption (A4) and Lemma 1 imply that the credit constraint binds for an agent with wealth $\underline{w}$ when the policy pair is $(\varepsilon_{\max}, B - \varepsilon_{\max})$. Given that $h^* < h^U(\varepsilon)$, and thus $\eta_\kappa(\varepsilon, w) < G'(\varepsilon) + 1$, when the credit constraint binds, we then have that $\eta_\kappa(\varepsilon_{\max}, \underline{w}) < 1$. Hence, $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$ if w_{med} is close enough to $\underline{w}$. The last auxiliary result we derive states that a necessary condition for $\varepsilon < \varepsilon_{\max}$ to maximize $V_\kappa^*(\varepsilon, w)$ is that the credit constraint binds for an agent with wealth w when the policy pair is $(\varepsilon, B - \varepsilon)$; see Appendix A for a proof.

Lemma 7. $\varepsilon < \varepsilon_{\max}$ *is an element of* $\mathcal{E}_\kappa(w)$ *only if* $d^U(w, \varepsilon, B - \varepsilon) > \kappa\omega(h^U(\varepsilon), \varepsilon)$.

The intuition for Lemma 7 is as follows. If the credit constraint does not bind for an agent with wealth w when $\varepsilon < \varepsilon_{\max}$, then a marginal increase in ε is beneficial for the agent. Indeed, since he is not credit constrained, the agent can enjoy the greater return from the accumulation of human capital and still optimally smooth his consumption, so that he is not hurt by the reduction of transfers in period one. We can now establish our comparative statics results.

Proposition 3. *Fix the borrowing limit. An increase in* w_{med} *never leads to a smaller equilibrium expenditure on human capital policies. Moreover, an increase in* w_{med} *leads to a higher equilibrium expenditure on human capital policies if, and only if,* $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$.

The proof of Proposition 3 is in Appendix A. The first part of Proposition 3 follows from a monotone comparative statics argument. The intuition for the second part is as follows. Note that if $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$, then $\varepsilon < \varepsilon_{\max}$ for all $\varepsilon \in \mathcal{E}_\kappa(w_{\text{med}})$. Hence, the credit constraint binds for the median voter when $\varepsilon \in \mathcal{E}_\kappa(w_{\text{med}})$. In this case, an increase in w_{med} allows the median voter to better smooth his consumption, which increases his gain from accumulating human capital, and thus his benefit from expenditures on human capital policies.

Given that a higher borrowing limit allows better consumption smoothing, the reasoning in the previous paragraph suggests that relaxing credit constraints should lead to higher public spending on human capital policies. Our next result confirms this intuition; see Appendix A for a proof.

Proposition 4. *Fix the median wealth. An increase in* κ *never leads to a decrease in the equilibrium expenditure on human capital policies. Moreover, an increase in* κ *leads to a higher equilibrium expenditure on human capital policies if, and only if,* $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$.

To finish, observe from (A6) that $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) = 1$ if w_{med} is large enough. So, alleviating credit constraints has no effect on public spending on human capital policies if a country's median income is high enough. On the other hand, $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$ if w_{med} is small enough. Hence, a consequence of Proposition 4 is that alleviating credit constraints should have a positive impact on government spending on human capital policies only if a country's median income is low enough. More generally, by continuity, the impact of a reduction in credit market frictions on government spending on human capital policies should be stronger in societies with a sufficiently low median income than in societies with a sufficiently high median income.

5 Empirical Evidence

In this section, we provide some evidence in support of our results about the impact of credit market frictions on the composition of government expenditures. We first test whether better functioning credit markets are associated with higher public spending on human capital policies. We do so by estimating the following econometric model in order to capture conditional correlations between credit constraints and government spending on human capital policies:

$$I_{it} = \beta_0 + \beta_1 C_{it} + \boldsymbol{\beta} \boldsymbol{X}_{it} + \xi_i + u_{it}, \tag{12}$$

where I_{it} is a measure of country i's government spending on human capital policies at time t, C_{it} is a proxy for country i's credit constraints at time t, and $\boldsymbol{X}_{it}$ is a vector of control variables for country i at time t. The error term is the sum of two components, country i's time invariant unobservable error term ξ_i and country i's time varying idiosyncratic error term u_{it}.

Our data consists of an unbalanced panel of 214 countries between 2004 and 2010, and comes from the World Bank's database. We consider three different measures of government spending on human capital policies: (*i*) expenditure per student in public elementary schools (as a percentage of GDP per capita); (*ii*) student-to-teacher ratio in public elementary schools; and (*iii*) per capita public spending on health (in constant 2005 international US Dollars).

Our proxy for credit constraints is an index measuring the strength of legal rights calculated by the World Bank on their "Doing Business" project. It ranges from 0 to 10, with 10 being the highest score, and it measures how good is the protection that collateral and bankruptcy laws give to lenders. This measure suits well with our framework, since we model credit constraints by the fraction $\tilde{\kappa}$ of an agent's income in period two that can be pledged as collateral.

The control variables we use are: (*i*) government revenues and expenses (as a percentage of GDP); (*ii*) the Polity index, a commonly used measure of political institutions (it ranges from -10 to 10); (*iii*) gross and net enrollment ratios for primary schools; (*iv*) the proportion of the population aged 14 years or less; (*v*) the enrollment in private primary schools as a fraction of total school enrollments; (*vi*) per capita private health expenditures (in constant 2005 international US dollars); and (*vii*) the proportion of the population aged 64 years or more.

Since our model implies that median wealth affects preferences for public spending on human capital policies, we should also include country median income as a control variable. One could proxy a country's median income by using World Bank data to compute the average per capita income of the third quintile of the country's income distribution. Using this data significantly reduces our sample size, though. So, instead, we use GDP per capita (measured in constant 2005 international US dollars) as a proxy for country median income.[15] Given that our analysis is based on the median voter theorem, we restrict our sample to countries with a Polity index of 6 or more, as only such countries are considered democratic countries.

Tables 1 to 3 report our estimations. The regressions in Table 1 show a positive and statistically significant correlation between the index of legal rights and the expenditure per student in public elementary schools. The regressions in Table 2 show a negative and statistically significant correlation between the index of legal rights and class size. Finally, the regressions in Table 3 show that the index of legal rights is positively correlated with the dependent variable and the coefficient is statistically significant.

[Insert Tables 1 to 3 around here]

[15]There is a high correlation (about 0.92) between GDP per capita and the average per capita income of the third quintile of the income distribution for the countries for which the data on income distribution is available.

It is possible that credit constraints also affect public spending on human capital policies by affecting preferences for government size. Given that we control for government size (government revenues and expenses) in our regressions, the fact that we find that the coefficient β_1 in (12) is statistically significant and different from zero in the third regression of Tables 1 to 3 suggests that credit constraints do affect public spending on human capital policies by affecting preferences for the composition of government expenditures. In order to reinforce this conclusion, we also consider the relationship between credit market frictions and military expenditures, which is an example of a government policy that does not affect the returns to human capital accumulation. Table 4 reports that there is no statistically significant correlation between the log of per capita military expenditures (measured in constant 2005 international US dollars) and our measure of credit constraints.[16]

[Insert Table 4 around here]

We also test whether a reduction in credit market frictions is associated with a greater increase in public spending on human capital policies in countries with a low median income than in countries with a high median income. In order to test for this possibility, we estimate the same econometric model as above, but now for two different sub-samples of countries: the countries in the first (lowest) quartile of the GDP per capita distribution and the countries in fourth (highest) quartile of the GDP per capita distribution.

Tables 5 to 7 report our estimations for this second econometric exercise. The first regression in each table reports our results for countries in the first quartile of the GDP per capita distribution, while the second regression in each table reports our results for countries in the fourth quartile of the GDP per capita distribution. For our first measure of public spending on human capital policies, we find a positive and statistically significant correlation between the index of legal rights and the dependent variable only for countries in the first quartile.[17] For our second measure of public spending on human capital policies, we find no statistically significant correlation between the index of legal rights and the dependent variable for countries the first quartile and a positive

[16]We control for GDP per capita, the Polity index, and government size in the regression of Table 4.

[17]The coefficients in the regressions of Table 5 are different at the 10% level (with a p-value of 0.0861).

(instead of negative) and statistically significant correlation between the index of legal rights and the dependent variable for countries the fourth quartile.[18] Finally, for our third measure of public spending on human capital policies, we find a positive and statistically significant correlation between the index of legal rights and the dependent variable for countries in both quartiles. The coefficient in the first regression of Table 7 is higher than the coefficient in the second regression of Table 7, though, suggesting a stronger effect for countries in the first quartile.[19]

[Insert Tables 5 to 7 around here]

Even though weaker, the results in Tables 5 to 7 suggest that the impact of a reduction in credit market frictions on policy preferences is stronger in countries with low median wealth than in countries with high median wealth.

While our empirical analysis does not allow us to claim a causal relationship between credit constraints and government spending on human capital policies, the correlations that we find in the data are robust and lend plausibility to our model.[20] Conversely, as simple as they are, our empirical results interesting and our model provides a natural explanation for them.

6 Conclusion

This paper studies how credit constraints affect preferences for government spending on human capital policies. We show that credit constraints can lead poorer societies to prefer less government spending on human capital policies than richer societies, and that reducing credit market frictions can increase government spending on human capital policies, with this increase greater in poorer societies. We also provide cross-country evidence that better functioning credit markets are indeed associated with higher government spending on human capital policies and that this association is stronger in poorer economies.

[18]The coefficients in the regressions of Table 6 are equal at the 10% level (with a p-value of 0.3658).

[19]The coefficients in the regressions of Table 7 are different at the 10% level (with a p-value of 0.082126).

[20]We are aware that controlling for unobservable fixed effects is probably not enough to identify a casual effect of credit constraints on government spending on human capital policies, as we would have to rely on a very strong identification hypothesis, namely, that there are no time varying unobservable characteristics that are correlated with the independent variable. Also notice that since we are estimating conditional correlations, we are more interested in the sign of the marginal effect than in its magnitude.

An important assumption in our analysis is that the size of the government is taken as given. This allows us to focus on the question of interest, which is how credit market frictions affect the composition of government expenditures by affecting preferences for government spending on human capital policies. An interesting question is whether (and if so, how) credit constraints affect preferences for government size. This is left for future research.

References

[1] Andolfatto, D., and M. Gervais (2008): “Endogenous Debt Constraints in a Life-Cycle Model with an Application to Social Security," *Journal of Economic Dynamics and Control*, 32(12), 3734-3759.

[2] Bearse, P., G. Glomm, and D. M. Patterson (2005): “Endogenous Public Expenditures on Education," *Journal of Public Economic Theory*, 7(4), 561-577.

[3] Behrman, J. R., and B. L. Wolfe (1987): “How Does Mother’s Schooling Affect Family Health, Nutrition, Medical Care Usage, and Household Sanitation?," *Journal of Econometrics*, 36(1-2), 185-204.

[4] Benabou, R. (2002): “Tax and Education Policy in a Heterogeneous-Agent Economy: What levels of Redistribution Maximize Growth and Efficiency?," *Econometrica*, 70(2), 481-517.

[5] Bleakley, H. (2007): “Disease and Development: Evidence from Hookworm Eradication in the American South," *Quarterly Journal of Economics*, 122(1), 73-117.

[6] Bobonis, G. J., E. Miguel, and C. Puri-Sharma: “Anemia and School Participation," *Journal of Human Resources*, 41(4), 692-721.

[7] Bursztyn, L. (2013): “Poverty and the Political Economy of Public Education Spending: Evidence from Brazil," University of California at Los Angeles, mimeo.

[8] Calderón, C., and L. Liu (2003): “The Direction of Causality between Financial Development and Economic Growth," *Journal of Development Economics*, 72(1), 321-334.

[9] Chatterjee, S., D. Corbae, M. Nakajima, and J.-V. Ríos-Rull (2007): “A Quantitative Theory of Unsecured Consumer Credit with Risk of Default," *Econometrica*, 75(6), 1525-1589.

[10] Christopoulos, D. K., and E. G. Tsionas (2004): “Financial Development and Economic Growth: Evidence from Panel Unit Root and Cointegration Tests," *Journal of Development Economics*, 73(1), 55-74.

[11] Epple, D., and R. E. Romano (1996a): “Public Provision of Private Goods," *Journal of Political Economy*, 104(1), 57-84.

[12] Epple, D., and R. E. Romano (1996b): “Ends Against the Middle: Determining Public Service Provision when there are Private Alternatives," *Journal of Public Economics*, 62(3), 297-325.

[13] Fernandez, R., and R. Rogerson (1995): “On the Political Economy of Education Subsidies," *Review of Economic Studies*, 62(2), 249-262.

[14] Fernandez, R., and R. Rogerson (1996): “Income Distribution, Communities, and the Quality of Public Education," *Quarterly Journal of Economics*, 111(1), 135-164.

[15] Gans, J. S., and M. Smart (1996): “Majority Voting with Single-Crossing Preferences," *Journal of Public Economics*, 59(2), 219-237.

[16] Galor, O., and J. Zeira (1993): “Income Distribution and Macroeconomics," *Review of Economic Studies*, 60(1), 35-52.

[17] Gertler, P., and P. Glewwe (1990): “The Willingness to Pay for Education in Developing Countries: Evidence from Rural Peru," *Journal of Public Economics*, 42(3), 251-275.

[18] Glomm, G., and B. Ravikumar (1992): “Public versus Private Investment in Human Capital: Endogenous Growth and Income Inequality," *Journal of Political Economy*, 100(4), 818-834.

[19] Glomm, G., and B. Ravikumar (1998): “Opting Out of Publicly Provided Services: A Majority Voting Result," *Social Choice and Welfare*, 15(2), 187-199.

[20] Gradstein, M., and M. Kaganovich (2004): “Aging Population and Education Finance," *Journal of Public Economics*, 88(12), 2469-2485.

[21] Jayachandran, S., and A. Lleras-Muney (2009), “Life Expectancy and Human Capital Investments: Evidence from Maternal Mortality Declines," *Quarterly Journal of Economics*, 124(1), 349-397.

[22] Lavy, V. (1996): “School Supply Constraints and Children’s Educational Outcomes in Rural Ghana," *Journal of Development Economics*, 51(2), 291-314.

[23] Lavy, V., J. Strauss, D. Thomas, and P. de Vreyer (1996): “Quality of Health Care, Survival and Health Outcomes in Ghana," *Journal of Health Economics*, 15(3), 333-357.

[24] Lee, L.-f., M. R. Rosenzweig, and M. M. Pitt (1997): “The Effects of Improved Nutrition, Sanitation, and Water Quality on Child Health in High-Mortality Populations," *Journal of Econometrics*, 77(1), 209-235.

[25] Levine, R., N. Loayza, and T. Beck (2000): “Financial Intermediation and Growth: Causality and Causes," *Journal of Monetary Economics* 46(1), 37-77.

[26] Levy, G. (2005): “The Politics of Public Provision of Education," *Quarterly Journal of Economics*, 120(4), 1507-1534.

[27] Livshits, I., J. MacGee, and M. Tertilt (2007): “Consumer Bankrupcy: A Fresh Start," *American Economic Review*, 97(1), 402-418.

[28] Lochner, L., and A. Monge-Naranjo (2011): “The Nature of Credit Constraints and Human Capital," *American Economic Review*, 101(6), 2487-2529.

[29] Lochner, L., and A. Monge-Naranjo (2012): “Credit Constraints in Education," *Annual Review of Economics*, 4, 225-256.

[30] Milgrom, P., and C. Shannon (1994): “Monotone Comparative Statics," *Econometrica*, 62(1), 157-180.

[31] Milgrom, P., and I. Segal (2002): “Envelope Theorems for Arbitrary Choice Sets," *Econometrica*, 70(2), 583-601.

[32] Oster, E., I. Shoulson, and R. Dorsey (2012): “Limited Life Expectancy, Human Capital and Health Investments", unpublished manuscript.

[33] Saint-Paul, G., and T. Verdier (1993): “Education, Democracy and Growth," *Journal of Development Economics*, 42(2), 399-407.

[34] Soares, J. (2003): “Self-Interest and Public Funding of Education," *Journal of Public Economics*, 87(3-4), 703-727.

Appendix A: Omitted Proofs

Lemma 8 and Proof

Lemma 8. *$G(\varepsilon)$ is strictly concave and such that* $\lim_{\varepsilon \downarrow 0} G'(\varepsilon) > 0$.

Proof. We first show that (A2) implies that $G(\varepsilon)$ is strictly concave in ε. Note from (14) that

$$G''(\varepsilon) = \frac{1}{R}\left[\frac{\partial^2 \omega(h^U(\varepsilon), \varepsilon)}{\partial \varepsilon^2} + \frac{\partial^2 \omega(h^U(\varepsilon), \varepsilon)}{\partial h \partial \varepsilon}\frac{\partial h^U(\varepsilon)}{\partial \varepsilon}\right].$$

Moreover, applying the Implicit Function Theorem to (2), we have that

$$\frac{\partial^2 \omega(h^U(\varepsilon), \varepsilon)}{\partial h^2}\frac{\partial h^U(\varepsilon)}{\partial \varepsilon} + \frac{\partial^2 \omega(h^U(\varepsilon), \varepsilon)}{\partial h \partial \varepsilon} = 0. \tag{13}$$

Thus, (A2) and (13) imply that $G''(\varepsilon) < 0$ for all $\varepsilon > 0$. Now observe that the first-order condition (2) implies that

$$G'(\varepsilon) = \frac{1}{R}\frac{\partial \omega(h^U(\varepsilon), \varepsilon)}{\partial \varepsilon} - 1. \tag{14}$$

for all $\varepsilon > 0$. Since $\lim_{\varepsilon \to 0} \partial \omega(\varepsilon, \varepsilon)/\partial h > R$ by (A2), condition (2) also implies that $h^U(\varepsilon) > \varepsilon$ for $\varepsilon \approx 0$. Hence, (A1) implies that

$$G'(\varepsilon) > \frac{1}{R}\frac{\partial \omega(\varepsilon, \varepsilon)}{\partial \varepsilon} - 1$$

for $\varepsilon \approx 0$, from which it follows that $\lim_{\varepsilon \downarrow 0} G'(\varepsilon) > 0$. □

Proof of Lemma 1

Consider first the case in which $\varepsilon > 0$. It is immediate to see that if $d^U(w, \varepsilon, \tau) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$, then the first-order condition (2) implies that the pair $(h^U(\varepsilon), d^U(w, \varepsilon, \tau))$ satisfies the Kuhn-Tucker conditions (5) to (8) with $\lambda = \mu = 0$. Suppose then that $d^U(w, \varepsilon, \tau) > \kappa\omega(h^U(\varepsilon), \varepsilon)$. Given that $\lambda = 0$, conditions (5) and (6) imply that h^* satisfies the first-order condition (2) if $\mu = 0$, in which case $h^* = h^U(\varepsilon)$. Condition (6), however, implies that $d^* = d^U(w, \varepsilon, \tau)$ if $\mu = 0$ and $h^* = h^U(\varepsilon)$, a contradiction. Thus, $\mu > 0$ at the solution to (C).

Consider now the case in which $\varepsilon = 0$. Since $\partial\omega(h, 0)/\partial h \equiv 0$, it is immediate to see that if $d^U(w, 0, B) \leq \kappa\omega(h^U(0), 0) = \kappa\underline{\omega}$, then $(0, d^U(w, 0, B))$ satisfies (5) to (8) with $\mu = 0$ and $\lambda = u'(w + B + d^U(w, 0, B))$. Suppose then that $d^U(w, 0) > \kappa\underline{\omega}$. If $\mu = 0$, then (5), (6), and (8) imply that $h^* = h^U(0)$ and $d^* = d^U(w, 0, B)$, a contradiction. Thus, $\mu > 0$ when $d^U(w, 0) > \kappa\underline{\omega}$.

Proof of Lemma 3

Let $\varepsilon > 0$. We need some auxiliary results before we can prove (*i*) and (*ii*). First note that h^* is continuous in w and κ by the Theorem of Maximum. Now note that summing (5) and (6), we obtain that

$$\beta\left[\frac{\partial\omega(h^*,\varepsilon)}{\partial h}-R\right]u'(c_2^*)+\mu\left[\kappa\frac{\partial\omega(h^*,\varepsilon)}{\partial h}-1\right]=0.$$

Since $\kappa R < 1$ and $\mu \geq 0$, we then have that $\partial\omega(h^*,\varepsilon)/\partial h \geq R$ (so that $h^* \leq h^U(\varepsilon)$). Moreover, $\partial\omega(h^*,\varepsilon)/\partial h > R$ and $\kappa\partial\omega(h^*,\varepsilon)/\partial h < 1$ when $\mu > 0$.

(*i*) For each $\varepsilon > 0$, $\tau \geq 0$, and $\kappa \in [0, R^{-1})$, let w_b be such that $w_b > \underline{w}$ is the only value of w with $d^U(w,\varepsilon,\tau) = \kappa\omega(h^U(\varepsilon),\varepsilon)$ when $d^U(\overline{w},\varepsilon,\tau) < \kappa\omega(h^U(\varepsilon),\varepsilon)$ and $w_b = \overline{w}$ otherwise. By construction, if the policy pair is (ε,τ) and the borrowing limit is κ, then an agent with wealth w is credit constrained when $w < w_b$ and is not credit constrained when $w > w_b$.

First note that $h^* = h^U(\varepsilon)$ for all $w > w_b$. Now let $w < w_b$. In this case, (5) to (7) imply that

$$\Omega(h^*,w,\kappa,\varepsilon,\tau)=u'(c_1^*)\left[\kappa\frac{\partial\omega(h^*,\varepsilon)}{\partial h}-1\right]+\beta u'(c_2^*)(1-\widetilde{\kappa})\frac{\partial\omega(h^*,\varepsilon)}{\partial h}=0,$$

where $c_1^* = w+\tau-h^*+\kappa\omega(h^*,\varepsilon)$ and $c_2^* = [1-\widetilde{\kappa}]\omega(h^*,\varepsilon)$ given that the credit constraint binds. Moreover, observe that

$$\begin{aligned}\frac{\partial\Omega(h^*,w,\kappa,\varepsilon,\tau)}{\partial h} &= u''(c_1^*)\left[\kappa\frac{\partial\omega(h^*,\varepsilon)}{\partial h}-1\right]^2+\frac{\partial^2\omega(h^*,\varepsilon)}{\partial h^2}[\kappa u'(c_1^*)+\beta(1-\widetilde{\kappa})u'(c_2^*)]\\ &\quad +\beta u''(c_2^*)\left[(1-\widetilde{\kappa})\frac{\partial\omega(h^*,\varepsilon)}{\partial h}\right]^2<0\end{aligned}$$

and, since $\kappa\partial\omega(h^*,\varepsilon)/\partial h < 1$, that

$$\frac{\partial\Omega(h^*,w,\kappa,\varepsilon,\tau)}{\partial w}=u''(c_1^*)\left[\kappa\frac{\partial\omega(h^*,\varepsilon)}{\partial h}-1\right]>0.$$

Hence, $\partial h^*/\partial w > 0$ by the Implicit Function Theorem. The desired result follows from the fact that h^* is continuous in w.

(*ii*) For each $\varepsilon > 0$, $\tau \geq 0$, and $w \in [\underline{w}, \overline{w}]$, let κ_b be such that κ_b is the only value of κ with $d^U(w,\varepsilon,\tau) = \kappa\omega(h^U(\varepsilon),\varepsilon)$ when $d^U(w,\varepsilon,\tau) > 0$ and $\kappa_b = 0$ otherwise. By construction, when the policy pair is (ε,τ), an agent with wealth w is credit constrained if, and only if, $\kappa < \kappa_b$.

First note that $h^* = h^U(\varepsilon)$ for all $\kappa > \kappa_b$. Suppose then that $\kappa < \kappa_b$. Since $\kappa \partial\omega(h^*, \varepsilon)/\partial h < 1$ and $u'(c_1) - \beta R u'(c_2^*) > 0$ by (6),

$$\begin{aligned}\frac{\partial \Omega(h^*, w, \kappa, \varepsilon, \tau)}{\partial \kappa} &= u''(c_1^*)\omega(h^*, \varepsilon)\left[\kappa \frac{\partial \omega(h^*, \varepsilon)}{\partial h} - 1\right] + u'(c_1^*)\frac{\partial \omega(h^*, \varepsilon)}{\partial h} \\ &\quad -\beta R u''(c_2^*)(1-\widetilde{\kappa})\omega(h^*, \varepsilon)\frac{\partial \omega(h^*, \varepsilon)}{\partial h} - \beta R u'(c_2^*)\frac{\partial \omega(h^*, \varepsilon)}{\partial h} > 0.\end{aligned}$$

Hence, $\partial h^*/\partial \kappa > 0$ by the Implicit Function Theorem. The desired result follows from the continuity of h^* in κ.

Lemma 9 and Proof

Lemma 9. $\varepsilon = 0$ *is never an equilibrium.*

Proof. Let $\underline{\varepsilon} \in (0, B)$ be such that $d^U(\underline{w}, \underline{\varepsilon}, B - \underline{\varepsilon}) = 0$; note that $\underline{\varepsilon}$ does not depend on κ. By definition, $d^U(w, \varepsilon, B - \varepsilon) \leq 0$ for all $w \in [\underline{w}, \overline{w}]$ and $\varepsilon \in [0, \underline{\varepsilon}]$, and so $V_\kappa^*(\varepsilon, w) = V^U(G(\varepsilon), w)$ for all $w \in [\underline{w}, \overline{w}]$ and $\varepsilon \in [0, \underline{\varepsilon}]$ by Corollary 1. The desired result follows from the fact that $V^U(G(\varepsilon), w) > V^U(G(0), w)$ for all $w \in [\underline{w}, \overline{w}]$ if ε is close enough to zero. □

Proof of Proposition 2

Fix κ and let $\varepsilon_1, \varepsilon_2 \in (0, B]$. Since $V_\kappa^*(\varepsilon, w)$ satisfies the single-crossing property in (ε, w) for all $\varepsilon \in [0, B]$ and $w \in [\underline{w}, \overline{w}]$, it follows that: (*i*) if $\varepsilon_1 > \varepsilon_2$, then $V_\kappa^*(\varepsilon_1, w_{\text{med}}) \geq V_\kappa^*(\varepsilon_2, w_{\text{med}})$ implies that $V_\kappa^*(\varepsilon_1, w) \geq V_\kappa^*(\varepsilon_2, w)$ for all $w > w_{\text{med}}$; and (*ii*) if $\varepsilon_2 > \varepsilon_1$, then $V_\kappa^*(\varepsilon_1, w_{\text{med}}) \geq V_\kappa^*(\varepsilon_2, w_{\text{med}})$ implies that $V_\kappa^*(\varepsilon_1, w) \geq V_\kappa^*(\varepsilon_2, w)$ for all $w < w_{\text{med}}$. Hence, any element of $\mathcal{E}_\kappa(w_{\text{med}})$ is an equilibrium.

We now claim that if $\varepsilon \notin \mathcal{E}_\kappa(w_{\text{med}})$, then a majority of agents prefers any $\varepsilon^m \in \mathcal{E}_\kappa(w_{\text{med}})$ to ε, so that $\varepsilon \notin \mathcal{M}$. Suppose first that $\varepsilon > \varepsilon^m \in \mathcal{E}_\kappa(w_{\text{med}})$. Since $V_\kappa^*(\varepsilon^m, w_{\text{med}}) > V_\kappa^*(\varepsilon, w_{\text{med}})$ implies that $V^*(\varepsilon^m, w) > V^*(\varepsilon, w)$ for all $w \leq w_{\text{med}}$, the continuity of $V_\kappa^*(\varepsilon, w)$ in w implies that a majority of agents prefers ε^m to ε. Suppose now that $\varepsilon < \varepsilon^m$. Since $V_\kappa^*(\varepsilon^m, w_{\text{med}}) > V_\kappa^*(\varepsilon, w_{\text{med}})$ implies that $V_\kappa^*(\varepsilon^m, w) > V_\kappa^*(\varepsilon, w)$ for all $w \geq w_{\text{med}}$, the continuity of $V_\kappa^*(\varepsilon, w)$ in w implies that once again a majority of agents prefers ε^m to ε. This completes the proof.

Lemma 10 and Proof

Lemma 10. $\eta_\kappa(\varepsilon_{\max}, w) \leq 1$ *for all* $w \in [\underline{w}, \overline{w}]$ *and* $\kappa \in [0, R^{-1})$.

Proof. Suppose, by contradiction, that $\eta_\kappa(\varepsilon_{\max}, w) > 1$ for some $w \in [\underline{w}, \overline{w}]$, in which case $\eta_\kappa(\varepsilon_{\max}, \overline{w}) > 1$ by Lemma 4. Now note that (A6) implies that the credit constraint does not bind for the wealthiest agent in society when $(\varepsilon, \tau) = (\varepsilon_{\max}, B - \varepsilon_{\max})$, so that $V^*_\kappa(\varepsilon_{\max}, \overline{w}) = V^U(G(\varepsilon_{\max}), \overline{w})$. Hence, (11) implies that $\varepsilon_{\max}$ does not maximize $V^U(G(\varepsilon), w)$. This, however, implies that $\varepsilon_{\max}$ does not maximize $G(\varepsilon)$, a contradiction. □

Proof of Lemma 6

We are done if we show that $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) = 1$ implies that $\varepsilon_{\max}$ is the only equilibrium. Let κ be the borrowing limit. First note that if $h^* < h^U(\varepsilon_{\max})$, then (10) implies that $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$. Hence, $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) = 1$ implies that $h^* = h^U(\varepsilon_{\max})$. Now note that if $h^* = h^U(\varepsilon_{\max})$, then summing (5) and (6) we obtain that $\mu(\kappa R - 1) = 0$, so that $\mu = 0$ (for $\kappa R < 1$). It then follows from (6) that $d^* = d^U(w_{\text{med}}, \varepsilon_{\max}, B - \varepsilon_{\max})$, and so $V^*_\kappa(\varepsilon_{\max}, w_{\text{med}}) = V^U(G(\varepsilon_{\max}), w_{\text{med}})$. Thus, $\mathcal{E}_\kappa(w_{\text{med}}) = \{\varepsilon_{\max}\}$, which implies the desired result.

Proof of Lemma 7

Let $\varepsilon < \varepsilon_{\max}$. If $d^U(w, \varepsilon, B - \varepsilon) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$, then Lemma 1 implies that

$$\begin{aligned}\frac{\partial V^*_\kappa(\varepsilon, w)}{\partial \varepsilon} &= \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon} u'(c^*_2) - u'(c^*_1) \\ &= u'(c^*_1)\left[\frac{1}{R}\frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon} - 1\right] = u'(c^*_1)G'(\varepsilon),\end{aligned}$$

where the second equality follows from (6) and the last equality follows from (14). Given that $G'(\varepsilon) > 0$ for all $\varepsilon \in [0, \varepsilon_{\max})$, we then have that ε does not maximize $V^*_\kappa(\varepsilon, w)$.

Proof of Proposition 3

Let $\leq_s$ be the order on the subsets of $\mathbb{R}$ such that $S_1 \leq_s S_2$ if $s_1 \leq s_2$ for all $s_1 \in S_1$ and $s_2 \in S_2$. We want to show that: (*i*) $\mathcal{E}_\kappa(w') \leq_s \mathcal{E}_\kappa(w'')$ for all $w' < w''$ in $[\underline{w}, \overline{w}]$ and $\kappa \in [0, R^{-1})$; and (*ii*)

$\mathcal{E}_\kappa(w_{\text{med}}) <_s \mathcal{E}_\kappa(w)$ for all $w > w_{\text{med}}$ in $[\underline{w}, \overline{w}]$ and $\kappa \in [0, \kappa^*]$ if $\eta_{\kappa^*}(\varepsilon_{\max}, w_{\text{med}}) < 1$ for some $\kappa^* \in (0, R^{-1})$.

(*i*) Fix $\kappa \in [0, R^{-1})$ and let $w', w'' \in [\underline{w}, \overline{w}]$ be such that $w' < w''$. We claim that $\mathcal{E}_\kappa(w') \leq_s \mathcal{E}_\kappa(w'')$. The desired result follows from Lemma 5 if $\mathcal{E}_\kappa(w'') = \{\varepsilon_{\max}\}$. Suppose then that there is $\varepsilon'' \in \mathcal{E}_\kappa(w'')$ with $\varepsilon'' < \varepsilon_{\max}$. Note that $d^U(w, \varepsilon'', B - \varepsilon'') > \kappa\omega(h^U(\varepsilon''), \varepsilon'')$ for all $w \leq w''$ by Lemma 7. We claim that $d^U(w, \varepsilon, B - \varepsilon) > \kappa\omega(h^U(\varepsilon), \varepsilon)$ for all $\varepsilon \in (\varepsilon'', \varepsilon^*_{\max}]$ and $w \leq w''$. Suppose not, that is, there is $\varepsilon \in (\varepsilon'', \varepsilon_{\max}]$ and $w \leq w''$ with $d^U(w, \varepsilon, B - \varepsilon) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$. Then $d^U(w'', \varepsilon, B - \varepsilon) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$, in which case $V^*_\kappa(\varepsilon, w'') = V^U(G(\varepsilon), w'')$. Given that $V^*_\kappa(\varepsilon'', w'') \leq V^U(G(\varepsilon''), w'') < V^U(G(\varepsilon), w'')$, as $G(\varepsilon)$ is strictly increasing in ε when $\varepsilon \in (\varepsilon'', \varepsilon_{\max}]$, we then have that $\varepsilon'' \notin \mathcal{E}_\kappa(w'')$, a contradiction. Hence, by Lemma 4 in the text and Theorem 3 in Milgrom and Shannon (1994), $V^*_\kappa(\varepsilon, w)$ satisfies the strict single-crossing condition in (ε, w) for all $\varepsilon \in (\varepsilon'', \varepsilon_{\max}]$ and $w \leq w''$. Suppose now, by contradiction, that there is $\varepsilon' \in \mathcal{E}_\kappa(w')$ with $\varepsilon' > \varepsilon''$; note that $\varepsilon' \leq \varepsilon_{\max}$. Since $V^*_\kappa(\varepsilon', w') \geq V^*_\kappa(\varepsilon'', w')$, we can then conclude that $V^*_\kappa(\varepsilon', w'') > V^*_\kappa(\varepsilon'', w'')$, a contradiction. Thus, $\varepsilon' \leq \varepsilon''$, which establishes the desired result.

(*ii*) Note from the proof of Lemma 6 that $\mathcal{E}_\kappa(w_{\text{med}}) = \{\varepsilon_{\max}\}$ if $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) = 1$. Suppose then that $\eta_\kappa(\varepsilon_{\max}, w_{\text{med}}) < 1$. By assumption, $\varepsilon_{\max} \notin \mathcal{E}_\kappa(w_{\text{med}})$. Moreover, $0 \notin \mathcal{E}_\kappa(w_{\text{med}})$ by Lemma 9. So, by (11), $\varepsilon \in \mathcal{E}_\kappa(w_{\text{med}})$ only if $\eta_\kappa(\varepsilon, w_{\text{med}}) = 1$. Now note, using (11) again, that

$$\frac{\partial^2 V^*_\kappa(\varepsilon, w_{\text{med}})}{\partial w \partial \varepsilon} = \frac{d[u'(c^*_1)]}{dw}[\eta_\kappa(\varepsilon, w_{\text{med}}) - 1] + u'(c^*_1)\frac{\partial \eta_\kappa(\varepsilon, w_{\text{med}})}{\partial w}$$

for all $\varepsilon > 0$. Hence, if $\varepsilon \in \mathcal{E}_\kappa(w_{\text{med}})$, then Lemmas 4 and 7 imply that

$$\frac{\partial^2 V^*_\kappa(\varepsilon, w_{\text{med}})}{\partial w \partial \varepsilon} = u'(c^*_1)\frac{\partial \eta_\kappa(\varepsilon, w_{\text{med}})}{\partial w} > 0.$$

Thus, there is a neighborhood $\mathcal{N}$ of w_{med} such that if $\varepsilon \in \mathcal{E}_\kappa(w_{\text{med}})$, then

$$\frac{\partial V^*_\kappa(\varepsilon, w_{\text{med}})}{\partial \varepsilon} > 0$$

for all $w \in \mathcal{N} \cap (w_{\text{med}}, \overline{w}]$. Therefore, $\mathcal{E}_\kappa(w) \cap \mathcal{E}_\kappa(w_{\text{med}}) = \emptyset$ for all $w \in \mathcal{N} \cap (w_{\text{med}}, \overline{w}]$. By (*i*), we can then conclude that $\mathcal{E}_\kappa(w) >_s \mathcal{E}(w_{\text{med}})$ if $w > w_{\text{med}}$. The desired result follows from the fact that $\eta_\kappa(\varepsilon, w)$ is nondecreasing in w.

Proof of Proposition 4

Proposition 4 is a consequence of the following two facts: (*i*) $\mathcal{E}_{\kappa'}(w) \leq_s \mathcal{E}_{\kappa''}(w)$ for all $w \in [\underline{w}, \overline{w}]$ and all $\kappa', \kappa'' \in [0, R^{-1})$ such that $\kappa' < \kappa''$; and (*ii*) if $\eta_\kappa(\varepsilon_{\max}, w) < 1$ for some $\kappa \in [0, R^{-1})$, then $\mathcal{E}_\kappa(w) <_s \mathcal{E}_{\kappa'}(w)$ for all $\kappa' \in (\kappa, R^{-1})$.

(*i*) Fix $w \in [\underline{w}, \overline{w}]$ and let $\kappa', \kappa'' \in [0, R^{-1})$ be such that $\kappa' < \kappa''$. We claim that $\mathcal{E}_{\kappa'}(w) \leq_s \mathcal{E}_{\kappa''}(w)$. The desired result follows from Lemma 5 if $\mathcal{E}_{\kappa''}(w) = \{\varepsilon_{\max}\}$. Suppose then that there is $\varepsilon'' \in \mathcal{E}_\kappa(w)$ with $\varepsilon'' < \varepsilon_{\max}$. Note that $d^U(w, \varepsilon'', B - \varepsilon'') > \kappa'' \omega(h^U(\varepsilon''), \varepsilon'')$ by Lemma 7. We claim that $d^U(w, \varepsilon, B - \varepsilon) > \kappa \omega(h^U(\varepsilon), \varepsilon)$ for all $\kappa \leq \kappa''$ and $\varepsilon \in (\varepsilon'', \varepsilon_{\max}]$. Recall that $V^*_\kappa(\varepsilon, w)$ satisfies the single-crossing condition in (ε, κ) for all $\varepsilon \in [0, B]$ and $\kappa \in [0, R^{-1})$. Now suppose that $d^U(w, \varepsilon, B - \varepsilon) \leq \kappa \omega(h^U(\varepsilon), \varepsilon)$ for some $\varepsilon \in (\varepsilon'', \varepsilon_{\max}]$ and $\kappa \leq \kappa''$. This implies that $V^*_\kappa(\varepsilon, w) = V^U(G(\varepsilon), w) > V^U(G(\varepsilon''), w) \geq V^*_\kappa(\varepsilon'', w)$, and so $V^*_{\kappa''}(\varepsilon, w) > V_{\kappa''}(\varepsilon'', w)$ by single-crossing, a contradiction. So, once again by Lemma 4 in the text and Theorem 3 in Milgrom and Shannon (1994), $V^*_\kappa(\varepsilon, w)$ satisfies the strict single-crossing condition in (ε, κ) for all $\varepsilon \in (\varepsilon'', \varepsilon_{\max}]$ and $\kappa \in [0, \kappa'']$. The same argument as in the proof of Proposition 3 now shows that if $\varepsilon' \in \mathcal{E}_{\kappa'}(w)$, then $\varepsilon' \leq \varepsilon''$. This completes the proof of (*i*).

(*ii*) Suppose $\eta_\kappa(\varepsilon_{\max}, w) < 1$ for some $\kappa \in [0, R^{-1})$. The same argument as in the proof of (*ii*) of Proposition 3 (just exchange the roles of w and κ) shows that there is a neighborhood $\mathcal{N}$ of κ such that $\mathcal{E}_{\kappa'}(w) \cap \mathcal{E}_\kappa(w) = \emptyset$ for all $\kappa' \in \mathcal{N} \cap (\kappa, R^{-1})$. The desired result is now a consequence of (*i*).

Appendix B: Two-Generation Extension (Not for Publication)

Here, we present a two-generation version of our model and show that all results in the main text remain valid in this version of the model.

Environment

There is a mass one of agents, the first generation, who live for one period and only differ in terms of their income w, which is distributed in the interval $[\underline{w}, \overline{w}]$, with $\underline{w} > 0$. Each first-generation agent has an offspring, who lives for two periods. The utility function over consumption streams of an offspring is $u(c_1) + \beta u(c_2)$, where c_t is the offspring's consumption in his tth period of life and $\beta \in (0,1)$ is a common discount factor. The utility function of a first-generation agent is $u(c_p) + \rho U^s$, where c_p is the agent's consumption, U^s is the lifetime payoff of the agent's offspring, and $\rho \in (0,1]$ is the weight the first-generation agents assign to their offspring's utility. The per-period utility function u has the same properties as in the main text.

The timing of events is the following. The first-generation agents receive a transfer τ from the government, and decide how much to invest in the human capital of their offspring, h, and how much to bequest to their offspring, b. Both the investment in human capital and the bequest are in units of consumption. The offspring then decide how much to borrow or save, d, in their first period of life and supply their labor (inelastically) in their second period of life. The gross interest rate is $R > 1$ and the (labor) income of an offspring is $\omega(h, \varepsilon)$, where h is the offspring's human capital and ε is the government expenditure on human capital policies. The function ω has the same properties as in the main text. Only a fraction $\widetilde{\kappa} \in [0,1)$ of an offspring's income in his second period of life can be collateralized, so that $d \leq \kappa\omega(h,\varepsilon)$, where $\kappa = R^{-1}\widetilde{\kappa}$.

The policy pair (ε, τ) is determined through majority voting by the first-generation agents, and the government's budget constraint is $\varepsilon + \tau = B$, with $B > 0$. An equilibrium is a policy $\varepsilon^* \in [0, B]$ such that the policy pair $(\varepsilon^*, B - \varepsilon^*)$ is preferred to any other policy pair $(\varepsilon, B - \varepsilon)$ by a majority of the first-generation agents.

We place no restrictions on bequests in our analysis. This implies that utility is transferable between a first-generation agent and his offspring. The assumption of transferable utilities simplifies the analysis while keeping credit market imperfections as a key determinant of policy preferences. Indeed, by reducing the ability of offspring to smooth their consumption, credit constraints reduce the benefit the first-generation agents derive from investing in the human capital of their offspring.

Voting Behavior

We start by deriving a result that is useful in our analysis. Fix the policy pair (ε, τ) and consider the problem (P2) of an offspring with human capital h and bequest b. It is easy to show that (P2) has a unique solution $\hat{d} = \hat{d}(h, b)$. Consider now the problem (P1) of a first-generation agent who anticipates that his offspring saves $\hat{d}$. It is easy to show that (P1) has a solution (h^*, b^*). Let then

$U(h,b,d,w,\varepsilon,\tau) = u(w+\tau-h-b)+\rho\left[u(b+d)+\beta u(\omega(h,\varepsilon)-Rd)\right]$ and consider the problem

$$\begin{array}{ll} \max_{h,b,d} & U(h,b,d,w,\varepsilon,\tau) \\ \text{s.t.} & w+\tau-h-b \geq 0 \\ & b+d \geq 0 \\ & \kappa\omega(h,\varepsilon)-d \geq 0 \\ & h \geq 0 \end{array} .$$

By construction, the above problem is the problem (H) of a first-generation agent who controls the behavior of his offspring. A standard argument shows that (H) has a unique solution. We claim that (h^*, b^*, d^*), where $d^* = \hat{d}(h^*, b^*)$, is the solution to (H). Indeed, (h^*, b^*, d^*) is feasible for (H). Moreover, if (h, b, d) is another feasible triple for (H), then

$$\begin{aligned} U(h,b,d,w,\varepsilon,\tau) &\leq u(w+\tau-h-b)+\rho\left[u(b+\hat{d}(h,b))+\beta u(\omega(h,\varepsilon)-R\hat{d}(h,b))\right] \\ &\leq u(w+\tau-h^*-b^*)+\rho\left[u(b^*+d^*)+\beta u(\omega(h^*,\varepsilon)-Rd^*)\right], \end{aligned}$$

which establishes the desired result.

Let $V_\kappa(\varepsilon,\tau,w) = U(h^*, b^*, d^*, \varepsilon, \tau, w)$ be the indirect utility function of (H) and define $V^*_\kappa(\varepsilon, w)$ to be such that $V^*_\kappa(\varepsilon, w) = V_\kappa(\varepsilon, B-\varepsilon, w)$. The result from the previous paragraph shows that if the borrowing limit is κ, then the function $V^*_\kappa(\varepsilon, w)$ describes the policy preferences of first-generation agents as a function of their income. We use this fact in what follows.

Consider first the case in which credit markets are perfect. Let $h^U(\varepsilon)$ be such that $h^U(0) = 0$ and $h^U(\varepsilon)$ is the unique positive solution to $\partial\omega(h,\varepsilon)/\partial h = R$ when $\varepsilon > 0$. It is easy to see that $h^U(\varepsilon)$ is the optimal investment by a first-generation agent in the human capital of his offspring when the government expenditure on human capital policies is ε. The same argument as in the main text shows that $V^*_\kappa(\varepsilon, w) = V^U(G(\varepsilon), w)$, where

$$V^U(G,w) = \max\left\{u(c_p)+\rho\left[u(c_1)+\beta u(c_2)\right] | c_p, c_1, c_2 \geq 0 \text{ and } c_p + c_1 + c_2/R = w + G\right\}$$

and $G(\varepsilon)$ is the same function as in the main text. Hence, when credit markets are perfect, the policy preferences of first-generation agents are independent of their income and the unique equilibrium is $\varepsilon^* = \varepsilon_{\max}$, the unique maximizer of $G(\varepsilon)$.

Suppose now that credit markets are not perfect, and let $c_p^* = w + \tau - h^* - b^*$, $c_1^* = b^* + d^*$, and $c_2^* = \omega(h^*, \varepsilon) - Rd^*$. The necessary and sufficient Kuhn-Tucker conditions for (H) are

$$
\begin{aligned}
&- u'(c_p^*) + \rho\beta \frac{\partial \omega(h^*, \varepsilon)}{\partial h} u'(c_2^*) + \mu\kappa \frac{\partial \omega(h^*, \varepsilon)}{\partial h} + \lambda = 0, \\
&- u'(c_p^*) + \rho u'(c_1^*) = 0, \\
&\rho u'(c_1^*) - \rho\beta R u'(c_2^*) - \mu = 0, \\
&\mu[\kappa\omega(h^*, \varepsilon) - d^*] = 0, \\
&\lambda h^* = 0,
\end{aligned}
$$

where $\mu \geq 0$ and $\lambda \geq 0$. It is easy to see that $\lambda = 0$ when $\varepsilon > 0$, that $h^* \leq h^U(\varepsilon)$ for all $\varepsilon \geq 0$, and that if $\varepsilon > 0$, then $h^* < h^U(\varepsilon)$ when the credit constraint binds.

Let $d^U(b, \varepsilon)$ be the only value of d such that

$$u'(b + d) = \beta R u'(\omega(h^U(\varepsilon), \varepsilon) - Rd).$$

By construction, if the government spending on human capital policies is ε, then $d^U(b, \varepsilon)$ is the amount an offspring with bequest b and human capital $h^U(\varepsilon)$ needs to borrow (or save) in his first period of life to optimally smooth his consumption. Notice that $d^U(b, \varepsilon)$ is strictly decreasing in b and strictly increasing in ε. Now let $b^U(w, \varepsilon, \tau)$ be the only value of b such that

$$u'(w + \tau - h^U(\varepsilon) - b) = \rho u'(b + h^U(\varepsilon)).$$

By construction, if a first-generation agent invests $h^U(\varepsilon)$ in the human capital of his offspring, then $b^U(w, \varepsilon, \tau)$ is how much the first-generation agent should bequest to his offspring. It is easy to see that $b^U(w, \varepsilon, \tau)$ is strictly increasing in w and τ and strictly decreasing in ε. Moreover let $d^U(w, \varepsilon, \tau) = d^U(b^U(w, \varepsilon, \tau), \varepsilon)$; note the abuse of notation. By construction, $d^U(w, \varepsilon, \tau)$ is strictly decreasing in w and τ and strictly increasing in ε.

The same argument as in the main text now shows that $V_\kappa^*(\varepsilon, w) \leq V^U(G(\varepsilon), w)$ regardless of ε and κ, that $V_\kappa^*(\varepsilon, w) = V^U(G(\varepsilon), w)$ if, and only if, $d^U(w, B - \varepsilon, \varepsilon) \leq \kappa\omega(h^U(\varepsilon), \varepsilon)$, and that the credit constraint binds for a first-generation agent if $d^U(w, \varepsilon, \tau) > \kappa\omega(h^U(\varepsilon), \varepsilon)$. We then assume that $d^U(\underline{w}, \varepsilon_{\max}, B - \varepsilon_{\max}) > \kappa\omega(h^U(\varepsilon_{\max}), \varepsilon_{\max})$, otherwise $\varepsilon^* = \varepsilon_{\max}$ is again the only equilibrium. We also assume (as before) that $d^U(\underline{w}, 0, B) < 0$ and that $d^U(\overline{w}, \varepsilon_{\max}, B - \varepsilon_{\max}) < 0$.

For each policy pair (ε, τ), the Kuhn-Tucker conditions to (H) define h^* implicity as a function of w and κ. An argument similar to the proof of Lemma 3 shows that if $\varepsilon > 0$, then: (*i*) $h^*(w, \kappa)$ is nondecreasing in w and strictly increasing in w as long as the borrowing constraint binds; and (*ii*) $h^*(w, \kappa)$ is nondecreasing in κ and strictly increasing in κ as long as the borrowing constraint binds. Now observe that since the solution to (H) is unique, we can apply Corollary 5 in Milgrom and Segal (2002) to show that

$$\frac{\partial V_\kappa(\varepsilon, \tau, w)}{\partial \varepsilon} = \rho\beta \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon} u'(c_2^*) + \mu\kappa \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon}$$

for all $\varepsilon > 0$, and that

$$\frac{\partial V_\kappa(\varepsilon, \tau, w)}{\partial \tau} = u'(c_p^*) = \rho u'(c_1^*)$$

for all $\tau \geq 0$. Hence,

$$\sigma_\kappa(\varepsilon, \tau, w) = \frac{\partial V_\kappa(\varepsilon, \tau, w)/\partial \varepsilon}{\partial V_\kappa(\varepsilon, \tau, w)/\partial \tau} = \frac{\partial \omega(h^*, \varepsilon)}{\partial \varepsilon} \left(\frac{\partial \omega(h^*, \varepsilon)}{\partial h} \right)^{-1}$$

and

$$\frac{\partial V_\kappa^*(\varepsilon, w)}{\partial \varepsilon} = \rho u'(c_1^*)[\sigma_\kappa(\varepsilon, B - \varepsilon, w) - 1].$$

In particular, the properties of h^* imply that: (*i*) $\sigma_\kappa(\varepsilon, \tau, w)$ is nondecreasing in w and strictly increasing in w as long as the borrowing constraint binds; and (*ii*) $\sigma_\kappa(\varepsilon, \tau, w)$ is nondecreasing in κ and strictly increasing in κ as long as the borrowing constraint binds.

Given that $\sigma_\kappa(\varepsilon, \tau, w)$ and $V_\kappa^*(\varepsilon, w)$ have the same properties as before, we then have that the equilibrium consists of the policies most preferred by the first-generation agent with median income and that the comparative statics results of Propositions 3 and 4 hold.

Tables

Table 1: Legal Rights and Human Capital Policies

	Expenditure per Student, Public Primary Schools		
Strength of Legal Rights	0.55144***	0.35958*	0.39762**
	(0.008)	(0.086)	(0.036)
GDP per Capita		0.00062***	0.00053**
		(0.007)	(0.029)
Polity Score		-0.20124	-0.09844
		(0.401)	(0.803)
Government Revenues		-0.37183***	-0.38318***
		(0.000)	(0.000)
Government Expenses		0.42720***	0.43848***
		(0.000)	(0.000)
Gross Enrollment Ratio, Primary Schools			-0.20148*
			(0.073)
Net Enrollment Ratio, Primary Schools			0.07659
			(0.649)
Population 0 to 14 Years Old			-0.31448
			(0.480)
Enrollment in Private Primary Schools			-0.20815*
			(0.063)
Constant	15.36358***	5.13599	29.24158*
	(0.000)	(0.379)	(0.073)
Number of Observations	209	209	209
Number of Groups			56
Observations per Group:			
Min.			1
Avg.			3.7
Max.			7
F	7.45649	8.83604	6.61427

p-values in Parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 2: Legal Rights and Human Capital Policies

	Log of Student-to-Teacher Ratio, Public Primary Schools		
Strength of Legal Rights	-0.02260***	-0.01562***	-0.00744*
	(0.000)	(0.002)	(0.063)
GDP per Capita		-0.00002**	-0.00001
		(0.012)	(0.220)
Polity Score		-0.04646*	-0.02063
		(0.082)	(0.213)
Government Revenues		0.00362	0.00243
		(0.117)	(0.113)
Government Expenses		-0.00694***	-0.00499***
		(0.000)	(0.000)
Gross Enrollment Ratio, Primary Schools			-0.00272
			(0.228)
Net Enrollment Ratio, Primary Schools			0.00506
			(0.125)
Population 0 to 14 Years Old			0.05140***
			(0.000)
Enrollment in Private Primary Schools			-0.00134
			(0.688)
Constant	3.09292***	3.89685***	1.98219***
	(0.000)	(0.000)	(0.000)
Number of Observations	273	273	273
Number of Groups			59
Observations per Group:			
Min.			1
Avg.			4.6
Max.			7
F	24.59248	14.88325	14.51869

p-values in Parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 3: Legal Rights and Human Capital Policies

	Log of per Capita Public Health Expenditures		
Strength of Legal Rights	0.09796***	0.05794***	0.05267***
	(0.000)	(0.000)	(0.002)
GDP per Capita		0.00012***	0.00008***
		(0.000)	(0.000)
Polity Score		0.04205	0.01585
		(0.111)	(0.472)
Government Revenues		-0.01659**	-0.00647
		(0.022)	(0.329)
Government Expenses		0.03420***	0.01944***
		(0.000)	(0.001)
Per Capita Private Health Expenditures			0.24254***
			(0.003)
Population 64+ Years Old			0.17159***
			(0.000)
Constant	5.50488***	2.85247***	0.76324*
	(0.000)	(0.000)	(0.067)
Number of Observations	451	451	451
Number of Groups			79
Observations per Group:			
Min.			
Avg.			
Max.			
F	14.49100	58.71593	55.24833

p-values in Parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 4: Legal Rights and Military Expenditures

	Log of Per Capita Military Expenditures		
Strength of Legal Rights	0.0171	0.0123	0.00712
	(0.160)	(0.318)	(0.444)
GDP per Capita		0.0000323***	0.0000353***
		(0.003)	(0.003)
Polity Score		-0.0466	-0.0429
		(0.527)	(0.518)
Government Revenues			0.00608
			(0.422)
Government Expenses			0.00533
			(0.283)
Constant	4.900***	4.805***	4.434***
	(0.000)	(0.000)	(0.000)
Number of Observations	444	444	444
Number of Groups	78	78	78
Observations per Group:			
Min.	1	1	1
Avg.	5.7	5.7	5.7
Max.	7	7	7
F	2.017	4.532	3.071

p-values in Parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 5: Legal Rights and Human Capital Policies (Quartiles)

	Expenditure per Student, Public Primary Schools	
	First Quartile	Fourth Quartile
Strength of Legal Rights	0.74140*	-0.26678
	(0.083)	(0.661)
GDP per Capita	0.00206	0.00043
	(0.780)	(0.305)
Polity Score	0.73945	-1.01448***
	(0.344)	(0.004)
Government Revenues	-0.34513	-0.26149
	(0.206)	(0.262)
Government Expenses	0.79771*	0.63656***
	(0.081)	(0.002)
Gross Enrollment Ratio, Primary Schools	-0.06836	-0.92629
	(0.856)	(0.256)
Net Enrollment Ratio, Primary Schools	-0.06910	1.23590
	(0.912)	(0.145)
Population of 0 to 14 Years Old	0.24883	0.63611
	(0.850)	(0.704)
Enrollment in Private Primary Schools	-0.15921	0.70851
	(0.848)	(0.242)
Constant	-2.73656	-40.00229
	(0.972)	(0.490)
Number of Observations	53	52
Number of Groups	20	12
Observations per Group:		
Min.	1	1
Avg.	2.6	4.3
Max.	5	6
F	.	.

p-values in Parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 6: Legal Rights and Human Capital Policies (Quartiles)

	Log of Student-to-Teacher Ratio, Public Primary Schools	
	First Quartile	Fourth Quartile
Strength of Legal Rights	-0.01107	0.01569**
	(0.598)	(0.035)
GDP per Capita	-0.00032***	-0.00001*
	(0.000)	(0.075)
Polity Score	-0.08508***	0.00164
	(0.000)	(0.698)
Government Revenues	-0.00158	0.00778**
	(0.459)	(0.015)
Government Expenses	-0.00801***	-0.00443***
	(0.003)	(0.002)
Gross Enrollment Ratio, Primary Schools	0.00450	-0.01003
	(0.149)	(0.184)
Net Enrollment Ratio, Primary Schools	-0.00645	0.01509
	(0.268)	(0.154)
Population of 0 to 14 Years Old	-0.02177**	0.05312
	(0.038)	(0.132)
Enrollment in Private Primary Schools	0.00412	-0.00267
	(0.522)	(0.790)
Constant	5.91362***	1.59461
	(0.000)	(0.150)
Number of Observations	69	68
Number of Groups	17	12
Observations per Group:		
Min.	1	1
Avg.	4.7	6.2
Max.	7	7
F	13.09799	.

p-values in Parentheses

* p<0.10, ** p<0.05, *** p<0.01

Table 7: Legal Rights and Human Capital Policies (Quartiles)

	Log of per Capita Public Health Expenditures	
	First Quartile	Fourth Quartile
Strength of Legal Rights	0.11679**	0.03716***
	(0.016)	(0.003)
GDP per Capita	0.00050**	0.00006***
	(0.017)	(0.002)
Polity Score	0.02714	-0.06002***
	(0.582)	(0.000)
Government Revenues	-0.00152	-0.00322
	(0.897)	(0.629)
Government Expenses	0.02552**	0.01630**
	(0.025)	(0.043)
Per Capita Private Health Expenditures	0.04701	-0.27003
	(0.818)	(0.136)
Population 64+ Years Old	0.09677	0.18219***
	(0.720)	(0.001)
Constant	0.89813	4.64660***
	(0.341)	(0.000)
Number of Observations	113	112
Number of Groups	24	18
Observations per Group:		
Min.	1	1
Avg.	4.7	6.2
Max.	7	7
F	13.09799	.

p-values in Parentheses

* p<0.10, ** p<0.05, *** p<0.01