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ABSTRACT

Fiscal spending for economic growth in the presence of imperfect markets*

Political economy factors tend to induce many governments to spend on private goods (non-social subsidies) to the detriment of spending on social and public goods. We show that this bias in spending patterns is particularly costly for economic growth when capital markets are imperfect. We thus provide a simple taxonomy of government spending: spending in goods that mitigate market failures versus spending in non-social subsidies which frequently have the sole purpose of benefiting special interest groups. We develop a theoretical model and link it quite closely to an empirical model. The empirical results fully corroborate the hypothesis that spending biases in favor of non-social subsidies reduce the rate of economic growth over the long run. The empirical findings are exceptionally robust.

JEL Classification: H42, H44 and H5
Keywords: economic growth investment, government spending, market imperfections and non-social subsidies

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Fiscal spending for economic growth in the presence of imperfect markets

1. Introduction

This paper shows theoretically and empirically that under imperfect credit markets and increasing social returns to human capital through its effect on total factor productivity growth, government spending on social and public goods (including education, health, social transfers, and pure public goods) promotes a faster rate of economic growth while government spending on non-social subsidies (credit subsidies to firms, farm subsidies, and many others) is toxic for growth. The basic conceptual story is simple: Credit rationing affects a subset of households which leads to aggregate underinvestment and scarcity of human capital, but aggregate investment in physical capital is unaffected regardless of the number of firms constrained by credit rationing. The essence of this asymmetry emanates from imperfect substitutability of human capital investment across households in contrast to perfect substitutability of physical capital across firms. In other words, a reduction in human capital in one household (due to credit rationing affecting the household's investment in human capital) cannot be offset by a corresponding increase in another household because other factors (innate ability) cannot be transferred across households and, therefore, are in fixed supply. Thus the human capital allocation across households has important implications, underlining the significance of credit accessibility across households. On the other hand, a reduction in physical capital in one firm (due to credit rationing) can be offset by a corresponding increase in another firm because other factors (labor) can move freely across firms and, therefore, are not in fixed supply. Thus the allocation of capital across firms may be immaterial and consequently the allocation of credit is also immaterial for economic growth over the long run.

Fiscal spending on social goods mitigate the negative effects of credit rationing on the households' investment in human capital but non-social subsidies, even if directed to firms affected by credit constraints, may only affect the distribution of investments between credit-constrained and unconstrained firms but not the aggregate level of investments in physical capital by firms. Moreover, non-social government subsidies increase the incentives for firms to devote scarce human capital to rent-seeking activities needed to grab such subsidies subtracting human capital not only from directly productive activities but, more importantly, from the process of creation and adaptation of new productive ideas, perhaps the most vital role of human capital. Hence non-social fiscal subsidies reduce the rate of growth of total factor productivity leading to a permanent reduction of the rate of economic growth.

We distinguish between what we call *pro-market expenditures (PME)* that alleviate the effects of market failure on knowledge creation and human capital investment and *market-restricting expenditures* (*RME*) that do nothing to alleviate market failures and instead exacerbate them. *PME* thus include social subsidies to households (education, health, and a variety of social protection programs), expenditures on knowledge creation and diffusion, as well as on pure public goods. *RME* include most non-social subsidies, such as commodity market subsidies, energy subsidies, credit subsidies and grants to corporations, loan guarantees, and bailouts of failed private financial institutions, among many others[1].

We first formalize these ideas by integrating several strands of a vast literature on market failures to develop a model that directly links fiscal expenditure patterns with productivity growth and investment. Specifically, we use ideas from the literature on credit market failure and human capital investment (Galor and Zeira, 2003), human capital accumulation and its spillovers on productivity growth (Acemoglu, 1996; Murphy et. al., 1991), and the flexibility of firms in adapting to market imperfections affecting only one factor of production (Eswaran and Kotwal, 1986; Carter and Barham, 1996). We then empirically test the hypothesis presented at the outset of this paper by establishing an unusually close link between the

[1] An illustration of the magnitude of *RME* is provided by the following examples: Worldwide farm subsidies reached $500 billion in 2001, 1.5% of the world GDP or 4.5% of total government revenues (Anderson et. al., 2006). Governments are estimated to spend in the range of 1 to 5% of annual GDP on fuel subsidies, tax exemptions and related subsidies mostly benefiting large firms (Coady et. al., 2006). The direct cost to US taxpayers of the S&L financial crises of the late 1980s has been estimated at $150 billion mostly spent over the period 1989-92 or about 4% of the total federal spending in each year (Curry and Shibut, 2000).

theoretical and empirical models and using a new empirical strategy that mitigates some of the most important objections to cross-country analyses raised in the recent literature (e.g., Durlauf et.al., 2005). We empirically show the validity of the above hypothesis and, moreover we show that the quantitative effect of shifting the composition of fiscal spending from *RME* to *PME* on economic growth is dramatic.

A large fraction of the national income, often 25 to 50% of GDP, is spent by governments. In times of economic crises, many governments use fiscal spending as a mechanism to stimulate the economy. Fiscal stimulus not only entails more or less temporary surges in fiscal spending but also significant revisions of governments priorities. Periods of crisis, when massive fiscal spending expansion can be easily justified, are propitious opportunities to change relative spending priorities without having to reduce politically sensitive programs. While the increased government spending may turn out to be temporary, the changes in the composition of fiscal spending often become more permanent.

Past crises have often led some governments to permanently change the structure of fiscal spending towards a greater emphasis on social protection programs, the development of new institutions as well as a greater provision of public goods[2]. It appears that the 2008-09 crisis may lead not only to large increases in total fiscal spending but also to a massive reallocation of government spending, although the direction of these compositional changes remain unclear.

Empirically measuring the strength of the effect of the fiscal mechanisms on growth has been the object of many studies. A weakness of this literature has been the general lack of a solid conceptual framework that would allow them to establish a clear taxonomy of expenditures to generically separate spending patterns that are pro growth from those that are not. This conceptual weakness is probably a reason for its rather disappointing and non-robust findings. Barro (1991), and Levine and Renelt (1992),

[2] The US government used the unprecedented fiscal spending expansion designed to deal with the Great Depression to dramatically increase social protection and welfare programs as well as education and other related programs resulting in an increase in the share of government spending on social programs from 2.48% in 1929 to 10.72% in 1940. In Korea, fiscal spending in social security and welfare increased from 7.8% of the total government expenditures in years prior to the 1997-98 Asia crisis to 13.5% by 2003-2005, and in Thailand from less than 4% to almost 9% in 2003-05 (Asian Development Bank, 2009).

for example, find that government spending has a negative effect on growth, while Ram (1986) finds a positive correlation. Still others find that there is no correlation between both variables (Kormendi and Meguire, 1985; Sala-i-Martin, 1997). More recent analyses have shifted the attention to the composition of government expenditures (Easterly and Rebelo, 1993; Islam, 1995; Devarajan et al., 1996). However, these studies have not yielded more definitive results than those that use aggregate spending.

2. Conceptual Model and the Central Hypothesis

We focus on two types of market failures: *(i)* Asymmetric information and moral hazard which foster an environment where collateral requirements are essential to access credit, and transaction costs in credit markets which introduce a wedge between lending and borrowing rates (Rothschild and Stiglitz, 1976; Stiglitz and Weiss, 1981; Hayashi, 1985)[3]. *(ii)* Human capital spillovers in the generation and adoption of knowledge (Hoff and Stiglitz, 2000; Acemoglu, 1996; Murphy et. al., 1991).

2.1 Assumptions.

We assume that workers or households invest in human capital and firms invest in physical capital. Credit rationing affects only some of the households and firms (presumably the least wealthy), while others can borrow freely in the formal sector (Galor and Zeira, 1993; Whited, 1992). To sharpen the analysis, we assume that constrained firms and households are those with net wealth below a certain critical level which impedes access to the formal credit market.

Additional assumptions are: (A.1) Capital flows freely across countries but labor movements are restricted (and the economy is small in the world capital market)[4]; firms and households are price-takers in input and output markets (and the unconstrained firms and households can borrow freely in the international market). (A.2) Firms produce a single output using physical capital and various types of labor

[3] Recent empirical literature has shown that credit market failure is pervasive in both poor countries (Haque and Montiel, 1989) and rich ones (Attanasio et. al., 2008; Grant, 2007;).

[4] International labor mobility is not in reality fully restricted as we assume here as shown by the relatively large migration flows occurring in certain contexts. However, the qualitative analysis is still valid as long as international labor flows are affected by a degree of restrictions while capital flows freely across countries.

skills, using a constant-returns-to-scale production function. The production function is weakly separable in capital and the various types of labor skills. (A.3) The various labor skills are perfect substitutes for each other in the firms' production function up to a scale factor. One hour of a high-skilled worker is equivalent to more than one hour of work of a lower skilled worker. (A.4) Workers invest in human capital, which combined with their fixed factors -such as their innate ability level- produce enhanced labor productivity through a "production function" which is subject to decreasing marginal product to human capital. (A.5) Due to credit transaction costs, the banks' lending interest rate is higher than their borrowing rate.

Assumption A.1 is consistent with the increasing integration of world capital markets that have taken place over the last three decades and with the permanence of severe restrictions to international labor migration. A.2 is fairly standard in the literature. Assumption A.3 is less so, but is made to reduce the dimension of the labor market effectively to just one market. This assumption, in combination with A.2, allows for the existence of a composite wage rate and a labor aggregator function in the firms' production function. Assumption A.4 is also common in the literature (Galor, 2000). Assumption A.5 as we shall see ensures that credit-constrained firms relying on their own capital are not entirely displaced by unconstrained firms.

2.2 Human capital investment

Each worker or household has one unit of raw labor. By investing in human capital (h), she can enhance her effective labor power (productivity) by a function $1+\psi(h)$. By A.4, $\partial\psi/\partial h > 0$ and $\partial^2\psi/\partial h^2 < 0$. Also, we assume that $\psi(0) = 0$. Financially unconstrained workers face a fixed lending rate r^f at which they can borrow unlimitedly. Constrained workers cannot borrow and consequently have to finance their human capital investment (and consumption) out of their own wealth. Each worker maximizes her utility over two periods. Initially the worker earns a given wage rate, according to her initial level of h-which without loss of generality we assume is zero- and has a fixed level of wealth, s_0.

Whether or not a worker is financially constrained depends on her initial level of wealth. Access to formal lending requires a minimum level of initial wealth that can be used as collateral. Let s* be the amount in period 1, in addition to wage income, needed to finance both (optimal) consumption and the investment in human capital. Lending institutions then set a minimum wealth level requirement to access formal lending. This required initial wealth level should cover a minimum fraction of s^*, $\bar{s} = \xi s^*$, where $0<\xi <1$.

In Appendix I we show the following lemma.

Lemma 1. *While the level of human capital investment by financially-unconstrained workers is unaffected by their initial wealth, human capital investment by financially-constrained workers is increasing in their wealth level.*

Consider the effect of an exogenous increase in the level of worker's wealth: The additional wealth reduces the internal marginal cost of capital for the financially-constrained worker and hence the worker will spend part of the additional wealth in financing more investment in human capital and part of it to increase consumption. By contrast, for financially-unconstrained workers, their increased wealth affects neither their marginal (market) cost of capital nor the rate of return to human capital. Hence, they do not change their investment level and instead devote the entire additional wealth to consumption.

From assumption A.4 it follows that since each worker has just one unit of raw labor, the worker $i's$ labor power in period 1 is $1+\psi(h^i(s_0^i, w_0))$, where s_0^i is the wealth of worker i in period 0. Suppose there are a fixed number of workers equal to N of which C_0 have levels of wealth below the critical level ($\bar{s}$) in period 0 and $N-C_0$ have wealth levels sufficient to allow full access to the credit market. Without loss of generality we can order workers according to their wealth level from the poorest to the richest. Then the economy's total supply of human capital or labor power in period 1 is

(1) $$L^S(s_0^1, s_0^2, ..., s_0^{C_0}; C_0, w_0) = \sum_{i=1}^{C_0}(1+\psi(h^c(s_0^i, w_0)) + \sum_{C_0+1}^{N}(1+\psi(h^u(r^f, w_0)).$$

Thus, the aggregate supply of labor power in period 1 is a function of the wealth levels, the wage rate, and number of financially-constrained workers in period 0. The fact that $h^c(s_0^i, w_0) < h^u(r^f, w_0)$ for all $s_0^i < \bar{s}$ implies that $L^S(s_0^1, s_0^2, ..., s_0^C; C_0, w_0)$ is decreasing in C_0 and w_0, and also $\partial h_i^c / \partial s_0^i > 0$ means that L^s is increasing in s_0^i (for all $i = 1, 2, ..., C_0$). Consider a lump-sum transfer in period 0 to each financially-constrained worker equal to m. From (1) it follows that the transfer has two effects on L^s: (i) an intra-marginal effect caused by increasing human capital of workers that remain financially constrained after the transfer, and (ii) a discrete effect on workers whose level of initial wealth is such that the transfer allows them to "jump" into the unconstrained regime, which we call the *"investment jump"* effect. The intra-marginal effect is equal to $\sum_{i=1}^{C_0}(\partial L^s / \partial s_0^i)(\partial s_0^i / \partial m)$>0 while the jump effect is equal to $(\partial L^s / \partial C_0)(\partial C_0 / \partial m)$ which is also positive because $\partial C_0 / \partial m$<0. The jump effect means that the investment-wealth schedule may have a discontinuity, having a discrete rise possibly of a much greater magnitude than what the within-regime marginal effect would be. Thus, the potency of subsidies to financially-constrained workers in raising their human capital can be quite large. For those workers that are near the border of the financial regime, even a small lump-sum subsidy can have a dramatic effect on investments in human capital by propelling them into an unconstrained financial regime.

The following lemma and its corollary summarize the implications of the previous analysis.

Lemma 2 (on investments in human capital). *(i) Workers facing binding credit constraints reduce their investment in human capital and these reductions cannot be compensated by increased human capital investments by workers that are not affected by credit constraints. (ii) Aggregate supply of labor power,* L^S, *is thus reduced by the existence of credit constraints affecting a subset of workers; (iii)* Subsidies to *workers in period 0 increase the aggregate supply of human capital or efficiency labor in period 1 if at* *least some of them are financially constrained, possibly inducing an investment jump effect among a subset of workers.*

2.3 Lobbying, the capture of government subsidies, and human capital waste.

The availability of government subsidies induces lobbying and other forms of directly unproductive activities (DUP) or rent seeking by interest groups to exert pressure upon the government to allocate subsidies in their favor (Ghate, 2001; Grossman and Helpman, 1996). Unproductive rent seeking behavior by firms creates a further misallocation of resources in the economy by attracting labor power (human capital) from other sectors of the economy towards such unproductive activities which has negative implications for productivity growth (Murphy et. al., 1991)[5]. Politicians also use spending in private goods or subsidies as a way of generating rents for themselves.

Subsidies to firms are more likely to elicit lobbying and DUP than social subsidies to households (Katel, 2006). This is true for at least three reasons. First, the fact that there are much fewer firms than households implies that it is easier for producers to organize lobbying efforts than for households (Olson, 1965). Second, firms are more easily grouped by production activities with common interests than households, which tend to be much more dispersed with regards to both activity type and geography. Third, from the viewpoint of public acceptance, it is easier to justify producers' associations influencing government for the sake of the productive sector than the association of a few wealthy households lobbying for a larger share of household subsidies, for example, foods stamps or public housing benefits.

Also, firms' size affects their lobbying capacity. A relatively small number of large firms can organize and lobby more effectively than a large number of small firms, and hence one may expect that large corporations tend to capture most of the government's non-social subsidies. In fact, several empirical studies have shown exactly this: most firm subsidies are engulfed by very few, typically the wealthiest,

[5] Lobbying attracts significant resources in the United States. In a summary of various literatures on lobbying, McGrath (2006) reports that the Washington component of lobbying-connected activities employs at least 100,000 people, most of them highly educated (Nownes, 2006). A survey of Oregon lobbyists by Berg (2009) found that 90% had a bachelor's degree with 51.8% having an advanced degree.

firms while most of the small ones receive little of them (Alston and James, 2002; Bambardini, 2008; Chen et.al., 2009; Slivinski, 2007). We use this important stylized fact on the modeling of firms' rent seeking that follows this section to justify our assumption that rent seeking is mostly done by financially unconstrained firms while the financially-constrained firms are shown to be too small to participate in rent seeking. Another implication of the above stylized fact is that subsidies to firms are unlikely to benefit poor households that may own small firms. That is, potential spillovers of subsidies to firms into the household sector which could help relieve household financial constraints (and thus reduce the underinvestment in human capital) are likely to be rather negligible.

In contrast with non-social subsidies, the lower lobbying efforts elicited by the availability of social subsidies to households implies that such subsidies tend to either concentrate on the lower income households (certain social transfers, food stamps, public housing) or at worst get more or less evenly dispersed across most households (free primary and secondary education, health care, social security, and others)[6]. Thus, low income households are able to mitigate their financial constraints through at least part of the cash or in-kind social subsidies available while non-social subsidies to firms tend to create rents mainly for the financially-unconstrained wealthier firms that can afford investing in lobbying. We summarize these results in the following lemma:

Lemma 3 (on rent-seeking and beneficiaries of subsidies to firms)*. (i) Rent-seeking activities divert resources, especially human capital, from other productive sectors. (ii) Subsidies to firms are grabbed mainly by larger firms that are often financially unconstrained rather than by smaller financially-constrained firms. (iii) Most rent-seeking activities to grab subsidies are then implemented by financially unconstrained firms and not by the financially-constrained firms. (iv) Non-social subsidies are not likely to spillover into credit-constrained households and, therefore, tend to do little to mitigate the effects of credit market imperfections on investment in human capital.*

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[6] Note that we refer here to *direc*t subsidies to households. We are excluding subsidies that may indirectly affect households by distorting commodity markets such as certain energy subsidies and others. Subsidies through commodity markets are likely to elicit DUP, in addition to creating other economic distortions.

2.4 Firms' resource allocation, lobbying and aggregate output

First consider financially unconstrained firms. We assume that they use labor and capital to produce new value (output) and rent-seeking activities necessary to grab part of the subsidies that the government makes available to firms. Consider first a firm's production function in period 1. By assumptions A.2 and A.3 we can write the firm's j production function as

$$y^j = af(k^j, l^j),$$

where y^j is output k^j is firm j's capital, $l^j = \sum_{s=0}^{M}(1+\psi_s(h_s))l_s^j$ is the firm's total labor power used in producing new value or output. l^j is an increasing and homogenous of degree one labor composite function of the M+1 labor skills used by the firm in the production of y^j (all variables correspond to period 1; we omit the subscripts indicating time period). Assumptions A.2 and A.3 also imply that the function f ( ) is homogenous of degree one in k^j and l^j. Total factor productivity, a, is assumed to be taken as given by firms.

The rent-capturing function is assumed to be a function of the firm lobbying efforts using capital (k_M^j) and labor power (l_M^j). In addition, the effectiveness of such effort depends on the availability of private subsidies and of the stock of institutions developed by the government to allocate such subsidies to firms (M). Thus, the (gross) rent-capturing function is,

$$R^j = \xi(k_M^j, l_M^j; M)$$

This function is assumed to be increasing, concave and linearly homogenous in k_M^j, l_M^j and M. Thus, firms need to divert factors of production for lobbying in order to share part of the rents made available by the government. The assumption of linearly homogeneity of the function $\xi(k_M^j, l_M^j; M)$ implies, as we show below, that the chosen levels of k_M^j and l_M^j are proportional to M and therefore that a doubling of M, for example, would result in a doubling of the factors used in lobbying and hence in a doubling of gross rents captured by firm j. Moreover, the fact that the function $\xi(k_M^j, l_M^j; M)$ is strictly concave in k_M^j and l_M^j means that rents are not fully dissipated and instead firms are able to obtain positive net rents after paying for the cost of the factors of production used in lobbying..

The full revenue maximization of the firm including both production and rent-grabbing activities is,

$$\pi \equiv \max_{k^j, l^j, k_M^j, l_M^j} \{af(k^j, l^j) + \xi(k_M^j, l_M^j; M) - r^f(k^j + k_M^j) - w(l^j + l_M^j)\},$$

where r^f is the cost of capital given by international capital markets and w is the wage of the labor power composite. From the first order conditions, profit maximizing firms adjust the levels of the labor power composite so that

$$af_2(l^j / k^j) = w, \qquad (2)$$

where f_2 denotes first derivative with respect to the labor composite. Given that f_2 is homogenous of degree zero (which follows from the fact that f is linearly homogenous) it can be expressed entirely as a function of the factor ratio (l^j / k^j).[7] The firm j chooses its composite level of labor independently of the decisions regarding the demand for specific labor skills, and with reference only to the composite wage rate. Equation (2) is valid for both financially constrained and unconstrained firms.

Consider now the investment choices. Let own financial capital for constrained and unconstrained firms be $\chi_i \geq 0$ ($i = c, u$) so that for financially unconstrained (constrained) firms total initial wealth is $\chi_u \geq \bar{k}$ ($\chi_c < \bar{k}$), where $\bar{k}$ is the minimum critical level of total owned wealth by the firm for accessing capital markets. Assume that for *financially-unconstrained* firms the marginal product of their own capital is higher than the market lending rate, $af_1(l^j / \chi_u^j) > r^f$, where f_1 is the first derivative with respect to k^j.

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[7] Condition (2) applies to the labor power composite used by the firm, l^j, but using the definition of $l^j = \sum_{s=0}^{M}(1+\psi_s(h_s))l_s^j$ we have that for each of the specific labor types the condition is $af_2(l^j / k^j)((1+\psi_s(h_s)) = w$. That is, given assumption (A.3) we can define the wage for workers of skill s as $w^s \equiv w/(1+\psi_s(h_s))$ for all $s = 1, \ldots\ldots, M$.

Then firms do borrow in the capital market and thus they equalize the marginal product of capital to the market lending rate.

$$af_1(l^j / k^j) = r^f \,, \tag{3}$$

where f_1 is the first derivative of f with respect to capital. f_1 is homogenous of degree zero which means that similar to the function f_2 in (2), f_1 can also be expressed as a function of only l^j / k^j.

By constant returns to scale, the only endogenous choice variable to the firm with respect to labor and capital employed in productive activities is l^j / k^j. Given that r^f is exogenously given to the economy, (2) and (3) cannot in principle hold simultaneously unless the wage rate adjusts to a unique equilibrium level, w^E, that is consistent with profit maximization of all (financially-unconstrained) firms. Competitive profit maximizing equilibrium implies exactly this: If $w > w^E$, profits are negative which cause firms to exit leading to lower demand for labor power and hence a fall of the wage rate until it reaches w^E. The opposite happens if $w < w^E$. Thus, competitive equilibrium implies that equations (2) and (3) solve for unique equilibrium levels of the composite labor power/capital ratio, $(l^j / k^j)^E$, and composite wage rate, w^E. Thus, from condition (3) we obtain,

$$(l^j / k^j)^E = \phi(r^f / a) \,, \tag{4}$$

where the function ϕ is increasing in r^f / a. Using (4) in (2) we obtain that the equilibrium composite wage rate,

$$w^E = w^E(a, r^f / a) \,, \tag{5}$$

where w^E is increasing in a and decreasing in r^f.

Similarly, firms adjust the levels of each labor input and capital employed in rent seeking activities such that:

$$\xi_1(k_M^j / M, l_M^j / M) = r^f \tag{6}$$

(7) $$\xi_2(k_M^j / M, l_M^j / M) = w^E,$$

where ξ_1 and ξ_2 are the first derivatives with respect to capital and labor respectively employed in rent seeking activities. The marginal products of the factors of production devoted to rent seeking are functions of the k_M^j / M and l_M^j / M ratios because the function $\xi(k_M^j, l_M^j; M)$ is linearly homogenous. Equations (6) and (7) then solve,

(8) (a) $l_M^j / M = \zeta^L(w^E, r^f)$; (b) $k_M^j / M = \zeta^K(w^E, r^f)$

Where $\zeta^L(\zeta^K)$ is decreasing (increasing) in w^E, and increasing (decreasing) in r^f. Also, w^E is a function of a and r^f / a as defined in (5).

Hence, it follows from Lemma 3 that equations (6) and (7) are only valid for financially-unconstrained firms who are large enough (and have the resources) to be able to qualify for subsidies as decided by politicians while financially-constrained firms do no lobby focusing only on productive activities. Below we show that financially-constrained firms can survive only if their size or scale of operations is smaller than that of financially-unconstrained firms.

Financially-constrained firms do not have access to commercial borrowing because $\chi_c < \bar{k}$ so their choice of capital is determined by their financial wealth level, χ_c. Suppose that the financial constraint is binding, which means that the marginal product of their owned capital is greater or equal to the market cost of capital. The opportunity cost of the constrained firms' own funds is equal to the banks' borrowing rate, r^b, which by assumption (A.5) is lower than the banks' lending rate. That is, $r^b < r^f$. Hence if the marginal product of own capital is greater or equal to r^f it will also be higher than r^b. This means that financially constrained firms will invest all their available funds in increasing their productive capital. Thus, for financially constrained firms we have that $k^c = \chi_c < k^u$.

Financially-constrained firms can choose labor power freely, as the financial constraint does not affect their choice of variable inputs, and are assumed to face the same composite wage rate that financially unconstrained firms face. Hence, they will maximize their profit by equalizing the marginal product of labor to the market wage rate,

(9) $$af_2(l^c / \chi^c) = w .$$

From equations (2) and (9) it follows that as long as unconstrained and constrained firms face the same wage rate

(10) $$(l^c / \chi^c)^E = (l^j / k^j)^E .$$

That is, the financial constraint does not prevent these firms to reach the same labor/capital ratio as the unconstrained firms.[8] Financially-constrained firms use less capital than unconstrained firms but they also must use less labor, so that the labor/capital ratio is identical to that of the unconstrained firms. Financially-constrained firms can survive as long as their scale of production is much lower that that of unconstrained firms. The following lemma follows from the previous analysis,

Lemma 4. *(i) Competitive equilibrium with profit maximizing firms in a small economy integrated to international capital markets is consistent with unique levels of the labor power/capital ratio employed in productive activities, which is identical for financially unconstrained and constrained firms,* $(l/k)^E$ *.(ii) The ratio* $(l/k)^E$ *is fixed given for given levels of* a *and* r^f *, as defined by (4). (iii) The ratio of lobbying labor power to government non-social subsidies,* l_M^j / M *, and lobbying capital to government non-social subsidies,* k_M^j / M *, are also fixed as determined by (8a) and (8b), respectively.*

Aggregate capital and labor market equilibrium

Using (4), (8a) and (10) we obtain the aggregate demand for labor power from financially unconstrained and constrained firms in period 1,

[8] Note that this implies that (3) must also be valid for financially constrained firms, but the mechanism to reach this condition is by adjusting labor, not capital. That is, for financially constrained-firms the condition $af_1(l^c / \chi^c) = r^f$ is also valid, which is attained by making $l^c < l^j$.

(11) $$L^D = \sum_{j=1}^{\tilde{U}} (l^j + l_M^j) + \sum_{j=1}^{\tilde{C}} l^c = \left[\sum_{j=1}^{\tilde{U}} k^j + \sum_{j=1}^{\tilde{C}} \chi^c \right] \phi(r^f / a) + \sum_{j=1}^{\tilde{U}} l_M^j ,$$

where $\tilde{U}$ and $\tilde{C}$ are the number of financially unconstrained and constrained firms, respectively. Thus, we can express the economy's total demand for labor power as,

(12) $$L^D = K\phi(r^f / a) + L^M (w^E, r^f ; M),$$

where $K \equiv \left[\sum_{j=1}^{\tilde{U}} k^j + \sum_{j=1}^{\tilde{C}} \chi^c \right]$ is the aggregate level of capital of financially unconstrained and constrained firms in period 1 used in productive activities, and $L^M \equiv \sum_{j=1}^{\tilde{U}} l_M^j$ is the total labor power used in rent seeking. We note that given that the economy is assumed to be fully integrated into international capital markets $\tilde{U}$ is variable; if the domestic profitability of capital increases then $\tilde{U}$ increases.

Labor market clearing implies that the total supply of labor power is equal to the demand for labor power. Thus, using (1) and (12) we have

(13) $$L^S (s_0^1, s_0^2, ..., s_0^{C_0}; C_0, w_0) - L^M (w^E, r^f, M) = \phi(r^f / a)K .$$

The left-hand- side of (13) is the total supply of labor power in period 1 as given by (1) minus the supply of labor power employed in rent seeking activities, and the right-hand-side is the total demand for labor power for productive activities in period 1. As shown in Section 2.2, $s_0^1, s_0^2, ..., s_0^{C_0}$ and C_0 are the levels of wealth of the financially-constrained workers and the total number of constrained workers in the period 0, respectively. Hence L^s is predetermined by the investments in human capital made in the earlier periods and so is the level of total factor productivity, which depends among other things on the past availability of human capital for production (see below for more about the determinants of productivity). Also, r^f is given by international capital markets and is thus independent of the level of domestic capital investment. Hence, the labor market clearing condition (13) can be attained when aggregate physical capital reaches a unique equilibrium level, K^E.[9] Equation (13) solves for $K^E = \Omega(L^S - L^M, a; r^f)$, where the function $\Omega(L^S - L^M, a; r^f)$ is increasing in L^S and a, and decreasing in r^f and L^M.

Aggregate output. Given constant returns to scale in production, firm's j production function can be written as $y^j = af(1, l^j / k^j)k^j$. Hence using (4) we have that $y^j = af(1, \phi(r^f / a))k^j$. Similarly, using (10) the production function of the constrained firms can be written as $y^c = af(1, \phi(r^f / a))k^c$. Thus the equilibrium aggregate output of the economy is,

$$Y \equiv \sum_{j=1}^{\tilde{U}} y^j + \sum_{c=1}^{\tilde{C}} y^c = af(1, \phi(r^f / a))K^E. \tag{14}$$

From Equation (14) it follows that aggregate output is not affected by credit constraints affecting firms. Also, Y in (14) does not appear to be directly affected by aggregate effective human capital, $L^S - L^M$, which may seem paradoxically. However, given $\phi(r^f / a)$ there is a fixed relationship between K^E and $(L^S - L^M)$ (by (17) $K^E / (L^S - L^M) = \phi(r^f / a)$). Hence, K^E adapts to the existing supply of the effective labor power, $(L^S - L^M)$, so that $K^E / (L^S - L^M)$ ratio is set equal to ϕ. Thus, we could equally write (14) in terms of $(L^S - L^M)$ instead of K^E. In (14) K^E can be regarded as an index for all factors used in production. Thus, household financial constraints reduce the aggregate level of effective human capital ($L^s - L^M$) and affect output in two ways, a direct productivity effect through the level of a and an indirect effect through the level of physical capital.

The following lemma and its policy corollary summarize the most important results of this section.

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[9] This means that the endogenous aggregate level of investment allows for the equalization of the aggregate (efficiency) labor supply and demand. At $w = w^E$ the whole wage structure is determined in accordance with $w_s = (1 + \psi(h_s))w^E$ for all $s = 1, \ldots, M$. At these wages equilibrium between supply and demand for each skill also occurs due to the assumption that labor skills are perfect substitutes in production. Suppose that this is not the case and that instead there is excess supply of workers of a particular skill, s. This causes w_s to become below the equilibrium one, $(1+\psi(h_s))\,w^E$, which, in turn, induces firms to instantaneously substitute among skills increasing their demand for workers with skill s until the equilibrium wage rate is reestablished. Thus, due to the perfect substitution assumption the demand for skills is completely flexible in adjusting to the supply of skills.

***Lemma 5*. *(on the effects of credit market imperfections affecting firms on aggregate capital and output)*.** *(i) Credit market imperfections affecting domestic firms are of no consequence for the level of aggregate capital. The aggregate level of physical capital is affected neither by the number of firms that are financially constrained nor by their levels of investment. Instead, the equilibrium level of the economy's total productive capital,* K^E *, is determined by conditions prevailing in the labor market as depicted by Equation (13).(ii) Credit market imperfections affecting firms are of no consequence for the level of aggregate output of the economy.*

Proof: As defined earlier in the text the aggregate capital used in productive activities is $K \equiv \left[\sum_{j=1}^{\tilde{U}} k^j + \sum_{j=1}^{\tilde{C}} \chi^c \right]$. Suppose that financial constraints become tighter so that χ^c or the market collateral requirement increase causing $\tilde{C}$ to increase and $\tilde{U}$ to fall concomitantly (firms that were financially unconstrained become constrained). The effect of this is to temporarily reduce the aggregate productive capital making $K < K^E$. Consequently according to (13) a temporary excess supply of labor emerges which, in turn, causes an incipient reduction of the wage rate. This makes capital temporarily more profitable thus inducing firms to enter the economy. That is $\tilde{U}$ increases until the disequilibrium in the labor market is completely erased at $K = K^E$. Thus the new equilibrium is different from the previous one only in the composition of firms, a higher number of financially-constrained firms each investing less and a larger number of unconstrained firms that exactly compensate for the initial fall in capital. This shows part (i). Part (ii) of the lemma 5 follows directly from Equation (14). ⊗

Policy Corollary to lemma 5. *Subsidies to firms do not increase the economy's aggregate productive capital, aggregate output and the rate of growth of total factor productivity as long as the market borrowing interest rate (* r^f *) remains unchanged and continues to dictate the marginal cost of capital.*

The solution to the equations (13) and (14) should be interpreted as snapshots in the sense that the solution defines a temporary equilibrium. That is, the equilibrium will be constantly changing even if no exogenous variable varies over time. The reason is that the total factor productivity a is constantly changing because its rate of change depends on the stock of human capital and not on its change. The changes in a induce concomitant changes in output growth and capital. We now turn to this issue.

2.5 Productivity growth, human capital and rent seeking

The aggregate stock of human capital or labor power determines the size of the pool of workers with the sufficient cognitive skills necessary to create new ideas (Acemoglu, 1996). Furthermore, the diversion of human capital from productive activities to unproductive rent-seeking activities reduces the pool of human capital engaged in the generation of new productive ideas, and therefore has a negative effect on the growth of productivity (Murphy et. al., 1991). Thus, we have the following lemma.

Lemma 6. (On the effects of credit market imperfections and rent seeking on productivity growth). *Credit rationing affecting households or workers and rent-seeking activities reduce the rate of growth of total factor productivity because both contribute to reducing the stock of labor power engaged in creating productive new ideas.*

Proof. The creation and adaptation of new ideas requires that a large number of workers be able to continuously participate and interact among each other in such intent *(*Acemoglu, 1996*)*. Human capital devoted to productive activities causes spillovers or externalities that promote total factor productivity. These productivity externalities are increasing in the number of workers able to optimally choose their human capital (the lower is C) and in the level of human capital of the constrained workers (the higher is h^c); that is, productivity externalities are increasing in L^S. Hence, since by Lemma 1 credit rationing affecting a subset of households reduces L^S it follows that the rate of total factor productivity growth, ceteris paribus, is reduced by credit market imperfections. In addition, rent seeking activities undertaken by firms involve a diversion of existing human capital from productive activities, where it contributes to create productive new ideas, towards unproductive rent-seeking activities where it engages in creating new ideas to improve rent grabbing rather than in creating new productive ideas. Labor power devoted to rent seeking activities in the economy diminishes the effect of total human capital on total factor productivity, and thus reduces productivity growth. More formally, the total factor productivity function in period 1 is, $a_1 \equiv a_0 + \Delta(L^S - L^M)$ which is comprised of the existing productivity level (a_0) plus its increase during the current period (Δ). The rate of *increase* in productivity, Δ, is increasing on the aggregate level of the *stock* of labor power engaged in productive activities; that is $\partial\Delta / \partial(L^s - L^M) > 0$. Even if $(L^s - L^M)$ is constant there will exist a constant flow of productive new ideas which may allow for the increase of the total factor productivity of the economy over time (i.e., Δ may be positive). ⊗

From Lemma 6 we can now define the rate of growth of total factor productivity over time as

$$\dot{a} / a = g^a(L^S - L^M; Z^a), \quad (15)$$

where Z^a are other factors that may affect productivity growth and the function g^a is increasing in L^S and decreasing in L^M. Thus, the growth rate of total factor productivity in period 1 depends on the aggregate net effective supply of skills in period 1($L^S - L^M$), which in turn depends on the wealth and number of financially-constrained workers in period 0.

2.2 Implications for government subsidy policies

The following two propositions summarize the key implications of the lemmas 1 to 6 for fiscal subsidy policies:

Proposition 1 (on social subsidies to households). *In economies affected by credit-rationing, subsidies to households or workers increase the aggregate supply of labor power and enhance the human creativity pool which, in turn, may cause a faster rate of productivity growth, and also more investment in physical capital. All this leads to a faster rate of economic growth.*

Proposition 2 (on non-social subsidies). *Non-social government subsidies (excluding subsidies to R&D) do not increase aggregate investment in physical capital, cause little spillovers into the household sector to* *relieve its financial constraints, and by contributing to divert more of the scarce stock of labor power to rent-seeking activities, reduce the rate of growth of total factor productivity and hence economic growth.*

2.3 Towards an empirical specification of the model

To link the theoretical model with an empirically estimable one we need to assume a functional form for the production function. A common practice in growth models has been to assume Cobb-Douglas production function. However, modern empirical studies have consistently rejected the assumption of a unitary elasticity of substitution implied by the Cobb-Douglas function and instead have shown that the elasticity of substitution between capital and labor is far lower than 1 (Pessoa et.al., 2005; Antras, 2004; Jalava, 2006; Claro, 2003). We thus assume a CES production function with a less-than-one elasticity of substitution:

$$y_j = a[\alpha k_j^{-\frac{(1-\sigma)}{\sigma}} + (1-\alpha) l_j^{-\frac{(1-\sigma)}{\sigma}}]^{-\frac{\sigma}{(1-\sigma)}},$$

where $\sigma < 1$ is the elasticity of substitution. In this case from (4) and (10) we have,

(16) $$(l_j / k_j)^E = (l_c / \chi_c)^E = \left[\left(\frac{r^f}{\alpha a}\right)^{\sigma-1} - \alpha\right]^{-\frac{\sigma}{(1-\sigma)}} /(1-\alpha) \ ,$$

and using (16) in (13) and (14) we obtain,

(17) $$\left[\left(\frac{r^f}{\alpha a}\right)^{\sigma-1} - \alpha\right]^{-\frac{\sigma}{(1-\sigma)}} K^E = (1-\alpha)(L^S - L^M)\ ;$$ (18) $$Y = a^{1-\sigma}\left(r^f / \alpha\right)^{\sigma} K^E$$

Logarithmically differentiating (18) and (17) with respect to time we derive the following growth specifications,

(19) $$g^y = (1-\sigma) g^a + g^k + \sigma g^{r^f}$$

(20) $$g^k = g^{L^S - L^M} + \sigma\tau(g^a - g^{r^f}) .$$

where g^y, g^a, g^k, g^{r^f}, and $g^{L^S-L^M}$ are the rate of growth of output per capita, productivity, capital per capita, the market interest rate, and productive labor power, respectively, and $\tau \equiv \frac{(\alpha a / r^f)^{1-\sigma}}{(\alpha a / r^f)^{1-\sigma} - \alpha} > 1$. The growth version of the left hand side of Equation (13), that is the growth of productive labor power, can be approximated as,

$$(21) \qquad g^{L^S-L^M} = \lambda_1 g^{s_0} - \lambda_2 g^C - \lambda_3 g^{L^M}$$

where g^{s_0} represents the rate of growth of the wealth of the financially-constrained workers and g^C is the rate of growth of the number of financially constrained workers, and g^{L^M} is the growth of labor power devoted to rent-seeking activities. λ_1, λ_2, and λ_3 are positive parameters. Finally, using a linear approximation for the equation of total factor productivity (Equation (15)),

$$(22) \qquad g^a = \gamma_1 (L^S(s_0^1, s_0^2, ..., s_0^C; C_0, w_0) - L^M(w^E, r^f, M)) + \gamma_2 Z^a;$$

where Z^a are factors other than L^S and L^M that may affect productivity growth, γ_1 and γ_2 are positive parameters and γ_2 is a fixed parameter. Equations (19) to (22) constitute the basic link between the theoretical model and the empirical econometric model derived below.

It might seem paradoxical that in (19) the effect of increases in the interest rate, r^f, on the rate of growth may be positive. This is true for a given rate of growth of capital, reflecting the fact that an increase of r^f induces greater use of labor power. However, from (20) it is clear that the rate of growth of capital is decreasing in r^f and, moreover, using (19) in (20) we obtain the following reduced-form output growth equation,

$$(23) \qquad g^y = (1 + \sigma(\tau - 1)) g^a + g^{L^S-L^M} - \sigma(\tau - 1) g^{r^f}$$

Thus, the net effect of g^{r^f} on economic growth is negative equal to $-\sigma(\tau - 1)$ (remember that $\tau > 1$). Similarly, from the above equation it is clear that the net effect of the growth of total factor productivity on economic growth is greater than 1. This is the *productivity-magnification* effect: The rate of growth of total factor productivity exerts a greater than proportional effect on economic growth.

2.4 The Hypotheses

Proposition 1 shows that total factor productivity, growth of physical and human capitals are all functions of the levels of government spending in social subsidies in period 0, PME_0. The wealth levels of households or workers are increasing in PME_0, $\partial s_0^i / \partial PME_0 \geq 0$ (for $i = 1, ..., N$ with a strict inequality for some i), and the number of financially-constrained workers is decreasing in PME_0, $\partial C_0 / \partial PME_0 < 0$. Hence, from (1) given that $L^S(s_0^1, s_0^2, ..., s_0^C; C_0, w_0)$ is increasing in s_0^i and decreasing in C_0, it follows that $\partial L^S / \partial PME_0 > 0$. Moreover, Proposition 1 also predicts that the rate of growth of total factor productivity is increasing in $L^S - L^M$ and hence is increasing in the lagged level of PME, $\partial g^a / \partial PME_0 > 0$.

The effect of *RME* on the rate of productivity is due to the link between RME and M. M is the stock of government-provided mechanisms to channel non-social subsidies to firms including of course the subsidies themselves. The subsidies can take many forms including tax exemptions, transfers in kind, exclusive access to certain markets as well as direct transfers. Expenditures in non-social subsidies are used to build the necessary institutional and financial infrastructure to establish and maintain the system of channeling and allocating the benefits. Hence we may expect that the stock of M at time 1 is the result of past expenditures in *RME*, say at time 0. Thus, given that L^M is increasing in M (see equation (8)) and M is increasing in *RME* it follows that $\partial L^M / \partial RME_0 > 0$ which by Lemma 6 (and equation (15)) implies that $\partial g^a / \partial RME_0 < 0$.

Thus we can write the rates of growth of total factor productivity, physical capital, human capital and the interest rate facing country i at time t as functions of the lagged spending patterns and other factors, $g_{it}^a(PME_{it-1}, RME_{it-1}; Z_{it}^a)$, $g_{it}^k(PME_{it-1}, RME_{it-1}; Z_{it}^k)$, $g_{it}^{L^S - L^M}(PME_{it-1}, RME_{it-1}; Z_{it}^L)$, and $g^{r^f}(Z_t^r)$, respectively, where Z_{it}^{a} , Z_{it}^{k} , Z_{it}^{L} and Z_{t}^{r} are other factors that may affect the growth of productivity, physical capital, human capital, and interest rate, respectively. Using equations (20) to (23) it follows that

$$g_{it}^{y} = \sigma g_{it}^{a}(PME_{it-1}, RME_{it-1}; Z_{it}^{a}) + (1-\sigma) g^{r^f}(Z_{t}^{r}) + g_{it}^{k} \tag{24}$$

$$g_{it}^{k} = g_{it}^{L}(PME_{it-1}, RME_{it-1}; Z_{it}^{L}) + \beta[g_{it}^{a}(PME_{it-1}, RME_{it-1}; Z_{it}^{a}) - g^{r^f}(Z_{t}^{r})] \tag{25}$$

where $\beta = \tau\sigma$.

Propositions 1 and 2 lead to the following testable hypotheses:

The Central Hypotheses: *The functions* g_{it}^{a}, g_{it}^{k} *and* g_{it}^{L} *are increasing in* PME_{it-1} *and decreasing in* RME_{it-1}*. Given (24) and (25) it follows that: (1) a reallocation of government spending from RME to PME promotes faster economic growth.* (2) *RME may reduce* g_{it}^{a}, g_{it}^{L}, or even g_{it}^{k} *and hence slowdown the rate of growth of the economy*.

3. Empirical Strategy

We derive a reduced-form equation for per capita GDP growth from the key theoretical equation (19). We first estimate this model using panel country level data focusing mainly on the government variables, using highly parsimonious and eclectic specifications which rely on fixed and country-specific time-varying coefficients to account for the other potential factors that may affect economic growth. We then sequentially expand the set of controls a great deal to ascertain the robustness of the estimates.

The approach is directed to at least partially mitigate some of the most serious objections to cross country panel analyses raised in the literature. Durlauf et. al., 2005 have summarized these objections: (1) model uncertainty which introduces significant ambiguity about the empirical specification, specifically the control variables included. This issue is particularly serious to the extent that the estimates of the parameters of interest may be affected by changes in the control variables used. (2) Parameter heterogeneity caused by the fact that cross country regressions often use data from countries that are at very different stages of development which may have different production functions. (3) Biased estimates due to reverse causality and to the omission of variables that may be correlated with the statistical error term.

To deal with (1) we use two approaches: A model that allows us to control for an unspecified number of factors relying on fixed and time-varying country-specific effects which we call Variable Country Effects (TVC) method. In addition, we expand the model to systematically introduce a large number of measured control sets using a procedure first proposed by Altonji (2005). We consider (2) by using several sub-samples comprising of countries that are at similar stages of development to see whether the narrowing of the samples in several directions cause the basic results of interest to change. With respect to (3), we use a lagged structure of the explanatory variables that is in fact predicted by the theoretical model which in the context of the TVC method should greatly reduce the risks of inconsistent estimates associated with the combination of reverse causality and omitted variables.

3.1. Estimating Model

To estimate the output growth equation (24) we normalize the variables of interest as follows: PME_{it-1} is divided by total government expenditures, defining $s_{it-1} \equiv PME_{it-1} / G_{it-1}$; instead of using RME_{it-1} as a separate variable we use total government spending (excluding public investment) normalized by GDP using the variable $q_{it-1} \equiv G_{it-1} / GDP_{it-1}$. Also we follow the common practice of approximating capital growth by total investments (including private and public) in physical capital normalized by GDP using the variable $i_{it} \equiv I_{it} / GDP_{it}$. These are merely convenient normalizations that permit a more precise estimation and that allows for a direct assessment of the government spending composition effect. Furthermore, these normalizations make the newly defined variables unit free thus mitigating measurement problems originated in currency fluctuations, currency changes and inflation across countries and over time. Finally, we proxy the (largely unknown) control variables Z_{it}^{a} with country-idiosyncratic fixed and time-varying effects while we use common-to-all-country time effects in lieu of Z_{t}^{r} in (24)

Using the above normalizations we can write from (24) the rate of growth of per capita GDP as,

(26) $$g_{it}^{y} = \eta_1 s_{it-1} + \eta_2 q_{it-1} + \eta_3 i_{it} + \nu_{it} + \tau_t + \mu_{it}$$

where ν_{it} is a function that encapsulates the country-specific fixed and time-varying effects and τ_t are the common-to-all-countries time effects. μ_{it} is the stochastic disturbance assumed to be independent and identically distributed with a zero mean and fixed variance; η_1, η_2, η_3 and η_4 are fixed parameters. Since we use i_{it} instead of growth of per capita physical capital, η_3 is not equal to 1 as suggested by equation (20). Since $g^k = i(GDP/K) - \delta$ (where δ =rate of capital depreciation) it follows that $\eta_3 \approx (GDP/K)^A$, where $(GDP/K)^A$ is the average GDP/K ratio in the sample. Since the capital stock values are typically much larger than annual levels of GDP (Hamilton, 2005), it is expected that η_3<1.

The use of fixed and time-varying country-specific effects in lieu of the vectors Z_t^r and Z_{it}^a, respectively is recognition of our ignorance about the many other factors that are likely to affect international capital markets and domestic productivity growth. This is a drastic departure from the standard approach where authors often guess what such factors may be on the basis of specific conceptual models as well as on the availability of data. However, we do check the robustness of our results by combining this approach by adding a large number of specific control sets.

We need to specify the nature of the country-idiosyncratic time-varying effect function, ν_{it}. The TVC approach assumes that ν_{it} is a function which can be approximated by a (T-2)th order (country specific) polynomial function of time where its parameters are allowed to take different values for each country. Typically potential important control variables, for example microeconomic policies, political institutions, property rights and so forth, follow certain patterns which tend to change over time non-linearly, not always monotonically, and in a country-idiosyncratic manner, but their changes may exhibit some degree of systematic correlation with time. Thus, such omitted control variables may be adequately captured by polynomial functions of time that are sufficiently flexible. We postulate the following polynomial function,

(27) $$v_{it} = b_{0i} + b_{1i}(trnd) + b_{2i}(trnd)^2 + b_{3i}(trnd)^3 + ... + b_{T-2i}(trnd)^{T-2} + e_{it}$$

Where $b_{0i}, b_{1i}, b_{2i}, b_{3i}, \ldots.. b_{T-2,i}$ are fixed coefficients which are allowed to be different for each country, and $trnd$ is a time trend variable. The coefficients b_{0i} correspond to the fixed country effects and the remaining coefficients capture the country-idiosyncratic time-varying effects.

Substituting (27) into (26) we obtain the estimating equation with new disturbance term $\tilde{\mu}_{it} = \mu_{it} + e_{it}$. We assume the polynomial in equation (27) is an exact approximation of v_{it}, and thus the residual of the polynomial approximation, e_{it}, is assumed to be random and independent of time, and assumption that is empirically tested. If this not rejected then the TVC model would be able to control for omitted time-varying country-specific variables thus mitigating possible biases to the coefficients of interest that would arise if the unknown control variables are correlated with the explanatory variables considered, a perennial problem of cross country analyses (Acemoglu et. al. 2001; Bose et. al. 2007).[10]

One could fully control for the time-varying country-specific effects (i.e., all the v_{it} effects) by using the complete matrix of country-year dummies but of course this would leave no degrees of freedom to estimate the effect of any other variable. It is easy to see that estimating a $(T-1)^{th}$ order polynomial function of time for each country would be equivalent to estimating the complete matrix of country-year dummies. However, if we assume that the unobserved effects are not completely time-anarchic, a (T-2)th polynomial may be sufficiently flexible to capture these patterns while still permitting the estimation of the effects of observed variables. Thus, if e_{it} and hence $\tilde{\mu}_{it}$, is time independent, then the (T-2)th polynomial

[10] One concern might be that the TVC imposes a continuous rather than discrete control for time-varying effects. However, while the use of dummy variables in the standard approach to control for fixed country effects can be regarded as a discrete approximation, the effect of the effects of observed variables are indeed assumed to be continuous in most standard analyses. So the assumption of continuous unobserved effects is a natural extension of the standard regression analysis. Moreover, as we show below the TVC yields the discrete fixed effect model as a special case.

estimation may be sufficient to uncover the effects of the omitted variables and thus mitigate time-varying country-idiosyncratic omitted variable biases.

The TVC is a generalization of the standard fixed country effects model (FE) so often used in growth regressions (for example, Fölster and Henrekson, 2001 and Afonso and Furceri, 2010). The fixed country effects correspond to the b_{0i} coefficients in (27) and thus FE can be regarded as a special case of TVC where (27) is restricted by imposing that all coefficients other than the constants be zero. Since the FE model is nested in the TVC model we can test the validity of the FE model parametrically by imposing the following restrictions: $b_{1i} = b_{2i} = ... = b_{T-2i} = 0$ for all $i \in \{1, 2, ..., I\}$ while $b_{0i} \neq 0$, for all or some i.[11]

Investment in physical capital

Given that in the growth equation we control for the level of investment, to get the full effect of the government spending variables we need to also estimate an investment equation. We use equation (25) arising from the theoretical model to postulate the following investment equation using the same normalizations for the government spending variables as those used in the per capita GDP growth equation,

(28) $$i_{it} = \Gamma_1 s_{it-1} + \Gamma_2 q_{it-1} + \Gamma_3 g^y_{it-1} + \tilde{\tau}_t + \tilde{v}_{it} + \varepsilon_{it}$$

where $\Gamma_1, \Gamma_2, \Gamma_3$ are fixed parameters. Consistent with the theoretical analysis investment is determined by the lagged government spending variables. In addition we postulate that investments are also determined by past rate of economic growth (Garcia-Belenger and Santos, 2011). We use the same strategy to control for other unspecified factors using country-idiosyncratic time-varying functions ($\tilde{v}_{it}$) also specified as polynomial functions of time as in (27), as well as common-to-al-countries time effects ($\tilde{\tau}$).

To gain efficiency we estimate the investment and growth equations jointly using a Seemingly Unrelated (SUR) estimator. We thus compute the direct or productivity effect and the indirect or investment effect of PME and RME on economic growth.

[11] Similarly the Random Effects (RE) specification could also be tested if we allow for a random instead of deterministic intercept to the v_{it} function.

Further remarks about the empirical specification

The fact that we use lagged values for the two government spending variables is theoretically justified and also presents some advantages for the estimation by mitigating potential biases due to reverse causality. But of course if omitted variables are correlated with the lagged government expenditure variables the coefficient estimates may still be inconsistent. However, the fact that the TVC specification controls for time-varying omitted variables, implies that it may mitigate the potential inconsistencies of the estimated coefficients of interest.

Testing the predictions from the theoretical model

The hypotheses postulated by the theoretical model are valid if the coefficient of the share of *PME* in total expenditures, η_1 in (26), is positive and statistically significant and if the coefficient of the share of total government spending in GDP, η_2 in (26), is non positive. If these conditions are met then we can conclude that the effects of *PME* through total factor productivity is positive while the effect of *RME* is negative as predicted by the theoretical analysis. In addition, the theoretical model predicts that $0 < \eta_3 < 1$. These are the direct effects controlling for physical capital investments. Also, the theoretical analysis predicts that the rate of growth of physical capital represented by the investment/GDP ratio, is likely to be positively affected by *PME* due to their positive effect on productivity and negatively affected by *RME* due to the diversion of investment efforts caused by the fact that *RME* induce greater DUP. Thus, the theoretical analysis implies that $\Gamma_1 > 0$ and $\Gamma_2 \leq 0$ in (28). Therefore, using the estimated parameters η_1, η_2, η_3, Γ_1, and Γ_2 we can test the predictions of the theoretical model and compute the net growth effects of *PME* and *RME*.

We use an unbalanced 5-year panel from 1980 to 2009 for 29 developed and 66 developing countries. We choose to use 5-year averages for each country because the effect of the composition of government expenditures on economic growth is not likely to be instantaneous and we consider that five years is sufficient time to allow most of the effects of government spending to manifest themselves in patterns of growth.

3.2 Data

The lagged share of government expenditure on *PME*, is obtained from the Government Financial Statistics (GFS) complemented with national data sources. GFS data is widely used in the literature (Shelton 2007). *PME* include expenditures on health, education, housing, social protection, culture, environmental protection, and public order and safety. *RME* expenditures include all subsidies to firms (with the exception of R&D and environmental protection subsidies), agricultural subsidies, credit subsidies to firms and other non-social subsidies. Table A1 in Appendix II provides the data sources and definitions.

Table A2 shows the summary statistics of the variables used in the regressions. The median of the share of *PME* spending in the sample is 54.3% of total government spending with a standard deviation of 15.3. Table A3 presents composition of *PME* and *RME* spending as well as trends over time. About 82% of *PME* expenditure corresponds to social subsidies in the form of education, health care and social security. In general, there is a steady increase in *PME* spending over the sample period, mostly due to increases in social subsidies. Given the higher percentage of social spending in PME, we do not make much of a distinction between either. *RME* expenditures account for about 44% of government expenditures and have declined over time in most countries.

3.3 Results

3.3.1 Single Equation Estimators of growth

Table 1 presents the results for the various empirical methods considered in the previous section using the single equation specification for the rate of per capita GDP growth. Columns 2 and 3 in Table 1 show the estimates of the restricted versions of the model (26) using standard Two-Way Fixed (TWFE) and Two-Way Random effects (TWRE) (in column 1 we present the OLS estimates for comparison purposes). The robust standard errors of the coefficients are reported in brackets. [12] Columns 4 and 5 in Table 1 present the TVC-FE estimates as specified in Equation (26) and (27) using a second and third order approximations for the functions v_{it}, respectively.[13] The TVC-FE method imply estimating up to 4 additional coefficients for each country that should control for fixed country effects as well as for time-varying effects all of which are allowed to be different for each country.[14]

The various models provide remarkably similar qualitative estimates for the effects of s_{it-1} and q_{it-1} on the growth equation. All models show that lagged share of government expenditure on *PME* yields a positive and statistically significant coefficient at least at 5% level of significance. In addition, all estimates yield statistically insignificant coefficients for the effect of total government expenditure variable. The estimates for the effects of investment are positive and significant. These estimates suggest that a reallocation of government spending from *RME* to *PME* expenditures results in a faster rate of per capita GDP growth while the effect of total government expenditures is insignificant. It may be that the increase in total government coupled with a rise in taxes is what renders the effect of total government insignificant. To account for this, as a robustness check we also included the share of taxes over GDP as an additional control. Both total government and total taxes over GDP remained statistically insignificant. The finding that total government expenditures have non-positive effects on growth while the share of PME spending has a positive and significant effect on growth yields a negative and significant effect of RME on growth.

Specification tests

[12] Stock and Watson (2008) suggest that robust standard errors may be preferable to clustered standard errors under fixed-effects estimation when the number of countries is large and the number of observations per country is short as in our case.

[13] Most of the countries in the sample have 5 or less observations which limits the approximation of the v_{it} functions to a third order as a maximum; that is, we estimate 4 coefficients for each country to approximate the v_{it} function, a country-specific constant plus 3 coefficients associated with time up to the cubic level. For countries with 4, 3 and 2 observations we allow for second, first and a fixed country effect, respectively. There are a few countries that have 6 observations which may allow us to use a fourth order approximation for them. We provide the results with a 4th order approximations for these countries in tables B4 and B5 in the online appendix: http://www.arec.umd.edu/People/Faculty/Lopez_Ramon/OnlineAppendix.pdf.

[14] Table B4 in the Online Appendix shows the results obtained using TVC-RE method, which assumes that the constant terms in the v_{it} functions are random instead of deterministic.

We first test whether the residuals of the estimations are in fact time independent as is required for the TVC-FE to be a valid approach. Table 1 reports p-values of the test which shows that time trend variable for the estimation $\hat{\mu}_{it} = constant + \beta trnd$ is statistically insignificant. This is consistent with the assumption that the $\hat{\mu}_{it}$ error component is uncorrelated with time which suggests that the third order polynomial function of time used is a good approximation for the time-varying country-idiosyncratic effects. Next we test for the validity of the standard TWFE estimators by testing the null hypothesis $b_{1i} = b_{2i} = b_{3i} = 0$ for all *i*, using a maximum likelihood ratio test. As shown in Table 1, the restricted model is rejected by a broad margin meaning that the TVC-FE model should be preferred over standard TWFE model.

We also conducted further analysis on the time varying country specific effects. The estimated predicted value of the ν_{it} function is positive for 49 countries, which implies that the unobserved variables tend to improve per capita GDP growth. The predicted values of ν_{it} are time monotonic for 33 countries. For 23 countries the growth effect of the time-varying effects has just one turning point over time, while for 16 countries have two turning points (Table B1, online appendix).

3.3.2 TVC-FE-SUR approach: estimating the growth and investment equations jointly

The single equation estimation reported above yields a partial effect on growth because we are controlling for investment. The fact that the effect of investment on growth is positive and significant (under most estimates) means that it is possible that *RME* may increase investments and that this investment effect may dominate over the negative direct effect of RME on economic growth. Below we report the results of the joint estimation of the growth equation and investment equations. This serves a dual role: first it provides insights about the investment effects allowing us to compute the total net effects of *PME* and *RME* on growth considering both their direct or productivity impact and indirect effect via investment. Second, it serves as a robustness test to the estimates obtained using single-equation methods.

Table 2 reports the results of the *TVC-FE-SUR* estimation of the growth and investment equations. These results fully corroborate the finding for growth using the single equation approach just reported. In fact, the effects of the two government spending variables on the per capita GDP growth rate are practically identical to the effects obtained using single equation specification. Also, the effect of the share of *PME* on investment is positive and statistically significant but the effect of total government consumption expenditures is insignificant. These two results combined imply that the net effect of *PME* on investment is positive and significant while the effect of *RME* is negative and significant.

3.3.3 Potential dynamic effects: GMM approach

So far we have assumed that economic growth is not affected by inertia which could require using a dynamic panel approach. We thus use the Arellano-Bond two-step procedure "System" Generalized Method of Moments (GMM); results are shown in Table A4 of the appendix. We used both collapsed and un-collapsed instruments[15]. The GMM procedure mitigates potential reverse causality biases of the explanatory variable and accounts for inertia that may exist in the determination of GDP per capita growth. The lagged dependent variable is not statistically significant suggesting that the approaches reported in Tables 1 and 2 that ignore dynamic effects are correct.[16] The estimates for the share of PME expenditures are positive and significant at 1% while the effect of total government expenditures is not significant. Thus the GMM estimators are highly consistent with the single-equation and SUR estimates reported earlier.

3.3.4 Robustness to Parsimony and Country Heterogeneity

While the main results are robust to the methods of estimation the actual specifications used may be considered excessively parsimonious by failing to explicitly control for other variables that could affect the results. We address this issue by using a battery of robustness checks described below.

Added Controls Approach

[15] Collapsing the instruments imply creating one instrument for each variable and lag distance, rather than one instrument for each time period, variable, and lag distance (Roodman, 2006)

[16] The Hansen test indicates that the over-identifying restrictions are not rejected and thus instruments as a group are exogenous. The AR(2) test indicates there is no further serial correlation at all levels of significance for un-collapsed instruments and collapsed instruments.

Several studies have emphasized that governance and institutions (Rodrik et. al, 2004; Milesi-Ferretti et al, 2002), human capital and income distribution (Esteban and Ray, 2006; Alesina and Rodrik, 1994; Persson and Tabellini, 1994), and demographics and geography (Sachs et al., 1999), are potential important determinants of economic growth. We sequentially introduce one set of variables representing each of the determinants listed above in the TWFE and TWRE base models estimations. Table 3 shows how the estimated coefficients of share of PME expenditure on growth change. A set of added control variables raises the explanatory power of the estimation if the adjusted R-squared increases relative to the base level. Adding variables representing demography increase the explanatory power of the TWFE estimates with respect to the basic model. For all sets of controls, the explanatory power of the TWRE estimates increase. The sign and significance of the effects of PME are unaffected no matter what set of variables are included. Moreover, the lack of significance of the total government consumption expenditures on growth (not reported in the Table) also remains.

Country Heterogeneity

Despite that the use of TVC-FE estimators appears to control well for time-varying and fixed country heterogeneity we conducted a simple test to confirm this. We ranked all the countries in the sample according to average GDP per capita over the sample period. We then dropped the top and bottom countries, and re-estimated the coefficients. We started by dropping one country at each end and then two countries at each end and so forth until we dropped 30 countries at each end ending with a "homogenous" sample of just 23 middle income countries. The idea is to verify whether the coefficients sign and significance change as the degree of country heterogeneity gradually decreases. The coefficient of the s_{it-1} variable remains positive and statistically significant throughout the full process. Similarly, the coefficient of the q_{it-1} variable remains statistically insignificant in almost all cases. In addition, the estimates obtained using only the top half of the sample and developing countries only also remain qualitatively identical.[17]

3.3.5 Quantitative importance of the effects of PME and RME on growth

Increasing the share of *PME* in total government spending has two effects on the rate of economic growth, a direct one shown in column 3 of Table 2 which reflects mostly the effect of PME on productivity growth for a given level of investment and an indirect one through its effect on investment. According to the estimates using the two-equation SUR reported in the last two columns of Table 2, the direct or productivity effect of increasing the share of PME in total government spending by one standard deviation of the sample (an increase from the observed average of 54% of total spending to 69%) increases the annual per capita GDP growth rate by 0.83 percentage points when evaluated at the mean sample values. Additionally, the above increase of PME induces a rise in the rate of investment of about 0.67 percentage points which in turn is translated into a further increase of the per capita GDP growth of the order of 0.05 percentage points. Thus, the total effect of a one standard deviation increase of PME considering its productivity and investment effects is to expand the rate of per capita GDP growth by about 0.9 percentage points. The total effect is statistically significant at 1% level of significance.

To assess the importance of this effect consider that the average annual per capita GDP growth rate for the whole sample is 1.9%. Thus, increasing the participation of PME in total government spending by one standard deviation would raise the annual rate of per capita GDP growth from 1.9% to 2.8%. The 0.9 percentage point increase on the growth rate that the rise of PME induces is equivalent to almost one third of the standard deviation of per capita GDP growth over the sample.

The fact that the effects of total government spending on both per capita GDP growth and investment rate are insignificant implies that the effects of RME on growth and investment are practically

[17] Further sensitivity tests are available in an Online Appendix: We omitted from the sample observations for the top and bottom 5% values of share of PME expenditure, and the estimates were still significant for all estimating models. We also tested for country dominance by dropping one country at a time. The signs and significance for the share of PME spending remain positive and significant.

equal to the effect of PME but with opposite sign. That is, *RME* expenditures exert a negative and significant effect on economic growth. Raising RME by 15 percentage points induces the annual per capita GDP growth rate to fall by about 0.9 percentage points. Thus, the results show that while increasing social subsidies and public goods promote faster economic growth, spending on non-social subsidies is toxic for economic growth.

4. Conclusion

This paper has shown that switching fiscal expenditures from non-social subsidies to social subsidies and public goods, keeping total government consumption spending constant, promotes faster economic growth. Given the existing composition of government spending, increasing total government spending does not promote growth or investment. Increased total government spending entails increasing both social and public goods as well as non-social subsidies by the same proportion. This means that the positive growth effects of social and public goods spending are offset by the toxic effect of non-social government spending. These findings, which are fully consistent with the predictions derived from the theoretical model developed in this paper, are important because most countries spend a large fraction of their fiscal revenues in non-social subsidies or private goods; the average country in our sample spends more than 40% of the total government revenues on a variety of non-social subsidies.

The basic results passed broad and rigorous sensitivity tests with great consistency. Moreover, the analysis suggests that the quantitative effects are large. The average country may increase its growth rate by almost 50% if it raises its share of social and public good expenditures by about 30%. This is a large effect that could, after a few decades, make the difference between development and underdevelopment.

Should this large impact be astonishing? Given that governments spend one third of national income or more, a misallocation of part of such expenditures can be expected to have large consequences. Wasting 10% or more of the total output produced by the economy is a serious issue. Using such an enormous amount of resources in subsidies that are at best ineffective and at worst toxic for growth instead of allocating them to enhance the potential for creativity of individuals, in health care and better infrastructure is likely to be highly deleterious for economic growth.

The findings in this paper provide an encouraging message. Economic crises which have often given governments an opportunity to correct fiscal spending misallocation built up during “normal” times may have a positive dividend for countries that use the opportunity to restructure fiscal spending towards social goods that are more consistent with a faster rate of economic growth over the medium run. This is consistent with casual evidence that some countries often emerge from deep crises able to grow faster than in periods before them.

TABLE 1: GOVERNMENT SPENDING AND PER CAPITA GDP GROWTH – SINGLE EQUATION ESTIMATORS

	OLS	Two-Way Fixed Country Effects (TWFE)	Two-Way Random Country Effects (TWRE)	Variable Country Effects (TVC-FE)	Variable Country Effects (TVC-FE)
Share of government PME in total government Expenditures (lagged)	0.048***	0.084***	0.056***	0.115**	0.112**
	[0.009]	[0.019]	[0.011]	[0.046]	[0.052]
Total government consumption expenditures over GDP (lagged)	-0.04	0.041	-0.038	-0.115	-0.076
	[0.032]	[0.105]	[0.041]	[0.211]	[0.193]
Total investment over GDP	0.067***	0.083**	0.069***	0.186***	0.134*
	[0.020]	[0.033]	[0.023]	[0.070]	[0.079]
Log of initial per capita GDP	0.004		0.005		
	[0.017]		[0.021]		
Federal dummy	-0.008**		-0.008*		
	[0.003]		[0.004]		
Country dummies x time trend	No	No	No	Yes	Yes
Country dummies x (time trend)^2	No	No	No	Yes	Yes
Country dummies x (time trend)^3	No	No	No	No	Yes
Adjusted R^2	0.25	0.41	0.25	0.47	0.53
Number of observations	370	370	370	358	358
Number of countries	95	95	95	83	83
Specification Tests					
Test for the time independence of the residuals: p-values				0.9977	0.1783
Correlation coefficient between the residuals and time trend				-0.0002	0.0713
Test for fixed country effect model Ho: $b_{1i} = b_{2i} = b_{3i} = 0,$ *for all i* Log Likelihood Ratio Test				295***	469***

Significant at *10%; ** 5%; *** 1%, Unit of observation: 5 year averages. Robust standard errors in brackets; All estimates include time period dummies common to all countries. OLS and RE estimates include region dummies for Latin America, East Asia, and Developed. TVC estimates include 212 and 254 country specific coefficients in column 4 and 5, respectively to capture the ν_{it} effects.

TABLE 2: GOVERNMENT SPENDING AND PER CAPITA GDP GROWTH – SYSTEM ESTIMATORS

	TVC-FE-SUR with 2nd order approximation of v_{it}		TVC-FE-SUR with 3rd order approximation of v_{it}	
Dependent Variable	GDP per Capita Growth	Investment over GDP	GDP per Capita Growth	Investment over GDP
Share of government PME in total government Expenditures (lagged)	0.119*** [0.025]	0.148*** [0.034]	0.112*** [0.025]	0.095*** [0.035]
Total government consumption expenditures over GDP (lagged)	-0.09 [0.078]	0.027 [0.106]	-0.056 [0.068]	0.084 [0.096]
Total investment over GDP	0.124*** [0.038]		0.084** [0.037]	
Real GDP per capita growth (lagged)		0.296*** [0.054]		0.200*** [0.049]
Country dummies x time trend	Yes	Yes	Yes	Yes
Country dummies x (time trend)^2	Yes	Yes	Yes	Yes
Country dummies x (time trend)^3	No	No	Yes	Yes
Number of observations	357	357	357	357
Number of countries	83	83	83	83
Specification Tests				
Test for the time independence of the residuals: p-values	1.0000		1.0000	
Correlation coefficient between the residuals and time trend	0.0000		0.0000	
Test for fixed country effect model Ho: $b_{1i} = b_{2i} = b_{3i} = 0,$ *for all i* Log Likelihood Ratio Test	896***		1206***	

Significant at *10%; ** 5%; *** 1%, Unit of observation: 5 year averages. All estimates include time period dummies common to all countries. TVC estimates include 212 and 254 country specific coefficients for the first 2 columns and last 2 columns respectively, to capture the v_{it} effects.

TABLE 3: ADDED CONTROLS APPROACH (ACA)

	Two Way Fixed Effects (TWFE)		Two Way Random Effects (TWRE)	
Specification	Coef. (std. err)	Adjusted R^2	Coef. (std. err)	Adjusted R^2
Base	0.084*** [0.019]	0.41	0.056*** [0.011]	0.25
Added Control Sets				
Governance and Institutions Presidential System Dummy Quality of Government Corruption Polity Index lagged Political Competition lagged Total Tax over GDP	0.065*** [0.022]	0.39	0.044*** [0.011]	0.26
Stability Years of Democratic Stability lagged Log of (1+black market premium) – 1980-89 Average Average no. revolutions (1980-1995)	0.085*** [0.019]	0.40	0.053*** [0.011]	0.26
Human Capital and Income Distribution Gini of Education Initial Income Gini Initial Primary School Completion Rate Life Expectancy Years of Schooling lagged	0.083*** [0.021]	0.34	0.053*** [0.012]	0.28
Demographics and Geography Labor force size Population Density % Land in Tropical Areas	0.082*** [0.021]	0.43	0.057*** [0.012]	0.26
Openness Trade over GDP Primary export share of total exports in 1970	0.058*** [0.020]	0.38	0.035*** [0.011]	0.27

Significant at *10%; ** 5%; *** 1%, Unit of observation: 5 year averages. All estimates include time period dummies common to all countries. Robust standard errors in brackets.

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APPENDIX I

Financial constraints and investment in human capital

The worker's utility in period 0 is $u(c_0)$, where c_0 is the level of consumption, with budget constraint $c_0 = w_0 + s_0 + B - h$, where w_0 is the market wage rate for unskilled workers in period 0, for which the level of borrowing is $B \geq 0$ for unconstrained workers and $B = 0$ for constrained ones. In period 1, the worker earns an augmented wage level caused by investing in human capital in the first period and repays the amount borrowed. The discounted utility in period 1 is $u(c_1)/(1+\rho)$ (ρ is time discount rate) and the budget constraint in period 1 is $c_1 = (1+\psi(h))w - (1+r^f)B$. The worker maximizes the present discounted value of her utility over the two periods by choosing the optimal levels of B and h subject to the budget constraints.

Assuming an interior solution the first order conditions for the financially *unconstrained* workers (i.e., those with $s_0 \geq \bar{s}$):

(A1) $$u'(c_0) - ((1+r^f)/(1+\rho))u'(c_1) = 0,$$

(A2) $$-u'(c_0) + (\psi'(h)w_0/(1+\rho))u'(c_1) = 0.$$

Condition (A1) says that unconstrained workers will choose their level of borrowing so that the marginal net present utility value of B is zero and condition (A2) says that the level of investment, h, is chosen at a level that makes the marginal net present utility value of human capital equal to zero. Combining (A1) and (A2) yields,

(A3) $$\psi'(h^u)w_0 = 1 + r^f.$$

Financially-unconstrained workers choose h^u by equalizing the marginal value product of human capital to the marginal cost of borrowing. From (A3) it follows that $\partial h^u / \partial s_0 = 0$, human capital investment by an unconstrained worker is unaffected by her initial wealth level.

Financially-constrained workers are affected by a binding borrowing restriction which implies that the marginal net present value of the utility of B is positive. That is, they could increase the present value of their utility if they could borrow, which means that

$$u'(c_0) - ((1+r^f)/(1+\rho))u'(c_1) > 0. \quad \text{(A4)}$$

However, equation (A2) still holds for financially-constrained workers as long as their human capital investment is positive, i.e. $h^c > 0$. In fact, the level of h^c is given by solving the equality in equation (A2). The marginal cost of investing in h for financially-constrained workers is given by their own internal marginal cost of saving, equal to $u'(c_0)(1+\rho)/u'(c_1)$ and not by the market cost of capital $(1+r^f)$ as in the case of financially-unconstrained workers. As shown by (A4) the internal marginal cost of money, $u'(c_0)(1+\rho)/u'(c_1)$, is higher than the market cost of capital $(1+r^f)$. Thus, using (A2) and (A4) it follows that,

$$\psi'(h^c)w_0 > 1 + r^f. \quad \text{(A5)}$$

This implies that $\psi'(h^c) > \psi'(h^u)$, which is the key distortion caused by credit rationing. Strict concavity of $\psi(h)$ implies that for identical individuals $h^u > h^c$.

It can be easily seen that the internal marginal cost of money, $u'(c_0)(1+\rho)/u'(c_1)$, is decreasing in the level of wealth, s_0. Given strict concavity of $\psi(h)$, this in turn implies that $\partial h^c / \partial s_0 > 0$. Hence, human capital investment by financially-constrained workers is increasing in their level of initial wealth.

APPENDIX II

TABLE A1: DEFINITION AND SOURCES OF VARIABLES

Variable	Description	Years Available	Source
GDP growth (2000 US$)	Real GDP per Capita growth (Constant US$ 2000)	1980 – 2009	World Development Indicators, World Bank (WDI)
Share of Government Expenditure on PME	Include: (1) Subsidies to Households: Education, Health, Social security and welfare, Housing and community amenities (2) Environmental Protection, Research and development (3) "Pure" Public Goods: Transport, Communication, Public order and safety (4) Other public goods - Religion and culture	1980 – 2009	Government Financial Statistics (IMF), Asian Development Bank, Country data
Share of Government Consumption over GDP		1980 – 2009	Penn World Tables (2011)
Share of Investment over GDP		1980 – 2009	Penn World Tables (2011)
Total Tax over GDP		1980 – 2009	Government Financial Statistics (IMF), Asian Development Bank
Years of Schooling	Average Years of Schooling of Population over 15	1980-2009 (5 year interval)	Barro and Lee (2010), updated http://www.barrolee.com /data/dataexp.htm
Trade Openness	Log of Total Trade of GDP	1980-2009	WDI
Population Density		1980-2009	WDI
Labor Force Size	Population between 15 and 64	1980-2009	WDI
Income Gini		1980-2009	WDI
Education Gini	Education Gini for total population age 15 and over	1980-2000	Thomas et. al (2001)
Primary School Completion Rate		1980-2009	WDI
Life Expectancy		1980-2009	WDI
Presidential Dummy	1 if system is considered presidential.	1980-2009	Database of Political Institutions (DPI)
Corruption Perception Index (CPI)	10-point scale where higher values indicate less corruption.	1995-2009 average	Transparency International www.transparency.org
Quality of Government Index	mean value of the ICRG governance variables "Corruption", "Law and Order" and "Bureaucracy Quality", scaled 0-1	1980-2009	International Country Risk Guide – The PRS Group http://www.icrgonline.com
Index of Democracy (Polity 2)	Score that indicates how democratic a country ranging between -10 and 10	1980-2009	Polity IV http://www.systemicpeace.org/polity/polity4.htm
Years of Democratic Stability	Square root of Durability of Polity if Polity 2>0	1980-2009	From Polity IV and updated to 2009 http://www.systemicpeace.org/polity/polity4.htm
Political Competition Index	10-point scale where higher values indicate more competition.	1980-2009	From Polity IV and updated to 2009

		http://www.systemicpeace.org/polity/polity4.htm
Average number of revolutions	1980-1995 average	Dollar and Kraay 2002
Logarithm of (1+black market premium)	1980-89 Average	Dollar and Kraay 2002
Primary export share of total exports in 1970		Dollar and Kraay 2002
% Land in Tropics		Sachs, Gallup, and Mellinger (1999)

Country List
Developing: Albania, Algeria, Argentina, Bangladesh, Bolivia, Botswana, Brazil, Bulgaria, Burundi, Cameroon, Chile, Colombia, Costa Rica, Croatia, Ecuador, Egypt Arab Rep., Gambia, Ghana, Honduras, Hungary, India, Indonesia, Iran Islamic Rep, Jamaica, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyz Republic, Latvia, Lesotho, Liberia, Lithuania, Malaysia, Mauritius, Mongolia, Morocco, Namibia, Nepal, Nicaragua, Niger, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russia, Rwanda, Slovak Republic, South Africa, Sri Lanka, Syrian Arab Republic, Tajikistan, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, Uruguay, Venezuela, Yemen, Zambia, Zimbabwe

Developed: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong-China, Ireland, Israel, Italy, Korea Rep., Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States

TABLE A2: SUMMARY STATISTICS, 5 YEAR AVERAGES, 1980-2009

Variable	Median	Std. Dev	Min	Max
Growth of Per Capita GDP	1.9	2.6	-7.6	9.8
Share of Government PME in Total Government Expenditures (lagged)	54.3	15.3	14.1	84.1
Share of Total Government Consumption over GDP (lagged)	9.3	4.8	2.9	36.9
Share of Investment over GDP	21.9	7.6	6.3	59.6
Tax over GDP	17.7	8.0	1.0	56.8
Years of Schooling	7.4	2.7	0.5	12.7
% Land In Tropics	6.8	41.1	0.0	100.0
Index of Democracy (Polity 2)	8	6.7	-9.0	10.0
Political Competition Index	9	3.4	0.5	10.0
Years of Democratic Stability	2.8	3.5	0.0	13.9
Population aged between 15 and 64	6,800,000	68,600,000	360,209	710,000,000
Initial Income Gini	36.1	10.9	19.4	74.3
Population Density	66.0	727.4	1.5	6615.6
Presidential Dummy			0	1
Corruption Perception Index (CPI)	4.6	2.4	1.7	9.6
Quality of Government Index	0.6	0.2	0.1	1
Average number of revolutions	0.1	0.3	0	2
Logarithm of (1+black market premium)	0.1	0.7	-0.01	6.9
Education Gini	0.4	0.2	0.1	0.9
Primary School Completion Rate	92.6	18.3	13.6	109.3
Life Expectancy	71.8	8.6	39.8	82.2
Primary export share of total exports in 1970	80	31.4	1	100
Total Trade over GDP	66.8	47.7	13.8	423.6

TABLE A3: COMPOSITION OF GOVERNMENT EXPENDITURES (% OF TOTAL SPENDING)

	PME expenditures		RME expenditures
	Social Subsidies	Other PME	Subsidies to Firms
Sample Average	46	10	44
Period Averages			
1980-1989	42	9	50
1990-1999	45	10	45
2000-2009	49	10	40
Top Third (based on PME)	62	10	28
Middle Third	47	10	43
Bottom Third	28	10	63
PME: Top 3 countries			
Slovenia	69	11	20
New Zealand	70	9	21
Croatia	65	13	22
PME: Bottom 3 countries			
Syrian Arab Republic	17	5	77
South Africa	18	9	73
Peru	22	5	72

Social subsidies include Education, Health, Social Security and welfare, Public Housing and social transfers. Other PME include: Environmental Protection, Research and Development, Public Order and Safety, Religion and Culture, Transport and Communication. Direct subsidies to firms include Economic Affairs (excluding Transport and Communication). Administration expenditures are included in each category.

TABLE A4: GOVERNMENT SPENDING AND PER CAPITA GDP GROWTH – DYNAMIC SPECIFICATION

	GMM Un-collapsed Instruments	GMM Collapsed Instruments
Share of government PME in total government Expenditures (lagged)	0.059*** [0.011]	0.056*** [0.011]
Total government consumption expenditures over GDP (lagged)	-0.028 [0.037]	-0.018 [0.040]
Total investment over GDP	0.070*** [0.021]	0.066*** [0.020]
Log of Initial per capita GDP	0.011 [0.018]	0.013 [0.018]
Federal Dummy	-0.008** [0.003]	-0.008** [0.003]
Lagged GDP per Capita Growth	0.043 [0.060]	0.077 [0.065]
Hansen Test (P-value)	0.207	0.210
Arellano-Bond test for AR(2) in first differences	0.206	0.248
Number of Observations	369	369
Number of Countries	95	95

Significant at *10%; ** 5%; *** 1%, Unit of observation: 5 year averages. Robust standard errors in brackets; All estimates include time period dummies common to all countries.