Effect of the Structure of Rural Public Expenditures on Agricultural Growth and Rural Poverty in Latin America

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The Rural Development Unit commissioned this study with the purpose of examining the relationship between the structure and composition of rural public expenditures and agricultural growth. This empirical analysis was one of the first to use a newly created FAO database on disaggregated rural expenditures for Latin America and the Caribbean.

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Executive Summary

The provision of public goods and the related issue of ameliorating the impact of market failures are the classical justifications for government intervention in the economy. In reality governments do not do a good job in fulfilling these roles. (1) Governments intervene in markets that cannot be even remotely considered affected by failure or imperfections. (2) They spend a large share of the financial, human and institutional public resources on private goods (subsidies), not on public goods.

The high degree of attention that the economics literature has given to issue (1), contrasts with the relatively little attention that issue (2) has received from both academic and policy economists. This despite the potentially large efficiency and equity losses arising from misguided allocations of public expenditures. This paper empirically documents the size of (2) in the rural sector and investigates its consequences for rural development (agricultural growth, patterns of growth and rural poverty) for ten Latin American countries over 1985-2000.

This paper has provided econometric evidence suggesting that the structure of public expenditures is an important factor of economic development. The quantitative importance of this factor appears to be greater than the traditional factors on which the development literature focuses. In particular, expanding total public expenditures in rural areas while maintaining the existing public expenditure composition prevailing in the countries does little to promote agricultural income and reduce rural poverty. The key issue is not so much how much money is spent on the sector but rather how are public monies being spent. Spending a significant share of government resources in non-social subsidies causes not only less agricultural income but it also induces an excessive reliance of agricultural growth on land expansion, thus exacerbating the negative effects of agriculture on the remaining forests and reduces the income of the rural poor.

Over the last decade and a half there has been some restructuring of public expenditures in rural areas toward public goods and away from subsidies. But still by the year 2000 about 45% of the rural public expenditures in the countries considered in the analysis were on average spent in non-social subsidies. We have shown that such a high share of non-social subsidies impose a dramatic cost for economic efficiency, social equity and the environment in rural areas. Inducing governments to deepen public expenditure reform in favor of public goods and toward reducing subsidies to the wealthy should a matter be of high priority for international organizations concerned on genuine economic and social development.

I. Introduction

The provision of public goods and the related issue of ameliorating the impact of market failures are the classical justifications for government intervention in the economy. In reality governments do not do a good job in fulfilling these roles. (1) Governments intervene in markets that cannot be even remotely considered affected by failure or imperfections. (2) They spend a large share of the financial, human and institutional public resources on private goods (subsidies), not on public goods.

Misguided public policies that interfere with essentially efficient markets have been for a long time a central concern to economists. The literature documenting and measuring the efficiency costs of market interferences for many commodities and many countries around the world is indeed massive[1]. On the basis of these studies international organizations as well as several other economic institutions have forcefully argued for the removal of government interference with markets operation for several decades[2].

The high degree of attention that the economics literature has given to issue (1), contrasts with the relatively little attention that issue (2) has received from both academic and policy economists. This despite the potentially large efficiency and equity losses arising from misguided allocations of public expenditures. This paper empirically documents the size of (2) in the rural sector and investigates its consequences for rural development (agricultural growth, patterns of growth and rural poverty) for ten Latin American countries over 1985-2000.

The fact that raising government revenues is costly and that the availability of government financial, human and institutional resources is usually tight, implies that deviating part of these resources to private goods crowds out the supply of public goods. Spending large volumes of public resources in private goods means that governments are over taxing the private sector, or under supplying public goods or both. Whatever the means used by the public sector to finance spending in private goods, it implies efficiency losses associated with the inevitable distortions caused by raising more taxes than needed or by under providing public goods.

The under provision of public goods may have serious consequences for the productivity of private investments as public goods are important complementary assets with private capital. A low supply of public goods means scarcity of human capital[3], under investment in research and development (R&D), less infrastructure, insufficient environmental protection, etc. (World Bank,

[1]The book by Krueger, Schiff and Valdés, 1991, constitutes a distinguished example of the great efforts spent by the profession in documenting and criticizing government interference with otherwise efficient markets.

[2]In this respect agriculture has been at the center stage of the concerns of the literature. It has been shown that the inefficiencies caused by market interventions that distort commodity prices, trade patterns and exchange rates, have systematically discriminated against the sector in most developing countries causing large efficiency losses.

[3]Education and health care though not pure public goods have characteristics of public goods. Their positive externalities are well documented in the literature. Moreover, the poor are generally unable to finance even highly profitable investments in human capital, so if governments do not intervene in some form such investments are often not realized.

2000). All these are important assets that contribute to increase the productivity of private investments. Hence their scarcity is likely to constitute an obstacle to economic expansion.

The biased structure of public expenditure allocation may have important equity implications as well. For reasons to be discussed below, government expenditures in (non-social) subsidies and other private goods tend to be directed to the wealthier segments of society to the detriment of the poor. Over taxation that spending in private goods may cause, also has negative equity consequences. It is well known that in most developing countries taxes are not progressive, especially because of its great reliance on indirect taxation[4]. So the additional taxes needed to finance subsidies to the wealthy are in a significant part paid by the poor. In addition, the under supply of public goods affect the welfare of the poor much more than the welfare of the wealthy.

The only significant assets of the poor are their labor force and, for the rural poor, their natural resources. The income of the poor is thus extremely dependent on their ability to enhance their human capital and to protect the natural assets, both important public or semipublic goods.

There have been many empirical studies that have measured the impact of specific public goods such as R&D, rural roads and other infrastructure on agriculture as well as on other sectors. What seems to be missing, however, is a broader approach that may permit evaluating the impact of public goods vis-à-vis other types of government expenditures on efficiency and social equity. Without such a comparison the conceptual and policy implications of findings pointing to the high pay-offs of certain specific public expenditures is in part obscured.

At the policy level, there seems to be a degree of consensus regarding the importance of an adequate provision of public goods for economic expansion and social equity. However, the same lack of a clear conceptual framework and the general weakness of empirical studies due in part to such a conceptual deficit also mean a certain weakness in the policy recommendations. It is clearly a rather empty policy statement to advise governments to increase expenditures in education, health, roads, etc. without pinpointing the source of the low expenditures in such goods in the first place and without indicating what expenditures to cut (or what taxes to raise) in the second place[5]. In any case, the concerns shown by the national and international institutions about issue (2) appears to be puny compared to the overwhelming focus in reducing government market interventions. Below we provide evidence suggesting that such lack of balance is not justified.

Apart from affecting the rate of agricultural growth, the heavy emphasis of governments on subsidizing the wealthy (and thus under supplying public goods) is likely to affect the patterns of agricultural growth. In particular, a hypothesis that we test here is that (non-social) subsidies tend to make agricultural growth much more dependent on land expansion than on intensification. In many countries, especially in tropical ones, agricultural growth is much more linked to area ex-

[4] "Given the low importance of personal income taxes and property taxes in Latin American countries, the direct distributive leverage of the tax system in most countries should be expected to be very small or even negative" (p. 254), The World Bank, 2004. According to the World Bank while in developed countries income taxes and property taxes constitute more than 10.5% of GDP, in Latin America they comprise only 3.7% of GDP. Another study by Chu, Davoodi and Gupta (2000) corroborates this finding.

[5] And at the same time applauding or guarding accomplice silence about subsidies justified, for example, as mechanisms to "create jobs" or to promote "productive investment".

pansion than to intensification[6]. This pattern of growth is particularly deleterious for forests and is often responsible for the large deforestation impacts attributed to agriculture by many studies of deforestation (López and Galinato, 2004). When governments are more prone to provide non-social subsidies it has been shown that expanding farm size beyond optimal levels is a rational response by farmers as a way of signaling their disposition to offer bribes in exchange for subsidies (Bulte et.al., 2004). Land expansion is thus a vehicle to promote subsidies and knowing that governments are prone to subsidize induce farmers to expand land area. That is, land expansion and subsidies are cause and effect of each other. Without claiming to derive causal links, we empirically test for the existence of a positive correlation between subsidies and land expansion.

The objective of this paper is to shed light on the following questions: What is the effect of increasing rural public expenditures on agricultural income and rural poverty when such expenditures contain a high share of expenditures on private goods? What would be the impact of changing the structure of rural public expenditures (e.g., reducing expenditures on private goods and concomitantly increasing public good expenditures while keeping total expenditures constant) on agricultural income and poverty? To what extent subsidies promote greater reliance of agriculture on area expansion? How does the impact of such policies compare with the effect of traditional policy prescriptions associated with reducing certain market interventions?

A brief conceptual framework and hypotheses are first presented. Next we review existing empirical evidence suggesting that the issues raised are likely to be of great policy relevance. Then we present a quantitative description of the evolution of non-agriculture factors likely to affect the performance of agriculture over the period 1985-2000 for ten Latin American countries. The countries considered to have consistent rural public expenditure series with a degree of detail sufficient to allow us to aggregate them into expenditures in public goods and in private goods. We show that for the countries considered to have a large share of total public expenditures in the rural sector, it is mostly spent on private goods. Next we discuss the econometric model, and in the following section the econometric results are presented. We conclude with an evaluation of the empirical findings as a contribution to the development of a policy agenda that is broader than the conventional one.

II. Conceptual Issues

The central focus of this paper is to study how factors external to agriculture impinge upon its performance and how such factors have affected rural poverty. We emphasize one mechanism that having potentially a large policy connotation has, in our view, been insufficiently emphasized and analyzed by the literature: The way in which the public sector spends tax revenues in the rural sector. We do not intend to evaluate whether or not governments spend enough in agriculture. This is an old debate[7]. We instead are interested on the *structure* or composition of gov-

[6] Graham *et al*. (1987), for example, concluded that area expansion rather than yield increases accounts for practically all of the growth of Brazilian agriculture between 1950 and 1980. Similar findings are documented by López (1987) and (1998) for west Africa.

[7] In fact, if government expenditures have little efficacy as a consequence of its highly unbalanced structure toward subsidies, this debate is quite misguided. More rural public spending may simply mean greater support to certain groups within the rural sector, but not necessarily greater support to agriculture and other rural industries.

ernment expenditures in rural areas (including of course in agriculture). But we are not interested either on analyzing the impact of particular government expenditure items. The literature is full of studies that do this. Measuring the impact of road expenditures, R&D investments, credit subsidies, farm extension, rural education, expenditures in rural health, are some of the favorites in the literature. This paper makes a contribution by showing that certain specific items may have high pay-offs while others do not. These findings may have relevance by emphasizing the need to improve the cost-benefit evaluation of particular public expenditures and investments. But it is difficult to obtain more general policy implications from them.

We instead use a broader taxonomy of public expenditures that is conceptually and policy grounded. The classification of public expenditures into *public* (or semi public) goods and *private* goods arises from the conceptual view that governments' prime responsibility is to use taxpayers money in supplying public goods, including goods and services that are under supplied as a consequence of missing markets or of market imperfections. To be sure, there are many grey areas. Sometimes expenditures on private goods are difficult to distinguish from expenditures in public goods. But by and large these are the exceptions; in practice more often than not the separation is quite sharp.

Political motivations and socio-economic consequences of public expenditures. The source and political motivation of the government's decision to invest in public or private goods is fundamentally different and public/private good choices have important socio-economic consequences. By definition the benefits of public or semi-public goods tend to disperse much more among the population than those of private goods. Thus, political lobby groups agitate for more private goods that wholly benefit their particular constituency group than they do for public goods of which the lobby group shares only a fraction of the benefits. The struggle by lobby groups to elicit subsidies from the government is often their prime motivation. It is well known that most successful lobbies are typically small groups with a clear common interest and objective (Olson, 1965). In addition, and most importantly, successful lobby groups almost always have enough financial means to bribe and to pay political campaign contributions to politicians, or have enough social status to be able to affect public opinion through a variety of means[8].

The above requirements for constituting a successful lobby group are often satisfied by economic elites and rarely by the poor. The implication is by now a stylized fact: government expenditures in subsidies and other private goods go almost always to the wealthy, only very rarely to the poor[9]. This is in sharp contrast with expenditures in public goods, which generally produce benefits that tend to disperse across all groups in society, poor and non-poor. The social equity effects of the composition of public expenditures are obvious. The greater the share of government expenditures in private goods the worse, ceteris paribus, is income distribution and poverty. Because the structure of public expenditures tends to be more biased towards private goods when the economic power of the elites is in the first place already greater, such biased composition of public expenditures is both cause and effect of poverty and social inequity.

[8] See Lopez (2004) for a detailed analysis of this issue. Deacon (2002), among others have, empirically shown that less democratic government (and in general those that give less space to the civil society to participate in decisions and are, therefore, more susceptible to lobby pressures from the wealthy) tend to provide a lower share of public expenditures in public goods and more emphasis is placed on non-social subsidies.

[9] For an empirical illustration of this phenomenon see Calmon (2004) with dramatic evidence for Brazil.

The structure of public expenditures and economic efficiency. The public/private good dichotomy is grounded on another factor which has to do more directly with economic efficiency than with equity. Investment in public goods provides factors of production that are almost by definition rarely supplied by the private sector. For this reason one can reasonably expect that such investment will fill a vacuum that is not fulfilled by the private sector. As a consequence, a complementary relationship between private investments and public goods is likely to arise. Government expenditures in private goods (subsidies), by contrast, often finance assets that can equally be financed directly by private entrepreneurs. Even more importantly, as argued above these government subsidies go to the wealthy, those that face generally no constraints to invest at optimal levels (that are likely to face no liquidity constraints or other types of market imperfections). As shown below, the effect of these subsidies is almost always detrimental for economic efficiency and, far from contributing to promote private investment, they tend to crowd it out and to increase the consumption of the wealthy instead[10].

Thus we have another important contrast that justifies the public/private goods dichotomy. While increasing public goods is likely to promote economic growth directly (as factors of production) and indirectly (through its positive effect on private investment), increasing subsidies is more often than not deleterious for growth and private investment.

Crowding-out and agricultural performance. Government provision of private goods or subsidies causes three forms of crowding-out with negative efficiency and equity effects:

(i) Subsidies crowd out the supply of public goods through the government *budget, institutional and human constraints*. This first crowding-out is obvious; the government's efforts to provide subsidies compete with the provision of public goods, not only for government's financial resources but also for other public resources that also tend to be scarce. The administration of subsidy programs often absorbs a large share of the limited supply of the government's human capital. Scarce institutional capital is also preferentially allocated to such programs. This means that subsidies directly crowd-out financial and non-financial government efforts to provide public goods[11]. The crowding out of public good expenditures within the government's resource budget can have large negative effects on social welfare. Governments forego investments in public goods that according to many studies have extremely large rates of return. The survey by Alston et.al.(2000), for example, reviews hundreds of studies around the world estimating rates of return to agriculture R&D revealing extremely high and non-declining rates. Psacharopolous's (1994) survey does the same for studies measuring returns to education over many countries, also showing very high rates. Similarly several studies at IFPRI by Fan and his associates (2000) have found unusually high returns to a variety of public infrastructure in agriculture in India and China. The World Bank (2000) has gathered evidence pointing to also very high rates of return to

[10]Subsidies may, however, be directed in some cases to mitigate market imperfections and externalities that otherwise may prevent even wealthy entrepreneurs from optimally invest. The evidence available, however, seems to indicate that subsidies that can be justified in this way are rarely implemented.

[11]To be sure, there exists the option of increasing taxes so that at least the financial resources for public good provision at adequate levels may still be available. But raising taxes is costly in terms of economic efficiency and also entails political costs to the government. Moreover, more tax revenues may allow having the needed human and institutional capital required to administer the provision of public goods only in the long run.

investments in certain investment in protecting the environment. Thus, on the basis of this rather massive evidence one may presume that governments under invest in public goods (the persistence of such unusually large rates of return can only be explained by insufficient investment) and that such under investment is likely to have large negative effects on welfare. This conclusion is reinforced by further empirical evidence showing that subsidies have low or even negative economic rates of return and that they crowd out private investment. We turn to these issues next.

(ii) Subsidies may *directly* crowd out private investments. Consider what is often regarded as a "desirable" subsidy; the government offers to pay a portion of the costs of a particular investment[12]. Assume further the best possible circumstance in terms of the allocation of the subsidy. The subsidy is of course rationed as the funds are obviously less than the demand, but their allocation among producers is transparent, not subject to corruption. Consider an investor that is able to extract a profitable return out of an investment (even in the absence of the subsidy) that potentially may qualify for the subsidy. Suppose that in that year there was a large demand for the subsidy and that the investor was not lucky enough to get the subsidy. The producer may go ahead with the investment (and never get the subsidy) anyway since it is a profitable one. Alternatively, she/he may opt to postpone the investment and try again next year in the hope of then getting the subsidy. If the expected value of the subsidy is sufficiently large to compensate the foregone profits in one year the producer may decide to delay the investment.[13] Thus, investments that are privately (and socially) profitable may be postponed as a consequence of the existence of the subsidy. Among the investors that actually get the subsidy there are two types: Those that would have implemented the investment anyways and those that would have not (because they would not be able to get high enough returns) but they in fact invest because they have obtained the subsidy. For the former the subsidy was ineffective, the subsidy is likely to promote more consumption by them rather than more investment as intended. For the latter the subsidy was effective in causing them to invest but, in the absence of positive externalities associated with the investment, at a low social return. Thus, the subsidy scheme does two things. First, it increases consumption of producers that would have invested anyway but that are able to obtain the subsidy. Second, a reallocation of investment from producers that potentially can get high rates of return but do not obtain the subsidy (and decide to postpone the investment expecting to get the subsidy in the future) to producers that obtain a low social return but invest only because they are able to access the subsidy. The net effect on total investment is ambiguous, but the efficiency impact is negative as a consequence of the second effect. Moreover, subsidies induce agricultural growth to be more based on extending

[12] This example is based on an actual irrigation-drainage public subsidy scheme for "small" projects (subsidy amount: up to US$275,000 per producer) in Chile that costs about US$30 million per year, using parameters obtained from the program.

[13] Suppose the subsidy is 50% (the Chilean subsidy pays between 25% and 75% of the total investment up to US$275,000) of the value of the investment cost and the rate of return per annum of the investment is quite high, 20%. Assume further that the producer estimates that the probability of getting the subsidy next year is 0.5 (in the Chile example about 45% of the proposals are funded). If the producer is risk neutral he/she will decide to *delay* the investment for one year.

the land area than on intensifying production[14]. The above example is not just a curiosity. It illustrates a phenomenon that has received important empirical support in recent years. That subsidies, at least in the form in which they are usually allocated, do not generally promote investment or more R&D has been shown by several studies in various countries. Empirical studies using detailed firm level data by Bregman et.al. (1999) for Israel, Fakin (1995) for Poland, Lee (1996) for Korea, Bergstrom (1998) for Sweden, Estache and Gasper (1995) for Brazil, Harris (1991) for Ireland and several others have shown that subsidies and corporate tax concessions are at best ineffective to promote investment and technological adoption and, in some instances, even counterproductive. Crowding out of private investment as a consequence of the subsidies occurs.

(iii) Subsidies may *indirectly* crowd out private investment in the intermediate run. The third type of crowding-out of private investment due to public expenditure biases toward subsidies is long- run in nature. The low stocks of public goods caused by continuous under investment in public goods, contributes to low productivity and diminished margins of return for private investments over time. This, in turn, is translated into lower future levels of private investments, lower productivity, and lower growth over the long run[15].

The structure of Public expenditure and rural poverty. Public goods affect rural poverty through a *direct* effect and through an *indirect* effect:

(i) Direct effects. Important components of rural public goods are human capital and investment in the protection of natural resources and the environment. Human capital is the main productive asset for most poor. However, as a consequence of credit and other market failures they are not in general able to fully finance investments in human capital, regardless of how high the rate of return to these investments might be (World Bank, 2000). They are, therefore, largely dependent on the public sector as a source of financing for these investments[16]. On the other hand the rural poor are also highly dependent on natural resources as a source of subsistence (Barbier, 2004). Resource degradation is often disproportionly paid by the rural poor. Increasing investment to protect natural resources and in mitigating environmental externalities is, therefore, vital to reduce rural poverty.

(ii) Indirect effects. As discussed earlier an adequate stock of rural public goods contributes to sustain growth for agriculture and related rural industries. In general much of the rural industry linked to agriculture is highly intensive in unskilled labor (López and Anriquez, 2003). Moreover, it appears that the rural sector in many developing countries is important enough within the unskilled labor market to significantly affect the real wages for unskilled workers even at a national level. Thus a dynamic rural productive sector is a vital source of employment for unskilled workers as may play a role in supporting higher real wages. To

[14] Bulte, Damania and López, 2004 study farmers' investment decisions when subsidies are allocated through lobbying by a corrupted government. In this case producers over invest in land and under invest in capital as a means to signal the government their ability and willingness to pay bribes in exchange for subsidies. See also López, 2004.

[15] López et.al. (2001) provide a formal analysis of the effects of under investing in public goods on long-run economic growth.

[16] The state support to human capital formation among the poor does not necessarily means direct government provision of education and health care. It may imply simply the provision of vouchers and other transfers that may allow the poor to acquire education and health care from private sources.

the extent that most poor are unskilled workers, these effects may be important in reducing poverty.

III. The Model

The agriculture per capita value-added function. The approach is to specify a reduced-form model that explains agricultural GDP per capita as a function of variables that are exogenous to agriculture as well as of policy variables. We start with specifying a production function,

$$(1) \qquad Q = F(L, K, X; A),$$

where Q is agriculture output, K is a vector of factors of production owned by farmers, L is labor used in the sector, X is a vector of purchased inputs and A is a productivity index. We assume that F( ) is concave in K, L, and X, and that it is subject to constant returns to scale; that is, F( ) is homogenous of degree one in L, K and X[17].

Agriculture value added or GDP is defined as the returns to primary factors, K, L. Thus,

$$(2) \qquad G(p, v; K, L; A) \equiv \max_{X} \{ pF(L, K, X; A) - vX \},$$

where G( ) is agriculture GDP, p is output price and v is a vector of purchased input prices. The function G( ) is a (dual) revenue function and must satisfy certain conditions: The most important from our point of view is that, apart from being increasing and concave in L and K, is also homogenous of degree one in K and L. This implies that we can express per capita agriculture GDP as

$$(3) \qquad \bar{g}(p, v; k; A) \equiv \frac{G(p, v; K, L; A)}{L}.$$

Thus, per capita GDP is a function of output and purchased input prices, and the per capita values of the farmers owned assets, k, as well as of the productivity factor, A. It is increasing in p, k and A, and decreasing in v. The remainder of this section is devoted to the estimation strategy of the per capita agricultural GDP function, $\bar{g}(p, v; k; A)$.

We postulate that output and purchased input prices are determined by world prices, domestic government policies, including trade policy, subsidies, etc. as well as by the performance of the non-agriculture economy, which may also play a role in affecting prices of non-traded commodities. That is,

$$(4) \qquad p = \phi(p^*, H, Y) \; ; \qquad v = \psi(v^*, H, Y),$$

[17] The assumption of constant returns to scale in agriculture has been often not rejected by empirical studies using farm household data. See, for example, López and Valdés (2000) who provide estimates for five countries in Latin America.

where a star indicates world prices, H stands for a vector of government policies affecting domestic prices and Y reflects conditions in sectors other than agriculture, but that could affect prices relevant to agriculture. The variables p^*, H, and Y are all subject to change over time as world market conditions, policies, and non-agricultural growth conditions vary.

The variables k and A are also endogenous and affected by the exogenous variable, world market conditions, government policies and the performance of the non-agricultural economy.

(5) $\quad k = k(p, v, A, H, Y); \qquad A = A(H).$

The per capita level of agricultural assets, k, is assumed to be increasing in output prices, decreasing in purchased input prices and increasing in the level of agricultural productivity, A. Also, A is postulated to be increasing in government policies, particularly public expenditures in public goods such as R&D and education. Government policies also affect the accumulation of k both through the commodity and input prices as well as directly by providing non-market benefits to agriculture, including grants, technical assistance and others.

Similarly, the conditions of the non-agriculture economy play a role on agriculture through the market effects associated with demand conditions for the commodities relevant to agriculture and also via non-market mechanisms. Among the non-market mechanisms the neighborhood or contagion effect is the most interesting: When the rest of the economy booms, agriculture may share a psychological boost that shifts upwards the investment schedule for the sector for a *given* level of agricultural profitability of the investments. The opposite happens in times when the overall economy is depressed; even if the returns to investment in agriculture are not much affected, investors are going to invest less in the sector as well as a consequence of the contagion effect.

Combining (4) and (5) we obtain a reduced-form function for k,

(6) $\quad k = \bar{\Omega}(p^*, v^*, H, Y).$

The vector H can be decomposed into the several dimensions of government policies. Trade and other economy-wide policies, other commodity market interventions, government expenditures in public goods for the sector and government subsidies. That is, we can disaggregate the vector H into T (trade policies), E (per capita total government expenditures in the sector) and S (the share of government subsidies in the total expenditures in the sector). We note that S includes both the direct non-social transfers as well as subsidies that take place via markets that demand government outlays (credit subsidies, deficiency payments, stabilization payments, etc.). Thus, we can write

(7) $\quad k = \Omega(p^*, v^*, T, E, S, Y).$

We expect that k is increasing (or at least non-decreasing) in p^*, E, Y and decreasing in v^*. In addition the effect of S on k is, according to our previous discussion, expected to be negative. The variable T is defined as an index of trade openness. Thus we expect that in countries that

have used trade protection to discriminate against agriculture, as most countries in Latin America, the effect of T on k will be positive.

Using (4), (5) and (7) in (3) we have now a specification for a reduced form for the per capita agricultural GDP function,

$$(8) \qquad g = g(\underset{(+)}{p^*}, \underset{(-)}{v^*}, \underset{(+)}{T}, \underset{(+)}{E}, \underset{(-)}{S}, \underset{(+)}{Y}) \ .$$

The signs underneath the variables indicate the expected effects of the various exogenous variables on the reduced–form per capita GDP. The sign pattern in (8) follows straightforwardly from the sign pattern of the structural GDP function, $\bar{g}(\ )$, and from the signs of the effects of the exogenous variables on k pointed out earlier. Equation (8) is the basis for the specification of the estimating model.

Econometric estimation of the GDP function. Consider the following benchmark econometric specification,

$$(9) \qquad g_{it} = \alpha_1 E_{it} + \alpha_2 S_{it} + \alpha_3 T_{it} + \alpha_4 Y_{it} + \mu_i + \omega_t + \varepsilon_{it} \ ,$$

where g_{it} is the log of per capita agricultural GDP in country i at year t

E_{it} is total government provided services to rural areas in country I and year t

S_{it} is the share of subsidies in E_{it}

T_{it} is an index of trade policy openness in country i at time t

Y_{it} is a measure of per capita non-agricultural GDP in country i at t

μ_i is either a fixed country effect or, alternatively, a random country disturbance

ω_t is a common time effect

ε_{it} is a random, independently distributed disturbance with mean 0 and variance σ^2.

The model in (9) is static. We alternatively allow for a *dynamic* model where the lagged dependent variable is included as an additional explanatory variable (g_{it-1}) to capture the potentially slow adjustment of agricultural GDP to policies and other conditions. As we discuss below this requires a more complex method of estimation to obtain consistent estimates with limited sample size (Arellano and Bond, 1991). Moreover, this generalization of the model into a dynamic framework involves significant trade-offs in terms of the plausibility of the estimates. Several important additional comments about (9) are in order:

(i) World prices. It is difficult to construct an appropriate price index for each country. As a proxy we use annual dummies (ω_t) which are supposed to capture international shocks including world price changes that may affect the countries in the sample.

(ii) Unobserved country characteristics. There are many country specific factors such as climate, land quality, institutions, etc., that may affect GDP but that we do not explicitly con-

trol for. These omitted variables may bias the coefficient estimated if they correlate with the explanatory variables, or at least affect the efficiency of the estimation. The role of μ_i is to control for such omitted variables as country fixed effects or, alternatively, as random effects.

(iii) Government expenditures. While the vast majority of the government expenditures are current expenditures, a portion of them are investments that accumulate over time as capital goods. To control for this we experimented allowing both current and lagged values of E to influence current GDP levels. The same approach was used for the variable S.

(iv) Simultaneous equation biases. Public expenditures in agriculture may be increased when agriculture is performing well. This causes a potential simultaneity biased in the estimated coefficient of E. We thus use lagged values of E as instruments when we estimated regressions with the annual data. Similarly, the relationship between agriculture and non-agriculture income is likely to be simultaneous rather than unidirectional. This may potentially bias the estimates of the effect of Y in (9). To diminish the risk of such biases we use instruments so that predicted rather than actual values of Y are used in estimating (9). In the case of the dynamic model we used Generalized Method of Moments (GMM) which uses instruments in a more comprehensive and systematic way (Green, 2003).

(v) Agricultural land area. Expanding the land area, especially in countries with remaining frontier areas can be considered to be at least in part a government controlled policy, rather than purely an endogenous-producer determined variable. If we assume that it is fully an endogenous variable (part of the k variable) there would be no reason to explicitly include it in the reduced-form specification, so that (9) in this case would be appropriate. If, however, land is in part exogenous to the sector, then one needs to use it as an additional explanatory variable. We also estimate an equation that is an extended version of (9) that uses land area (through instruments to allow for its possibly endogenous component) as an additional explanatory variable.

(vi) Trade policy openness. The usual measure of trade openness used is the total value of trade (imports plus exports) over GDP. Large countries (population and area wise), however, inherently tend to trade less than small countries, as they are naturally more self-sufficient, regardless of trade policy. If we want to use trade over GDP as a proxy for trade policy we must, therefore, normalize for country size and other structural characteristics (access to sea ports, oil wealth, etc.) that may affect the natural tendency of countries to trade. Thus we estimate trade volume over GDP using such structural variables as explanatory variables using data for a large number of countries. The actual index of trade policy openness used reflects the deviations of trade over GDP with respect to the norm thus derived.

Estimating rural poverty. It is postulated that rural poverty is affected by government policies and other exogenous factors through direct and indirect channels. Government expenditures in rural areas are likely to affect rural poverty directly through social expenditures that target the poor. In addition, government expenditures in rural infrastructure provide employment to part of the rural poor thus contributing to reduce poverty. Trade policy may also have direct poverty effects by affecting domestic prices of food necessities and other commodities important to the

poor. Also it may affect the incentives to commodities mostly produced by the poor vis-à-vis those produced by the non-poor. These policies also indirectly affect the rural poor if they have an impact on the performance of the agricultural sector. Finally, the rural poor may also be affected by the non-rural sectors of the economy through migration, remittances and by affecting real wages in the rural areas.

We estimate variants of the following poverty equation,

$$(10) \qquad pov_{it} = \beta_1 g_{it} + \beta_2 Y_{it} + \beta_3 E_{it} + \beta_4 S_{it} + \beta_5 T_{it} + \xi_i + \tau_{it},$$

where ξ_i is a random country effect and τ_{it} is a random disturbance. We expect that the effects of g, E and Y on poverty to be non-positive while the impact of T is ambiguous and, according to the discussion in the previous section, the effect of S to be positive. As in the case of the GDP equation, we tried various lag structures to capture for cumulative effects of the explanatory variable E over time.

Poverty head count measures may be quite heterogeneous across as the definition of poverty lines tend to differ quite considerably across countries and over time. For this reason we also estimate another proxy for rural poverty, the per capita income of households that are at the bottom quintiles as a complement to (10). We use a specification that is similar to the one presented in Equation (10) but we estimate the per capita income of the poorest 40% of the rural population instead of head count poverty as specified above.

IV. The Data

In this section we examine a new data set for rural public expenditures for ten countries in Latin America recently assembled by FAO Regional Office with the support of the World Bank and others. The annual data for the ten countries covers the period 1985-2000[18]. An advantage of this data is that they are quite disaggregated while at the same time they have been measured using a reasonably consistent methodology across countries and over time. In addition the public expenditure data as provided is quite comprehensive, covering the vast majority of the variety of items in which the public sector spends money in the rural areas. The level of detail of the data allows us to obtain a fairly accurate measure of the evolution of total government expenditures in rural areas over the period.

The data for public expenditures in the rural sector covers all rural expenditures, including expenditures for agriculture as well as rural infrastructure, animal and plant sanitary protection, environmental expenditures and social services to rural areas. The latter group covers expenditures in rural education, health and other social sectors. All in all rural public expenditures are disaggregated into 12 categories. The expenditure groups (including in brackets their respective average country share in total public expenditures for the year 1995) are the following: marketing assistance (28), irrigation (7.7), technological generation and transfer (4.7), soil conservation

[18]The countries for which the data covers the full period are: Costa Rica, Dominican Republic, Ecuador, Honduras, Jamaica, Panama, Paraguay, Peru, Uruguay and Venezuela.

(1.2), forest promotion (0.09), plant and animal sanitation (4.2), communication and information (1.6), "focalized" expenditures directed to particular commodities (4.9), integral rural development (IRD) (4.1), rural public infrastructure (16.3), rural social services (25.5), and others (1.7).

To allocate the above expenditures into private versus public goods we first account for items that clearly fall into one or the other category. Next we deal with those categories that fall into a grey area where it is difficult to determine a priori whether they correspond to public or private goods. In these cases we have looked into more detailed components falling into these categories in the various country statistics available. This allowed us to obtain an educated guess as of what proportion of these expenditure items should be approximately allocated to public or private goods. Finally there are some minor items for which we were not even able to have a reasonable guess. In the latter cases we simply use a 50-50 rule.

Among the items that clearly qualified as public or semi public goods were: technology generation and transfer, soil conservation, plant and animal sanitary protection, telecommunication and information services, rural roads, and social services (education, health and anti-poverty programs). In classifying the above expenditures as public goods, we considered the fact that they include areas where there are important positive externalities associated with such services (technology generation and diffusion, soil conservation, plant and animal sanitation), that were expenditures directed to at least in part palliate the impact of market failures (social services) and expenditures in expanding assets that directly benefit the general public (telecommunication and public roads).

Items that were considered private goods are: commodity-specific or focalized expenditures, marketing promotion (excluding expenditures in communications and market information which are among the public goods items) and irrigation expenditures. An important portion of "market promotion" includes direct subsidies to producers as well as subsidized credit. Similarly, most of the irrigation services are completely or, almost completely subsidized[19]. The third group (the grey group), included the categories of forest promotion, IRD programs and "others". Among these items, a high proportion of the forest promotion expenditures were in the end allocated to public goods while a smaller fraction of IRD were considered to qualify as public goods. An important portion of tree planting expenditures is allocated to eroded areas, thus inducing positive externalities by protecting soils, contributing to regulate water regimes, etc. IRD expenditures are mostly subsidies to promote particular patterns of agricultural expansion that the planners desire. As such a high portion of them does not qualify as public goods.

Table 1[20] provides an overview of the total public expenditures in rural areas and its public good/private good distribution for the ten countries studied using average annual values for the 1985-2000 period. On average, more than 54 % of the total government expenditures in rural areas were spent on private goods while only 45% were spent on public goods. The average coun-

[19] One may argue that classifying irrigation expenditures as private goods while other public infrastructure such as roads, bridges, etc. as public goods may appear as arbitrary. However, unlike other forms of public infrastructure irrigation projects are targeted to a limited number of farmers who usually pay little if at all for the water service, *excluding* everyone else from directly benefiting out of the irrigation investment. In response to a referee's concern we did some sensitivity analysis with the regressions. We allocated part (up to 50%) of the irrigation expenditures to public instead of private goods expenditures. The econometric results, however, showed little change.

[20] All tables are in Annex.

try in the sample spent about US$214 million (2002 dollars) per annum in the rural sector, of which only $96 million corresponded to public goods and $116 million to private goods. This rather massive allocation of public resources on private goods may suggest a significant degree of waste.

At the same time it provides an indication of the importance of analyzing the impact of such an unbalanced allocation of public resources especially on economic performance and social equity.

The evolution of government expenditures over the period 1985-2000 is presented in Table 2. We divided the period into three five-year sub-periods for each country. Annual total rural expenditures remained largely stagnated during the first two five-year periods, but experienced a significant increase in the last period with an average per country increase of almost 20% (from $177 to $215 million per country per year). The structure of government expenditures changed quite significantly over the period. The share of subsidies in total expenditures substantially declined, particularly over the last five years of the period. The share of subsidies steadily fell from 60% in 1985-90 to 58% in 1990-94 and to 44% in 1995-2000. Moreover, in practically all countries the participation of subsidies in total government expenditures decreased or remained stable with the only exceptions of Ecuador and Paraguay. The structure of public expenditures, not surprisingly, varies a lot across countries. Moreover, it also exhibits a meaningful and large variability within countries over time. These large and seemingly meaningful variances are extremely important features which allow us to appropriately use panel data econometrics, including fixed effects methods[21].

Table 3 shows the data for rural poverty (measured as head count poverty) available for the ten countries in our initial sample as well as for a few other countries in the region for which there is partial information on government expenditures in rural areas as well. The rural poverty data considered has been gathered through household expenditure surveys which are representative at the rural national level. As can be seen in the table, the rural poverty data is rather spotty with most countries having three or less data points over the period analyzed. Rural poverty is extremely high throughout the sample of countries. Moreover, in the countries that have more than one observation during the period there is no defined trend in the evolution of poverty rates with the possible exceptions of Chile and Brazil that exhibit downward trends.

[21] See Nerlove (2002) for a powerful critique of the indiscriminate use of fixed effect methods with little concern about how meaningful and significant is the within variance.

V. The Results

We estimate the reduced-form for per capita agricultural GDP using various methods of estimations and aggregating the data in several alternative ways. Our interest is primarily probing the robustness of the estimated coefficients. Here we present two types of data aggregation: (1) regressions using country data aggregated for relatively long periods of time; (2) regressions using annual data alternatively assuming static and dynamic specifications and using with various specifications for the lag effects.

"Long-run" effects. An attractive feature of (1) is that is consistent with the fact that much of the effects of the independent variables upon per capita agriculture GDP are likely to be embodied through processes that may take considerably more than one year to have an effect. One can of course specify dynamic processes and then design a lag structure accordingly. This is obviously difficult to do and requires procedures, such as the Arellano-Bond method, which has been subject to significant criticism in the literature (Nerlove, 2002) and that, for the sake of finding out the robustness of some of the results, we also use below. Working with several year averages instead of annual data might help in elucidating what can be considered long-run effects of the explanatory variables. A drawback of the approach is that one loses degrees of freedom by reducing the number of observations. We consider several aggregation options (3, 4 and 5 year averages) using simple averages[22]. In general as we increase the length of the observation period the estimates show a fairly consistent pattern: their absolute values tend to increase while their degree of significance changes only moderately as we increase the length of the observation periods.

Tables 4 and 4A provide the Random Effects (RE) and Fixed Effects (FE) estimators of the per capita agricultural GDP regressions using five year simple averages as units of observation. The most important message emerging from these estimates (as well as from the several alternative specifications used that we do not report here) is that while government expenditures have a positive and highly significant effect on agriculture per capita income, the structure or composition of such expenditures is quantitatively much more and also of great statistical significance. In fact, the results show that increasing the share of (non-social) subsidies keeping the total public expenditures constant has a large negative impact on agricultural per capita GDP. According to the estimates a reallocation of just 10% of the subsidy expenditures to supplying public goods instead may cause an increase in per capita agriculture income of about 2.3%. And this is obtained *without* increasing the total government expenditures[23]. By contrast, increasing government expenditures without altering its composition is much less effective in raising per capita agriculture incomes: A ten per cent expansion of government outlays causes on average only a 0.6% increase of agriculture income.

[22] We also use moving averages.

[23] It is important to emphasize that this result is purely a composition effect under the assumption that the efficiency on the use of resources in public goods remains unchanged (which several analysts have judged to be low). Of course if the efficiency of public goods programs increases, the change in the composition of public expenditures would have an even greater impact.

In 1996-2000 the 50% of the countries that spent the least in rural areas spent about $35 per capita while the top 50% of the countries spent about $74 per capita. Thus if the average bottom spender increased their per capita outlays to levels comparable to the average top, per capita agricultural GDP in that country could increase by more than 3%. With respect to the share of subsidies, in 1996-2000 it ranged from approximately 30% average for the bottom half to 65% for the top half. This means that if an average country in the top half could readjust its public expenditure share to the level of the average country in the bottom half its per capita agricultural GDP may increase, ceteris paribus, by a whopping 12.5%!

The results confirm the positive role of trade liberalization on agriculture income. This reflects the fact that agriculture is still discriminated against through protective trade policies. An opening up of trade policies consequently is not only good for overall economic efficiency but also for agriculture income. The marginal effect of trade openness index on agricultural per capita income is about 0.002 and statistically significant. Moreover, this estimate is remarkably stable and robust to changes of specification. To get an idea of the meaning of this number it is useful to indicate that the trade openness index for the period of the most open country within the sample (Costa Rica) is about 60 points higher than that of the country that is least open (Uruguay). This means that if Uruguay had been as open as Costa Rica over the period its per capita agricultural income would have been about 0.12 % higher. Thus, though the effect of trade openness is highly significant, its quantitative value is quite small, a result that is consistent with other studies showing that the static gains of trade liberalization may not be too great.

The estimates are consistent with an important positive effect of the rest of the economy upon agriculture. This large effect may, however, be affected by biases due to omitted variables that could exert similar effects upon agricultural and non-agricultural GDP. The FE estimators do control for the impact of fixed omitted variables that are country specific. But not for shocks that happen over time and that could influence the dependent variable and be correlated with the explanatory variable. We have also used instruments which could at least deal with reverse causality biases, but certainly the issue of time varying omitted variables remains[24]. In any case, it appears that the performance of the non-agricultural sector also positively affects agriculture. This could be due to a neighborhood effect; when the overall economy flourishes, investors would be more willing to invest in all sectors (Gardner, 2003).

"Short-run" effects: The static model. Tables 5 and 5A present estimates of agricultural per capita GDP using annual data, that are representatives of the results obtained under various static specifications. We tried various lag structures for the explanatory variables. The sign pattern of the coefficients does not change, although their sizes and standard errors are mildly affected by the lags used. We present in the Tables the estimates using one-year lags.

The fact that now we have much more observations allow us to use annual time dummy variables to control for unobserved shocks (common to the countries) that vary over time in addition to the random or fixed country effects[25]. The pattern of significance of the estimated coefficients and their sign are highly consistent with the "long-run" estimates reported earlier. Consistent with the

[24]In the annual estimates reported below we do control for time varying shocks that have similar effects across countries. As will be seen this reduces the value of the coefficient but the effect remains statistically significant.
[25]Both the FE and RE estimates passed the White's test of heteroscedasticity at 5% level of statistical significance.

short-run/long-run interpretation, in general the elasticity estimates using annual data have lower absolute values than the coefficients estimated using the five-year averages.

In particular, the effects of total government expenditures in rural areas are still positive and statistically significant, but their values are about 50% lower than the values estimated using five-year averages. Similarly, the share of government subsidies in total expenditures is now negative and significant as before but the estimates are smaller in absolute value. Still, the message is the same: total government expenditures are important in promoting agricultural income, but the structure of public expenditures is even more important. Switching resources from subsidies to public goods can be an extraordinarily effective instrument to achieve faster agricultural growth.

The reduction of the size of the effect of the non-agriculture income is even more pronounced than that of the public expenditures variables. In fact, the effect of non-agriculture GDP falls by about 66% when annual data is used compared to five-year averages, though the coefficient is still significant. This drastic reduction of the size of the coefficient may reflect not only the short run/long run dichotomy, but also a possible reduction of the size of the omitted variable biases caused by the fact that we now control for the effects of omitted variables that do change over time. In any case, an elasticity of about 0.13 still reflects a sizable positive impact of the rest of the economy upon agriculture.

The GMM Estimates. Table 6 presents the Arellano-Bond one-step procedure (assuming random effects) GMM estimates of the agriculture GDP function. Although the GMM procedure has the advantage over the static estimates of accounting for the inertia that is likely to exist in the determination of agricultural GDP and in mitigating potential endogeneity biases of the explanatory variables, it also has some disadvantages. In particular, the Arellano-Bond estimates tend to have low efficiency and, while first order autocorrelation is expected, if second order autocorrelation exists it may lead to inconsistent estimates.

In any case the estimates in Table 6 suggest that GDP adjust relatively fast, taking about two years to complete the adjustment to changing exogenous variables. The estimates concerning the level and composition of government expenditures are highly consistent with the static ones presented earlier. The sign pattern and significance and the relative magnitudes of the total public expenditures vis-à-vis the share of expenditures in subsidies on GDP is the same as in the static estimators.

The implicit long-run elasticities (that is the steady state effects) of these variables are obtained assuming that per capita GDP does not change over time. Given that the coefficient of the lagged dependent variable coefficient is about 0.52 in the regression without controlling for annual dummies, the implicit long-run elasticity of total government expenditures is about 0.046 (0.022/(1-0.52)) while the elasticity of the share expenditures in non-social subsidies is more than three times bigger equal to -0.16. The estimates when we control for time dummies (3rd column in Table 6) yield implicit long-run effects equal to 0.06 and -0.20 for total expenditure and share variables, respectively. These long-run estimates obtained using the Arellano-Bond dynamic approach are remarkably similar to the corresponding long-run estimates obtained using five-year averages (Table 4) using static random effects method, which were 0.055 and -0.228.

This high degree of consistency among estimates obtained using very different approaches suggests that the estimates are very robust indeed.

Rural poverty. The quantitative analysis of the impact of the level and structure of public expenditures on rural poverty is hampered by insufficient availability of rural poverty estimates for the countries considered and especially by issues of data quality and comparability discussed earlier in the paper. These data problems are reflected in the econometric estimates which are not nearly as robust and clear cut as the estimates of agriculture GDP reported earlier. Table 7 reports estimates of a rural poverty equation using data from the 1980s as well as 1990s. Because the data for the earlier years seems to have more problems than that in the later we also provide estimates using only the data for the period 1992-2000 (Table 7A). The fact that we have a rather shallow panel, with most countries having just two observations throughout the period, implies that the FE estimates are highly unstable and tend to yield implausible estimates. For this reason we present here only the RE estimates which tend to be more robust and stable.

In general we are not able to detect any direct effect of the structure of public expenditures on rural poverty. The estimates of the effect of the share of subsidies are positive and significant in some selective runs but by and large are not statistically significant. The same is true for the effect of total public expenditures. It is interesting to say that when we do not control for the composition of public expenditures, the estimates for total expenditures tend to be positive (Table 7A). This might be consistent with the hypothesis that, regardless of the public/private good composition, public expenditures tend to be socially regressive. That is, even the public goods provided may not be primarily those that benefit the rural poor.

The most robust finding is the negative effect of agricultural GDP on rural poverty. Non-Agriculture GDP also has a negative effect on rural poverty, but the size of its effect is more modest. This is of course not surprising as the effect of the rest of the economy on rural poverty is more indirect than the impact of agriculture. In any case, the elasticities of agriculture and non-agriculture are both statistically less than one. By contrast, studies relating poverty to overall GDP per capita often yield elastic effects.

Though we are not able to capture any direct effect of public expenditures on head count rural poverty, the fact that the level and structure of public expenditures have important effects on agriculture per capita income suggests that the indirect effects are significant. In particular, a 10% reduction of the share of subsidies in total expenditures may cause an increase in agriculture per capita GDP of about 2.3% which, in turn, may induce a 1.2% reduction in rural poverty.

Income of the rural poor. Though we were not able to detect any direct effect of the composition of rural public expenditures upon the head count rural poverty rate, there apparently exists an effect on the per capita income of the rural poor. Table 8 shows the estimates of the determinants of per capita income of the poorest 40% of the rural population for the period 1990-2002, which is the period for which such income is measured. The data correspond to an expanded sample of the countries used in the earlier analysis including now, in addition to the countries in Table 3, observations for Guatemala, Colombia and Nicaragua. The data on income of the poor is not annual, but rather consists in no more than three observations per country for different years during the period 1990-2002. We estimate the income of the poor function using average

lagged values of the explanatory variables over the previous 4 years of the observation[26]. This is supposed to capture the delayed effect of the explanatory variables on the per capita income of the poor.

The main finding in Table 8 is that both the level of rural public expenditures and its composition show highly significant coefficients. This suggests that the level and composition of expenditures are important determinants of the welfare of the rural poor. Public expenditures contribute to increase the income of the rural poor modestly while the composition of public expenditures has a more dramatic effect. Altering the composition of public spending from subsidies to public goods can cause a large increase of the income of the poor. This result is suggestive but one should be cautious because the data base for this analysis is weak and the number of observations is low.

Agricultural Land Expansion. One of the most negative environmental impacts of agriculture is its effect on deforestation. Agricultural expansion into forested areas has been found to be an important direct cause of deforestation, particularly in tropical countries (Pfaff, 1999, Chomitz and Thomas, 2003). In land-rich countries agricultural growth has been based more on extending the land area rather than on the intensification of production in already cultivated lands (Abdelgalil et.al, 2001; Foster et. al. 2003). The impact of agricultural expansion on deforestation is particularly large because of a land multiplier effect: According to empirical analyses, one additional permanent hectare of land cultivated requires clearing of between 4 and 5 hectares of forests (Chomitz and Thomas, 2003; López, 1997 and 2000). This sizable land use multiplier is due to the fact that one additional permanent hectare of land cultivated needs more infrastructure, more land for human settlements and the new land cultivated is often incorporated into a shifting cultivation cycle (to maintain one hectare under cultivation in shifting cultivation typically needs intervening at 3 to 5 hectares).

In this section we analyze the determinants of land expansion of agriculture. Table 9 shows the Two-way FE and RE estimates of agriculture land. We explain agricultural land area using agricultural GDP, non-agricultural GDP, total public expenditures in the rural sector, the share of government subsidies in total rural public expenditures and the index of trade openness. We normalize all variables except the last two by the rural population. To avoid problems of simultaneous equation biases affecting the per capita agricultural GDP explanatory variable, we use lagged values of per capita agriculture GDP in Table 9 (alternatively various instrumental variables were used, but the results do not dramatically change). In general the coefficient estimates are quite robust to changes in specification and the FE and RE estimators are remarkably similar.

Not surprising, agriculture GDP is an important determinant of the land area. The GDP elasticity has a value of about 0.30 which is highly significant. This relatively low value of the GDP elasticity suggests that agricultural growth in principle does not need to necessarily rely on large area expansion. There are factors other than GDP growth that are at play. Another important result in Table 8 is that more trade opening is a factor that contributes to intensify agriculture. This effect is also highly significant. This suggests that in the countries considered trade openness shifts the structure of incentives toward agricultural products that are less land-demanding and perhaps more labor-intensive. The observed trends towards increasing specialization in vegetables and

[26] We also tried 3 and 5 year average, but the result changed little.

fruits (which are much less land-demanding than traditional commodities or livestock) associated with trade openness is certainly consistent with this finding.

The most important finding for us is, however, the strong effect that changing the composition of public rural expenditures can cause. In fact, according to the estimates, reducing the participation of subsidies in total public expenditures from 50% to just 40% may cause, ceteris paribus, a reduction of agricultural land area of more than 2% with the consequent reduction of the pressure imposed by agriculture on the remaining forests. As Bulte et.al (2004) have shown, land expansion is an important instrument to elicit subsidies from governments in exchange for bribes or other political contributions paid by wealthy farmers to government politicians. For a variety of reasons discussed by Bulte et.al., the ability of farmers to lobby governments and the effectiveness of such lobbying in eliciting subsidies is related to their land size. Therefore, excessively expanding agricultural land when governments are prone to subsidize the wealthy is privately rational but socially costly. The empirical results found give support to this hypothesis.

VI. Conclusions

This paper has provided evidence suggesting that the structure of public expenditures is an important factor of economic development. The quantitative importance of this factor appears to be greater than the traditional factors on which the development literature focuses. In particular, expanding total public expenditures in rural areas while maintaining the existing public expenditure composition prevailing in the countries does little to promote agricultural income and reduce rural poverty. The key issue is not so much how much money is spent in the sector but rather how are public monies being spent. Spending a significant share of government resources in subsidies to the wealthy causes not only less agriculture income but it also induces an excessive reliance of agricultural growth on land expansion, thus exacerbating the negative effects of agriculture on the remaining forests.

The econometric results provide estimates that suggest that governments over spend in mostly politically-motivated private goods and subsidies and under spend in public goods and anti-poverty programs. Though the very large estimated effects of expenditure composition may be surprising to some, one should note that these estimates are highly consistent with two previous pieces of evidence available in the literature. First, the literature reports extremely large rates of return to many forms of public goods (often 25% to 60% per annum and above) including R&D, education, health care, some infrastructure, certain environmental protection investments, and others. Also, those studies that have performed analyses over time generally find that the rates of return show no tendency to decline over time. Recent surveys of this literature, cited earlier in the text, find an amazing degree of consensus on the estimated rates of return obtained in many studies that evaluate rates of return to public goods around the world. The fact that the studies reviewed have used different approaches, diverse data bases and have been applied to a large number of countries around the world, means that this consensus should be taken seriously.

These extremely high and non-declining rates of return suggest that there are important investment opportunities in public goods that are not being fully exploited. That is, it suggests under spending on public goods.

Second, many firm level studies around the world (some cited earlier in the text) have found that subsidies aimed at promoting investment, employment, and growth do not achieve these objectives. In some cases they are counterproductive to these goals. Thus, while the rates of return to public goods are very high, the rates of return to private goods or subsidies are very low or even negative. Yet, governments tend to spend a large share of their resources in the goods that have low returns while at the same time forego investments with very large rates of return. Switch spending priorities and you can obtain massive dividends. This is what the econometric results are saying.

As discussed earlier in the paper, governments make such an aberrant choice mostly because they respond to a variety of politico-economic forces. These forces at play are not only associated with openly corrupt practices, but they may also reflect a highly unbalanced configuration of political forces. The elites, because of their wealth and "contacts", are able to influence even well-meaning governments to their own advantage even if the rest of society suffer loses. Apart from political campaign contributions, the elites are able to shape public opinion, mainly through the presentation of intellectual arguments and adroit use of the media, to favor or to accept such flagrant misallocation of public resources. International institutions can, if they want it, be important players in creating domestic conditions favoring correcting such misallocation. They can also use their influence on the countries to reduce rather than deepen the massive imbalances in lobbying abilities between the elites and the rest of the civil society.

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ANNEX

Table 1. Government Expenditures in the Rural Sector: Annual Country Averages, 1985-2000 (millions US$)

Countries	Subsidies	Subsidies as % of Total Expenditure	Public Goods	Public Goods as % of Total Expenditure	Total Expenditure
Costa Rica	41.6	47.4%	46.1	52.6%	87.7
Dom Rep.	174.6	65.4%	92.2	34.6%	266.8
Honduras	3.3	10.8%	27.6	89.2%	31.0
Panama	82.9	80.8%	19.6	19.2%	102.5
Paraguay	106.5	86.5%	16.6	13.5%	123.1
Peru	197.3	55.0%	161.4	45.0%	358.7
Venezuela	283.8	54.2%	239.9	45.8%	523.8
Ecuador	89.8	67.3%	43.61	32.7%	133.4
Uruguay	7.7	19.1%	32.42	80.9%	40.1

Source: FAO, Regional Office for Latin America and the Caribbean

Table 2. Government Expenditures in Rural Areas (in millions of $US)

Countries	Period 1985-89		Period 1990-94		Period 1995-2000	
	Subsidies	**Tot. Exp.**	**Subsidies**	**Tot. Exp.**	**Subsidies**	**Tot. Exp.**
Costa Rica	7.5 (33.3%)	22.5	34.0 (29.3%)	116.2	31.7 (24.8%)	127.6
Dom Rep	164.0 (74.1%)	221.4	183.8 (75.4%)	243.8	162.0 (47.7%)	339.8
Honduras	0.7 (9.0%)	7.4	2.0 (13.9%)	14.1	7.7 (10.3%)	74.7
Panama	109.5 (84.4%)	129.7	51.5 (78.8%)	65.4	75.9 (63.3%)	119.8
Paraguay	72.7 (75.5%)	96.2	110.3 (79.2%)	139.3	111.1 (78.4%)	141.7
Peru	37.8 (63.5%)	59.5	288.1 (65.1%)	442.5	250.4 (43.3%)	578.2
Venezuela	485.7 (53.3%)	910.5	176.3 (41.4%)	425.8	95.2 (27.0%)	352.9
Ecuador	59.7 (60.2%)	99.2	67.8 (65.9%)	102.8	123.3 (78.0%)	158.1
Uruguay	7.3 (20.9%)	35.1	6.7 (16.7%)	39.9	8.4 (19.3%)	43.5

Table 3. Rural Poverty in 12 Countries in Latin America, 1988-2000 (Head Count Poverty in %)

Country	1988-1989	1990-1995	1996-2000
Bolivia			79.5
Brazil		58.5	46.0
Chile			27.3
Costa Rica		24.3	22.5
Dominican Republic	27.4	49.0	42.1
Ecuador		47.0	
Honduras	81.0	79.7	80.0
Jamaica		37.0	25.1
Mexico		46.5	51.0
Panama	48.0	42.0	42.5
Paraguay		28.5	
Peru		67.0	64.7

Source: World Bank and country sources

Table 4: Determinants of Per Capita Agricultural GDP Using Five-Year Averages. Random Effects

Dependent variable: log of average annual per capita agricultural GDP	Coefficient	Std. Err.	z-statistic
Log of average annual public expenditures in the rural sector	0.055	0.010	5.631
Share of non-social subsides in expenditures	-0.228	0.053	-4.291
Index of trade openness	0.002	0.001	3.135
Log of (predicted) non-agricultural per capita GDP	0.405	0.032	12.521
Constant	2.563	0.287	8.922

Number of observations: 30; Number of groups: 10

Table 4A: Determinants of Per Capita Agricultural GDP Using Five-Year Averages Fixed Effects Method

Dependent variable: log of average annual agricultural per capita GDP	Coefficient	Std. Err.	z-statistic
Log of average annual per capita public expenditures in the rural sector	0.057	0.010	5.722
Share of non-social subsides in ex-penditures	-0.231	0.053	-4.350
Index of trade openness	0.002	0.001	2.951
Log of (predicted) non-agricultural per capita GDP	0.396	0.033	11.997
Constant	2.606	0.253	10.297

Number of observations: 30; Number of groups: 10

Table 5. Estimating Per Capita Agricultural GDP Using Annual Data. Random Effects Method with Annual Dummies

Dependent Variable: Log of per capita agricultural GDP	Coefficient	Std. Err.	t-statistic
Log of total per capita public expenditures in the rural sector	0.028	0.009	3.012
Share of expenditures on non-social subsidies in total expenditures	-0.10	0.050	-2.01
Index of trade openness	0.002	0.0006	3.043
Log of (predicted) per capita non-agriculture GDP	0.140	0.042	3.399
Land Area in agriculture	0.712	0.105	6.794
Constant	3.98	0.687	5.797
D85	-0.245	0.039	-6.341
D86	-0.214	0.037	-5.724
D87	-0.212	0.036	-5.812
D88	-0.171	0.035	-4.837
D89	-0.162	0.035	-4.578
D90	-0.167	0.037	-4.457
D91	-0.143	0.034	-3.892
D92	-0.132	0.035	-3.785
D93	-0.149	0.031	-4.811
D94	-0.109	0.031	-3.529
D95	-0.070	0.030	-2.334
D96	-0.029	0.0290	-0.994
D97	-0.025	0.030	-0.860
D98	-0.022	0.029	-0.750
D99	-0.010	0.029	-0.368

Number of observations: 133; Number of countries (groups): 10

Table 5A: Estimating Per Capita Agricultural GDP Using Annual Data. Two-way Fixed Effects Method

Dependent Variable: Log of per capita agricultural GDP	Coefficient	Std. Err.	t-statistic
Log of total per capita public expenditures in the rural sector	0.031	0.009	3.246
Share of expenditures on non-social subsidies in total expenditures	-0.117	0.052	-2.250
Index of trade openness	0.002	0.001	3.195
Log of (predicted) non-agriculture GDP	0.133	0.042	3.131
Land area in agriculture	0.851	0.129	6.596
Constant	4.804	0.788	6.092
D85	-0.245	0.039	-6.260
D86	-0.213	0.038	-5.618
D87	-0.210	0.037	-5.658
D88	-0.169	0.036	-4.705
D89	-0.160	0.036	-4.461
D90	-0.167	0.037	-4.485
D91	-0.145	0.036	-3.965
D92	-0.133	0.035	-3.805
D93	-0.149	0.031	-4.749
D94	-0.109	0.031	-3.478
D95	-0.070	0.030	-2.326
D96	-0.030	0.030	-0.978
D97	-0.025	0.030	-0.849
D98	-0.022	0.029	-0.761
D99	-0.010	0.029	-0.384

Number of observations: 133; Number of countries (groups): 10

Table 6. Dynamic Arellano-Bond GMM Estimates of Per Capita Agricultural GDP

Dependent Variable: Log of annual per capita agricultural GDP	**Coefficients (Standard Errors)**	
Lag of Log of per capita agricultural GDP	0.520*** (0.194)	0.551*** (0.199)
Log of total per capita public expenditures in the rural sector	0.022** (0.012)	0.027*** (0.011)
Share of expenditures on non-social subsidies in total expenditures	-0.075** (0.041)	-0.090*** (0.042)
Index of trade openness	0.001 (0.001)	0.0003 (0.001)
Log of non-agriculture GDP	0.156 (0.116)	0.136 (0.087)
Log of land area in agriculture	0.202 (0.222)	0.212 (0.223)
Constant	0.003 (0.005)	0.002 (0.005)
D87		-0.034 (0.053)
D88		0.042*** (0.019)
D89		0.002 (0.028)
D90		-0.014 (0.031)
D91		0.012 (0.026)
D92		-0.004 (0.038)
D93		-0.016 (0.037)
D94		0.005 (0.034)
D95		0.022 (0.026)
D96		0.026 (0.025)
D97		0.004 (0.017)
D98		0.004 (0.023)
D99		0.007 (0.020)
Test for 2nd order serial autocor.	1.62	1.96***

Notes: *** 5%, ** 10%, level of significance. Number of observations: 129;
Number of countries (groups): 10. All Standard Errors are robust.

Table 7. Estimating Rural Poverty for 12 Countries in Latin America Using 1985-2000 Data. Random Effects Method.

Dependent Variable: Log of head count poverty	Coefficient	Standard Error	z-statistics
Log of total per capita rural expenditures	0.024	0.039	0.60
Log of share of non-social subsidies in total expenditures	-0.051	0.078	-0.64
Log of per capita agricultural GDP	-0.605	0.256	-2.36
Log of per capita non- agriculture GDP	-0.195	0.187	-1.04
Index of trade openness	-0.0057	0.0033	-1.71
Constant	2.17	0.98	2.20

Number of observations: 24
Number of groups: 12

Table 7A. Estimating Rural Poverty for 12 Countries in Latin America Using 1992-2000 Data. Random Effects Method.

Dependent Variable: Log of head count poverty	Coefficient	Standard Error	z-statistics
Log of total per capita rural expenditures	0.068	0.032	2.10
Log of per capita agricultural GDP	-0.525	0.171	-3.07
Log of per capita non- agriculture GDP	-0.300	0.160	-1.87
Index of trade openness	-0.0017	0.0036	-0.46
Constant	1.61	0.847	1.90

Number of observations: 20
Number of groups: 10

Table 8. Estimating the Determinants of Income Per Capita of the 40% Poorest in the Rural Sector, for Selected Countries, 1990-2002*
Dependent Variable: Log of Income Per Capita of the 40% Poorest in the Rural Sector

Variable	Panel Regression	
	Fixed Effects	**Random Effects**
Log of average annual public expenditures per capita in the rural sector	0.1818*** (0.095)	0.172*** (0.087)
Share of non-social subsides in public expenditures in the rural sector	-2.043*** (0.854)	-1.967*** (0.850)
Log of Lagged Agricultural GDP per capita	-1.504 (0.813)	0.148 (0.367)
Log of Lagged non-agricultural GDP per capita	2.028 (0.881)	0.266 (0.279)
Constant	1.649*** (1.768)	5.296*** (0.575)
Number of countries	15	15
Adj R-Sq	0.742	0.6208
# Observations	34	34
Hausman test Chi Square		0.056

Note: * Using 5 year lagged averages for all variables but for the dependent variable. All standard errors are heteroskedastic consistent. ***-5% level of significance.

Table 9. Estimating the Determinants of Agricultural Land Area for Ten Countries, 1985-2000. Dependent Variable: Log of Agricultural Land Area Per Capita

Variable	Fixed Effects	Random Effects
Log of lagged agricultural GDP per capita	0.307*** (0.061)	0.339*** (0.046)
Log of average annual public expenditures per capita in the rural sector	-0.020*** (0.006)	-0.019*** (0.006)
Share of non-social subsides in public expenditures in the rural sector	0.119*** (0.033)	0.113*** (0.030)
Log of (predicted) non-agricultural GDP per capita	0.028 (0.026)	0.035 (0.026)
Index of trade openness	-0.002*** (0.0004)	-0.002*** (0.0004)
D85	0.082*** (0.036)	0.097*** (0.026)
D86	0.080*** (0.034)	0.093*** (0.024)
D87	0.071*** (0.032)	0.084*** (0.024)
D88	0.059** (0.032)	0.071*** (0.023)
D89	0.058** (0.030)	0.069*** (0.023)
D90	0.068*** (0.031)	0.081*** (0.023)
D91	0.061*** (0.030)	0.071*** (0.023)
D92	0.049 (0.031)	0.059*** (0.022)
D93	0.056** (0.028)	0.064*** (0.020)
D94	0.042 (0.027)	0.048*** (0.019)
D95	0.031 (0.027)	0.035** (0.018)
D96	0.012 (0.028)	0.015 (0.018)
D97	0.010 (0.028)	0.012 (0.018)
D98	0.011 (0.028)	0.012 (0.018)
D99	0.008 (0.032)	0.008 (0.018)
Number of countries	10	10
Adj R-Sq	0.999	0.696
# Observations	153	153

Note: All standard errors are heteroskedastic consistent. ***-5% level of significance; **-10% level of significance.

APPENDIX

Table A1. Estimating Agricultural Productivity. Random Effects Method with Annual Dummy Variables

Dependent Variable: Log of per capita agricultural GDP normalized by land area	Coefficient	Std. Err.	t-statistic
Log of total per capita public expenditures in rural areas	0.032	0.009	3.464
Share of non-social subsidies in total expenditures	-0.123	0.049	-2.535
Index of trade openness	0.002	0.001	3.310
Log of per capita non-agriculture GDP	0.162	0.043	3.771
Constant	4.515	0.383	11.780
D85	-0.234	0.039	-6.070
D86	-0.201	0.038	-5.309
D87	-0.197	0.037	-5.367
D88	-0.157	0.036	-4.400
D89	-0.149	0.036	-4.164
D90	-0.156	0.037	-4.204
D91	-0.134	0.036	-3.669
D92	-0.124	0.035	-3.546
D93	-0.142	0.032	-4.502
D94	-0.102	0.032	-3.212
D95	-0.066	0.031	-2.150
D96	-0.025	0.030	-0.822
D97	-0.023	0.030	-0.751
D98	-0.020	0.030	-0.691
D99	-0.009	0.030	-0.316

Number of observations: 133; Number of countries (groups): 10

Table A2: Estimating Agricultural Productivity. Two-Way Fixed Effects Method

Dependent Variable: Log of agricultural GDP normalized by land area	Coefficient	Std. Err.	t-statistic
Log of total public expenditures in the rural sector	0.031	0.009	3.430
Share of expenditures on non-social subsidies in total expenditures	-0.119	0.048	-2.460
Index of trade openness	0.002	0.001	3.214
Log of (predicted) non-agriculture GDP	0.140	0.044	3.189
Constant	4.662	0.346	13.466
D85	-0.245	0.039	-6.341
D86	-0.211	0.038	-5.578
D87	-0.208	0.037	-5.644
D88	-0.167	0.036	-4.658
D89	-0.158	0.036	-4.425
D90	-0.166	0.037	-4.457
D91	-0.143	0.036	-3.923
D92	-0.132	0.035	-3.785
D93	-0.147	0.032	-4.680
D94	-0.107	0.032	-3.378
D95	-0.069	0.030	-2.276
D96	-0.028	0.030	-0.924
D97	-0.025	0.030	-0.833
D98	-0.022	0.029	-0.730
D99	-0.010	0.029	-0.328

Number of observations: 133
Number of countries (groups): 10