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# Structure of Public Support for National Agricultural Research Systems: A Political Economy Perspective

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## Abstract

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This paper initiates development of a set of stylized facts concerning the structure of public support for national agricultural research systems (NARS) within a neoclassical political economy framework. The aim is to place public funding of NARS in the broader context of the overall level of direct government assistance to agriculture. Using a newly constructed data set on NARS expenditures over the 1970-85 period, we observe a growing disparity in agricultural research intensity ratios, which measure the level of public support for NARS in relation to agricultural gross domestic production (AgGDP) between low and high-income countries. This growing disparity appears to be driven by much larger increases in support for agricultural research by high-income countries, coupled with a significantly slower growth in the size of their agricultural sector, despite the propensity of low and middle-income countries to increase real support to agricultural research.

As per-capita incomes rise the public agricultural expenditure ratio, which measures public expenditures on agriculture relative to the size of the agricultural sector, AgGDP, increases substantially. Public expenditures on agriculture were indexed on agricultural and non-agricultural populations to give a rough indication of the increasing incentives for rural 'distributional coalitions' to seek a redistribution of public expenditures in their favor.

A relative research expenditure (RRE) ratio is developed, which measures the proportion of total public expenditure on agriculture spent on agricultural research. It provides an indication of the relative importance given to research on agriculture within the constraints imposed by overall public spending on agriculture. In contrast to the agricultural research intensity ratios, the RRE ratios suggest that agricultural research appears to command as large a share of the public purse devoted to agriculture in low and middle-income countries as it does in high-income countries. Expectations derived from the neoclassical political economy literature that research may have fared relatively better in high compared with low-income countries were not supported by the data.

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## Introduction

Direct government intervention in the agricultural sectors of both developed and developing countries is pervasive. Much of this intervention takes place via pricing and marketing activities (World Bank, 1986), often through the operation of state-owned or parastatal enterprises. But, governments also make substantial interventions via investment in such things as general rural infrastructural development (Antle, 1983) including irrigation, transportation and communication facilities, plus rural health, education and research. There is consequently a myriad of competing claims on the limited budgets at the disposal of the public sector, particularly in many developing countries where practical considerations limit their capacity to even generate public funds (Goode, 1984). Rather than treat public sector agricultural research investments in isolation and as a special case, we obtain a more realistic understanding of the structure of support for agricultural research by placing publicly funded research in the context of the overall level of public support for agriculture.

In the next section we briefly review the traditional view of public support for agricultural research. We then introduce a political economy perspective which seeks to endogenize the public sector allocation process, treating public support for agricultural research as one element in a broader allocation process. After describing the data on research expenditures, the level and changes in support for public sector agricultural research as indexed by an agricultural research intensity ratio are assessed.

Turning to the neoclassical political economy perspective, we broaden the analysis to consider the overall level of direct government assistance to agriculture, and the place of publicly funded agricultural research in relation to other forms of intervention. The paper does not present an exhaustive consideration of all the relevant issues. Rather, it initiates the development of a set of stylized facts in order to motivate more formal analysis of the structure of public support for national agricultural research systems (NARS) than has hitherto been the case.

## Background

### Traditional view

Cross-country comparisons, and specific recommendations on the level of support afforded public sector agricultural research, are often based on the agricultural research intensity (ARI) ratio. This measures public sector expenditures on agricultural research as a proportion of the value of agricultural product (AgGDP). The 1974 U.N. World Food Conference suggested that developing countries should aim for a 1985 target of 0.5 percent of AgGDP on agricultural research (UN, 1984, p. 97). More recently the World Bank (1981, p. 8), in a widely quoted statement, asserted that a "desirable [agricultural research] investment target ... would be an annual expenditure (recurrent, plus capital) equivalent to about 2 percent of agricultural gross domestic product."

The difficulty with these rules of thumb is that the conceptual, empirical, and even practical bases for such recommendations are often not clearly established. What they do capture is a general feeling that, contrary to the tendency to oversupply bureaucratic services which Niskanen (1971) identifies, there exists a pervasive tendency to underinvest in public sector agricultural research.

Drawing on traditional welfare theory it is commonly argued that a distinguishing feature of (some) agricultural research is its public goods' characteristic – in particular the notion that there exists a free-rider problem whereby the benefits from agricultural research are often not fully appropriable by the innovator. Thus, on market failure grounds a prima facie case for intervention is established (Nelson, 1959; Arrow, 1970; Arndt, 1988)[1], presumably by a well-informed government motivated solely by a desire to maximize social welfare. Moreover, the form of intervention is usually taken to imply direct public sector financing and/or execution of agricultural research. Other, possibly more cost effective, forms of government intervention to bring agricultural research activity up to its socially optimal level are often ignored.

Citing empirical evidence of relatively high rates of return to agricultural research, often in excess of 35 percent, Ruttan (1980, p. 53) observes that "it is hard to imagine very many investments in either private or public sector activity that would produce more favorable rates of return", so that "... a level of expenditure that would push rates of return to below 20 percent would be in the public interest". Similar claims with regard to underinvestment in U.S. agricultural research are made by Bonnen (1983) and Rose-Ackerman and Evenson (1985). In the international context, Johnson (1982, p. 81) believes that "the evidence presented on the returns to agricultural research definitely supports the position that a given country should spend no less as a percent of the value of its agricultural output than is now being spent by the average of countries with comparable levels of income".

There have been numerous attempt to account for the apparent underinvestment that is implicit in these high rates of return. Ruttan (1980) hypothesized that, for the United States, two possibilities are: (a) an efficient allocation of resources to research; and (b) a lack of congruence between state-level costs and benefits of agricultural research resulting from research spillover effects. The former hypothesis implies that research managers are unusually successful in selecting 'efficient' research portfolios but, as Ruttan observes, that leaves unanswered the question of why additional funds are not

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still forthcoming. The latter hypothesis is a direct application of the market failure rationale discussed earlier, and suggests that the dual state versus federal funding mechanisms for research do not adequately compensate individual states for the benefits which spillover into other states.

Others, such as Hertford and Schmitz (1977) and Pasour and Johnson (1982), focus attention on the validity of the rates-of-return estimates themselves. The inference is that shortcomings in the analytical framework used to identify the costs and benefits from agricultural research have meant that many prior estimates of the (ex-post, marginal and average) social rate of return to agricultural research have, on balance, been biased upward.

Fox (1985) approaches the rates-of-return calculations from a public finance point of view. He argues that previous rates-of-return studies failed to discount their estimates by the deadweight losses in factor and product markets which occur when government expenditures are financed by distortionary tax collections. When coupled with the notion that the social rate of return to conventional capital is undervalued by neglecting benefits which do not accrue to the private investor, Fox (1985, pp. 810–811) concludes that "agricultural research conducted at public expense in recent years has generated a social rate of return comparable to investments in the corporate sector, and neither under nor overinvestment seems to be the case".

Fox's assessment notwithstanding, Oehmke (1986) has recently argued that actual research funding will be consistently smaller than optimal funding. He formally modelled the activities of a public sector agricultural research-funding agency, positing that a benign research-funding agency seeks to stimulate a level of technical progress that will minimize the cost of both the productive inputs and the level of research expenditures required to produce a given level of agricultural output. The research cost of achieving a certain level of technology is directly influenced by a supply-side parameter, $\rho$, which represents non-research factors which decrease the cost of doing research and translating research results into agricultural productivity gains. The demand for agricultural output is enhanced by increases in income and population which are represented by a shift parameter, $\delta$. The optimal level of research expenditures will increase if $\delta$ or $\rho$ increase, but over time the actual level of spending is less than optimal if institutional rigidities generate consistently slow responses to secular increases in $\delta$ or $\rho$, or the funding agency uses imperfect historical values of $\delta$ or $\rho$ in its optimizing calculus.[2]

Oehmke's model makes explicit the objectives of the public sector research-funding agency rather than presenting various ad hoc, albeit potentially legitimate, rationales to account for the perceived underinvestment in publicly funded agricultural research. Nevertheless, the approach is still firmly in the tradition of standard welfare analysis. The notion that public sector research funding agencies make investment choices in pursuit of a Pareto optimum outcome is central to this view of the world.

**Political economy perspective**

For our purposes, these traditional explanations of the underinvestment hypothesis are of limited value in understanding cross-sectional, temporal differences in the structure of public sector support for NARS. In particular, attempts to account for systematic variability in the relative levels of public sector investment in NARS across countries – whether stratified, for example, by per-capita income, the share of agriculture in GDP, or the relative size of the agricultural labor force – are not well served by arguments focusing more directly on a supposedly pervasive tendency to underinvest in agricultural research.

To be sure, Oehmke's model has the potential to address structure-of-support issues. One could envisage that cross-sectional differences in the $\delta$ and $\rho$ shift parameters which he identified could lead to systematic cross-sectional differences in the optimal level of research support. Whether or not this leads to systematic cross-sectional differences in the actual level of support is not entirely clear. This is certainly a function of the rate and level of adjustment of actual relative to optimal spending levels – an issue not specifically addressed in Oehmke's work.

An alternative and potentially rich approach for understanding structural differences in the absolute or relative level of public sector support afforded NARS lies in the neoclassical political economy perspective. The neoclassical political economy approach no longer views the state simply as an autonomous decision maker or "exogenous force trying to do good" (Colander, 1984, p. 2) but rather, as Wellisz and Findlay (1988, p. 60) aptly put it, more "as a broker or mediator between interest groups with economic policy resulting from the pushes and pulls of these factions". This shifts the focus towards income appropriation issues, whereby state (and indeed private) resources are used to acquire rather than simply generate income.

Srinivasan (1985) has characterized this literature into three strands, namely (a) the collective choice analyses of Olson (1965, 1982) and others which have sought to account for the pervasive lobbying activities of special interest groups or 'distributional coalitions'; (b) the public choice school of Buchanan and Tullock (1962; Buchanan et al., 1980) and their followers; and (c) the international trade and development school, which includes Krueger's (1974) celebrated work on the rent-seeking behavior of agents who seek to appropriate the scarcity premiums or rents often embodied in import licenses.[3]

Attempts to assess public support of agricultural research in a neoclassical political economy framework have been limited. Guttman (1978) and Rose-Ackerman and Evenson (1985) developed informal models of the collective choice genre to argue that rent-seeking behavior by the ultimate beneficiaries of research operates through the political system to draw resources into U.S. public agricultural research.[4]

Anderson (1981) draws on Downs' (1957) concept of a political market –

where public agencies, acting in their own self-interest, supply policy interventions which best favor the individuals or 'distributional coalitions' whose political support carries with it a demand for such interventions – to conclude that agricultural research in developing countries would be underinvested. Under such a regime, those governments or their bureaucracies which are subject to political instability, and hence also to short (political) planning horizons, will favor policies which apparently have short and certain payoff horizons. Moreover, while it is possible to target some agricultural research programs – particularly for those commodities which face relatively elastic export demand (e.g., export-oriented estate crops) or import supply, where much of the benefits from research are captured by domestic producers – it is generally the case that the benefits from other forms of government intervention in the agricultural sector can be directed with greater certainty to specific 'distributional coalitions'. Consequently, price supports for particular agricultural commodities or input subsidies are likely to be favored over investments in agricultural research.

Lipton (1977), Bates and Rogerson (1980) and Braverman and Kanbur (1987) point to an urban bias in many developing countries, where low prices are paid to farmers for their produce in order to benefit urban consumers. In a related vein, Anderson (1983) and Anderson and Hayami (1986) argue that policies which tax agriculture relative to manufactures, tend to be used since the political cost of obtaining additional support for agriculture is high relative to additional support for food-deficit households and manufacturers. Moreover, as countries move up the development ladder, rising per-capita incomes and Engel's Law conspire to drive down food's relative share in the consumer budget. Thus the political cost of public support for agriculture relative to manufacturing declines. At the same time, shrinking rural constituencies enable their members to reduce free-rider problems and capture a larger share of any redistributive efforts directed toward them, thereby strengthening incentives for these 'distributional coalitions' to seek their differential advantage (Becker, 1983). While this literature is generally concerned with market-related interventions (e.g., price and trade policies), the arguments are also appropriate when considering other forms of government intervention in agriculture such as agricultural research investments. Consequently, we would expect to see, ceteris paribus, an increasing commitment to support agricultural research as per-capita incomes rise.

## Data

The agricultural research expenditure figures used in this study are taken from Pardey and Roseboom (1987). The data represent a completely revised and updated series of total (i.e., capital and recurrent) public sector expenditures on national agricultural research systems (NARS), which differ from previous compilations in several substantive respects.[5]

Where possible the series measure public support from domestic and external sources for agricultural research, inclusive of crop and livestock research, as well as forestry and fisheries research. The series also attempt to include relevant university in addition to non-university research, while maintaining a commensurable institutional coverage within countries over time. The country coverage of the series is more comprehensive than most previous efforts, with a special attempt being made to include data from the numerous small NARS.

Most significantly, all expenditure data were collected in current local currency units. This enabled us to avoid potentially distorting currency manipulations when calculating any currency-based ratios such as the agricultural research intensity ratio.[6] Expenditure and output data were deflated to constant 1980 local currency units using country-specific implicit gross domestic product (GDP) and, where relevant, agricultural GDP deflators before performing any growth rate calculations. If required, value-based figures measured in constant local currency units were then converted to constant 1980 US dollars by applying 1980 Purchasing Power Parity exchange rates obtained from Summers and Heston (1988).

The idea was to standardize currency conversions. In particular, any currency manipulations of research expenditure data which were made represent a practical compromise to applying country-specific agricultural research deflators and agricultural research purchasing power parity indices. Inappropriate treatment of such matters can have non-trivial quantitative and qualitative impacts on the data, as Pardey and Roseboom (1988) demonstrate in some detail.

While we maintain that the temporal, cross-country commensurability of our research expenditure figures represents an improvement over previously available series, one should not underestimate the difficulties of ensuring consistency in such a series. To minimize the influence of spurious variability and missing observations, we chose to present all the indicators developed in this paper as quinquennial averages. While this may artificially dampen variability for strongly trending data, we would argue that 5-year averages offer more realistic global comparisons than the point estimates used by many previous analysts.

## Findings

Figure 1 plots public agricultural research expenditures in relation to agricultural gross domestic product (AgGDP) for 40 high and low-income countries over the 1970–1985 period.[7] Confirming Boyce and Evenson's (1975) earlier finding, we obtain a strong positive relationship between country-level per capita GDP and the agricultural research intensity (ARI) ratio for 90 high, medium and low-income countries over the 1970–85 period ($\rho$=0.61). This correlation appears to weaken a little during the 1980–85 period ($\rho$=0.55). None of the low-income countries managed to spend at or above the World Bank's 2% level, while 56% of the high-income countries report spending levels in excess of 2% of AgGDP by the 1980–85 period.

Table 1 aggregates the country-level data to show that the pattern of increase and average level of research spending, as indexed by the ARI ratio, varies markedly by income group. Averaging over the 1970–85 period, public expenditures on agricultural research by the low-income countries amounted to just on one-half a percent of agricultural GDP. As a group, high and middle income countries have ARI ratios which are 3.8 or 2.2-fold higher than corresponding ratios for the low-income countries.

Moreover, the 1970 to 1985 period has seen a divergence rather than convergence in the ARI ratios of high versus low and middle-income countries. For the 69-country sample in Table 2, the low and middle-income countries managed an average rate of growth in their ARI ratios of only 0.44% and 0.50%, respectively, while the high-income countries grew by 4.28% per annum. Turning to the components of the ARI ratio, we find there is a tendency over this period for per-capita income levels to be negatively related to the growth in real AgGDP, but positively correlated with the growth of real public sector agricultural research expenditures (Table 2). Thus, while the low and middle-income countries demonstrated a propensity to increase real support for agricultural research, the much larger increase in support by high-income countries, coupled with a significantly slower growth in the size of their agricultural sectors, results in a growing disparity in ARI ratios across income classes.

Table 1 also groups data on public agricultural expenditure (PAE) ratios by income class. PAE ratios measure direct government support for agriculture as a percent of AgGDP. Such support includes government expenditures on the administration of various government programs including agrarian reform, land settlement and management affairs; farm price and income programs; plus forestry and fisheries programs. It also includes direct government payments

Fig. 1. Agricultural research intensity (ARI) ratios – high and low-income countries, 1970–1985. 1, 1970–1974; 2, 1975–1979; 3, 1980–1985.

○, low-income countries: BG, Bangladesh; BF, Burkina Faso; BN, Benin; BR, Burundi; CH, China; ET, Ethiopia; GH, Ghana; HT, Haiti; IN, India; KY, Kenya; MG, Madagascar; MW, Malawi; ML, Mali; NP, Nepal; PK, Pakistan; RW, Rwanda; SO, Somalia; SL, Sri Lanka; SU, Sudan; TZ, Tanzania; TO, Togo; ZA, Zaire.

■, High-income countries: AU, Australia; AS, Austria, BE, Belgium; CA, Canada; DK, Denmark; FN, Finland; FR, France; IC, Iceland; IT, Italy; JP, Japan; NL, Netherlands; NZ, New Zealand; NW, Norway; SP, Spain; SW, Sweden; UK, United Kingdom; US, United States; WG, West Germany.

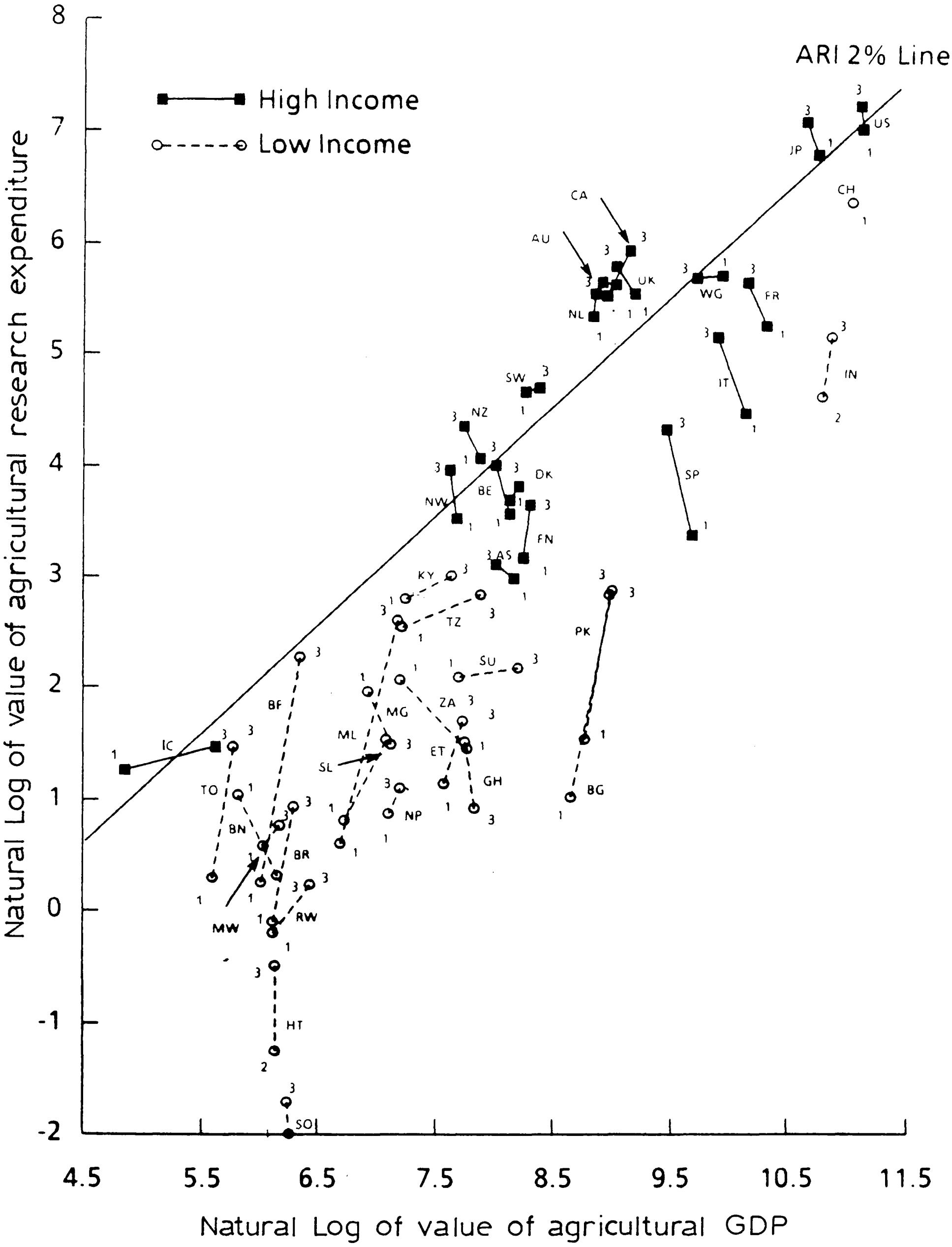
ARI 2% Line
High Income
Low Income
Natural Log of value of agricultural research expenditure
Natural Log of value of agricultural GDP
US
JP
CH
CA
AU
UK
NL
WG
FR
IN
IT
SW
NZ
SP
DK
BE
NW
FN
AS
KY
TZ
PK
SU
ZA
MG
ML
ET
SL
GH
BG
NP
IC
BF
TO
BN
BR
MW
RW
HT
SO

TABLE 1

Mean agricultural research intensity, public agricultural expenditure, relative research expenditure ratios, and share of agriculture in total public expenditure by time period and income group[a] (in percent)

| Income group | Agricultural research intensity ratio[c] | | | | Public agricultural expenditure ratio[d] | | | | Relative research expenditure ratio[e] | | | | Share of agriculture in total expenditure |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1970–74 | 1975–79 | 1980–85 | 1970–85 | 1970–74 | 1975–79 | 1980–85 | 1970–85 | 1970–74 | 1975–79 | 1980–85 | 1970–85 | 1970–85 |
| Low | 0.44 | 0.32 | 0.55 | 0.51 | 4.04 | 4.64 | 5.73 | 5.08 | 12.19 | 8.50 | 10.34 | 10.10 | 9.53 |
| | (16) | (14) | (15) | (21) | (22) | (26) | (22) | (29) | (16) | (13) | (14) | (21) | (30) |
| Lower- | 0.89 | 0.60 | 0.93 | 0.79 | 5.84 | 9.02 | 12.55 | 9.28 | 9.70 | 10.20 | 11.32 | 10.60 | 7.01 |
| Middle | (21) | (26) | (26) | (32) | (26) | (35) | (29) | (37) | (16) | (24) | (24) | (31) | (41) |
| Upper- | 0.87 | 0.91 | 1.09 | 1.00 | 12.58 | 14.08 | 18.00 | 14.83 | 12.06 | 10.03 | 10.96 | 10.36 | 5.00 |
| middle | (14) | (19) | (16) | (20) | (23) | (25) | (19) | (25) | (13) | (18) | (14) | (18) | (25) |
| High | 1.48 | 1.96 | 2.24 | 1.93 | 25.28 | 30.94 | 29.37 | 29.41 | 6.75 | 8.92 | 9.38 | 8.22 | 4.02 |
| (general) | (16) | (18) | (18) | (19) | (13) | (17) | (17) | (19) | (10) | (15) | (16) | (18) | (20) |
| High[f] | 1.59 | 1.86 | 2.24 | 1.91 | 21.03 | 22.98 | 23.98 | 23.21 | 10.13 | 10.61 | 14.72 | 11.18 | 4.00 |
| (central) | (17) | (17) | (18) | (19) | (17) | (18) | (18) | (19) | (14) | (15) | (16) | (18) | (20) |
| Total | 0.92 | 0.94 | 1.20 | 1.00 | 10.22 | 12.76 | 15.30 | 12.90 | 10.44 | 9.57 | 10.59 | 9.94 | 6.70 |
| | (67) | (77) | (75) | (92) | (82) | (101) | (87) | (110) | (53) | (70) | (68) | (88) | (116) |

[a]Excluded from all calculations: Eastern European non-market economies; High-income oil-exporting countries (Kuwait, Libya, Oman, Saudi Arabia, Bahrain, Brunei, Qatar); and People's Republic of China.

[b]Income Groups are defined using the World Development Report 1985 classification (per capita GNP in 1983 US$ where: Low, <$400; Lower-middle, $401–1635; Upper-middle, $1636–6850; High, Industrial market economies).

[c]Agricultural research intensity (ARI) ratio = Public agricultural research expenditure/Agricultural gross domestic product.

[d]Public agricultural expenditure (PAE) ratio = Government expenditure on agriculture/Agricultural gross domestic product.

[e]Relative research expenditure (RRE) ratio = Public agricultural research expenditure/Government expenditure on agriculture.

[f]For comparative purposes, the ratios calculated using central government level expenditures only are included.

Figures in parentheses denote number of observations.

Source: Authors' calculations based on data from Pardey and Roseboom (1987).

TABLE 2

Average annual rates of change for various agricultural research and output indicators over the 1970–74 to 1980–85 period (compound percent change)[a]

| Income group[b] | Number of countries[c] | Annual rate of change | | |
|---|---|---|---|---|
| | | ARI ratio (%) | Agricultural research expenditures (%) | AgGDP (%) |
| Low | 14 | 0.44 | 2.91 | 2.47 |
| Lower-middle | 23 | 0.22 | 3.96 | 3.71 |
| Upper-middle | 11 | 1.31 | 3.96 | 2.89 |
| High | 17 | 4.28 | 5.63 | 1.45 |
| Total | 65 | 2.42 | 4.72 | 2.38 |

[a]Calculated as $g=\text{antilog}\ [(\ln\bar{r}_{t_1}-\ln\bar{r}_{t_0})/(t_1-t_0)]-1$, where $\bar{r}_{t_0}$ *and* $\bar{r}_{t_1}$ represent the 1970–74 and 1980–85 average, respectively, and $t_0$ and $t_1$ represent the mid-point of the available observations of each sub-period.
[b]Figures are weighted group averages where the weights represent the 1979–81 average proportion of purchasing power parity converted agricultural gross domestic product for each income group accounted for by each country.
[c]Excludes Brazil, Bangladesh, India, Mexico and Pakistan because the relative size of the (large) agricultural sectors of these countries within each of their income groups, in conjunction with high growth rates in real agricultural research spending (> 14% except India (6.8%)) result in upwardly-biased weighted income group averages which distort the representativeness of the averages for their income group.
Source: Authors' calculations based on data from Pardey and Roseboom (1987).

to agriculture in the form of commodity support programs, input subsidy programs, and the management and execution of agriculture, forestry and fisheries research programs. However, invisible support for agriculture through undervalued exchange rates or price intervention mechanisms such as the variable levy scheme of the European Community are excluded from this measure.

The PAE ratio captures the relative priority which agricultural spending receives in relation to the size of the agricultural sector itself. As per-capita incomes rise the share of agricultural expenditures in total public expenditures declines dramatically, while PAE ratios increase nearly 5-fold when comparing low-income with high-income countries (Table 1). The neoclassical political economy perspective which is consistent with these increasing PAE ratios is given an empirical dimension in Table 3. With rising per-capita incomes there appears to be a substantially enhanced incentive for rural 'distributional coalitions' to secure disbursements of public expenditures in their favor. Direct public sector agricultural expenditures averaged US$ 30 per capita for those in the agricultural sectors of low-income countries and US$ 3,294 per capita for high-income countries – nearly a 110-fold increase in support per capita. At the same time, the direct financial burden of this expenditure, indexed over

TABLE 3

Public spending relative to economically active agricultural and non-agricultural population (1970–85 average)[a]

| Income group | Percent economically active population in agriculture | Total government expenditure per capita (US$) | Total agricultural expenditure (US$) | | Agricultural research expenditure (US$) | |
|---|---|---|---|---|---|---|
| | | | Agricultural population | Non-agricultural population | Agricultural population | Non-agricultural population |
| Low | 76.9<br>(37) | 245<br>(29) | 30<br>(28) | 125<br>(28) | 2.6<br>(28) | 10.9<br>(28) |
| Lower-middle | 51.5<br>(49) | 1093<br>(44) | 164<br>(41) | 157<br>(41) | 16.7<br>(42) | 14.6<br>(42) |
| Upper-middle | 29.0<br>(71) | 2966<br>(61) | 656<br>(57) | 232<br>(57) | 58.5<br>(59) | 14.4<br>(59) |
| High | 9.5<br>(20) | 7100<br>(20) | 3294<br>(19) | 296<br>(19) | 239<br>(20) | 19<br>(20) |
| Total | 47.1<br>(137) | 2311<br>(120) | 768<br>(111) | 188<br>(111) | 61<br>(112) | 15<br>(112) |

[a]All expenditure figures first deflated to 1980 constant local currency units using country-specific implicit GDP deflators, then converted to U.S. dollars using 1980 purchasing power parity indices from Summers and Heston (1988).
Figures in parentheses denote number of observations.
Source: Authors' calculations based on data from Kang (forthcoming) and Pardey and Roseboom (1987).

the non-agricultural sector, exhibits a relatively modest increase from US$ 125 per capita in low-income countries to US$ 296 per capita for high-income countries. To the extent these per-capita agricultural and non-agricultural figures serve as rough proxies for the direct benefits and costs, respectively, of public support for the agricultural sector, they reflect the fact that, as development proceeds, the size of rural 'distributional coalitions' narrows while the tax base to support them widens considerably.[8]

Dividing the ARI ratio by the PAE ratio yields a measure we call the relative research expenditure (RRE) ratio. It represents the proportion of total public expenditure on agriculture spent on agricultural research.[9] It thus provides an indication of the relative importance given to research on agriculture within the constraints imposed by overall public spending on agriculture. This gives a very different perspective for comparing the extent of agricultural research spending by the various country income groups than does the more commonly used agricultural research intensity ratio, which standardizes research expenditure on the basis of the absolute size of the agricultural sector.

While there is no clear movement over time in the calculated RRE ratios, the striking result in Table 1 is that agricultural research appears to command as large a share of the public purse devoted to agriculture in low and middle-income countries as it does in high-income countries. Thus, while the ARI ratio indicates that spending on agricultural research as a proportion of AgGDP increases substantially with rising per-capita incomes, this is accompanied by a corresponding increase in overall government spending on agriculture measured relative to the size of the agricultural sector itself.

Moreover, the pattern of public spending on agricultural research, indexed over the agricultural and non-agricultural populations, is similar to that observed for total public spending on agriculture. In particular, per-capita agricultural research expenditures also appear to increase dramatically for the agricultural sector but relatively modestly for the non-agricultural sector during the course of economic development. However, it was surprising to observe that the per-capita rate of increase in research support paralleled the per-capita rate of increase in direct support to the agricultural sector as a whole, to result in a fairly constant RRE ratio across country income groups.

Clearly the asymmetry between the long lags required to realize uncertain payoffs to agricultural research and the relatively shorter, politically-driven, planning horizons usually confronted by government policy makers, distinguish agricultural research expenditures from most other forms of public sector interventions in agriculture. According to the neoclassical political economy framework, it follows that research is likely to fare relatively worse than non-research forms of government assistance to agriculture as political and/or bureaucratic instability increases.

However, there are several reasons why average RRE ratios, stratified by per-capita income, may fail to capture this hypothesized relationship. First, the average level of instability in the politically mediated 'redistributive process' may not systematically vary by income class. Further, the government expenditure figure used here represents only a partial measure of transfers to the agricultural sector. If the proportion of total transfers captured by government expenditures does vary on average by income class, then we would not expect the RRE ratio adequately to represent the shifting propensity of governments to support research versus non-research forms of intervention. And finally, whether-or-not the ultimate benefits flowing from direct government support for agricultural research are appropriated by rural 'distributional coalitions' is not entirely clear. The trade status of the commodities being researched, the nature of pricing and marketing interventions in the agricultural sector, tenancy agreements, adoption patterns and the like all act to channel these benefits to one particular group or another. Unravelling these issues, while difficult, should provide useful insights into some of the fundamental mechanisms driving public intervention into agricultural research.

## Summary

The empirical analysis reported here shows significant positive correlation between the relative level of public support given to agricultural research and national per-capita income. Too, a growing disparity in ARI ratios between high income and low and medium-income countries appears to be driven as much by differences in the relative growth of AgGDP than simply by differences in the growth of real research expenditures.

Analyzing public agricultural research spending within the broader context of overall levels of support to agriculture gives a somewhat different perspective from that provided by ARI ratios. No dramatic differences between country income groups in the proportion of total government spending being allocated to agricultural research were observed. It is widely held that a lack of perception or predisposition on the part of policy makers to realize potential benefits to society from additional investments in agricultural research constrains public spending on research in low-income countries. The results in this paper suggest that a more fundamental limitation to increased public support in low-income countries may well lie in the financial and political constraints imposed by overall and agricultural-specific levels of public sector spending.

Placing agricultural research in a positive rather than normative conceptual and empirical framework may substantially improve our understanding of the policy-relevant forces which shape public support for agricultural research.[10] It may also serve to moderate expectations about the potential for large increases in public sector funding of agricultural research in low-income countries, which their relatively low agricultural research intensity ratios are taken to suggest are possible. This should improve the planning environment within which strategic decisions concerning national agricultural research systems are made.

## Notes

[1]Joseph and Johnson (1985) discuss the practical inadequacies of the market failure concept as a basis for government support of science and technology.
[2]One could presumably generalize this approach to admit the possibility that the public sector funding agency may also 'crowd out' private sector research activity so that public sector funding may 'over-shoot' the optimal level of support, and not merely 'under-shoot' as Oehmke seems to suggest.
[3]Bhagwati (1982) and others have generalized Krueger's work to account for a whole range of 'directly unproductive profit-seeking' activities such as the proliferation of quantitative trade restrictions (import quotas, domestic content rules, and voluntary restraints), import tariffs and the like. As Srinivasan (1985, p. 43) observes, "the essential feature of all these activities is that while they are rational and not wasteful from a private viewpoint they are often socially wasteful". Thus, the deadweight losses associated with publicly funded agricultural research which Fox (1985) identified, capture only part of the social losses, since they exclude the commitment by groups and/or individuals of resources (which would otherwise be productively employed) to lobbying efforts to influence government behavior.
[4]Pardey and Craig (1989) use U.S. data to provide empirical support for the notion that politically mediated demand-side forces matter in this instance.
[5]Kang (forthcoming) reports on the substantial quantitative differences between agricultural research intensity ratios obtained in this study with those reported by others such as Boyce and Evenson (1975), Oram et al. (1979), Oram and Bindlish (1981), and Judd, Boyce and Evenson (1986). For pre-1970 figures, see also Evenson and Kislev (1971, 1975). The draft version of the research expenditure data used in this study will be subject to some revision. We anticipate this will result in relatively minor qualitative changes, if any, to these findings.
[6]All supplementary expenditure data such as AgGDP and government spending on agriculture were also collected in current local currency units from the various UN, World Bank and IMF sources detailed in Pardey et al. (1988).
[7]For the sake of clarity, 50 middle-income countries were omitted.
[8]Of course, it is far too simplistic to infer that the direct costs for government support to the agricultural sector are entirely borne by the non-agricultural sector. However, as development proceeds the changing nature of the tax structure and the urban-rural population mix, shifts the predominant share of the tax burden to the non-agricultural sector.
[9]In compiling the government expenditure figures for the PAE and RRE ratio we elected to collect only expenditures at the central government level for the developing countries, in order to construct the most comprehensive time-series available. By examining the proportion of general government tax revenue accounted for by central government, it is possible to obtain some idea of the relative extent of central government activities in general government (i.e., central, state and local) activities. Using a 79-country sample (IMF, 1986b, pp. 52–53), centrally collected tax revenue for the overwhelming majority (80%) of developing countries accounts for at least 90% of total tax revenue, while the same was true for only six of the 20 industrial countries. Taking the ability to collect revenue as indicative of an infrastructure which has the capacity to administer independent expenditure policy decisions at the state and local level, we broadened the government expenditure series to include general expenditures for those high-income countries for which data were available (viz. Australia, Canada, Denmark, France, Iceland, Luxembourg, Fed. Rep. Germany, Switzerland, United States).
[10]See De Gorter and Zilberman (1986) for a useful start in this direction.

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