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On Intermediate Run Growth

Yair Mundlak

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On Intermediate Run Growth

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In models where economic growth is determined by technological change and resources devoted to activities which change technology, the scope for economic policies to increase growth is limited. Examples from experiences with policies and growth in Chile and in Argentina are used to develop an alternative framework to measure and understand the role of policies in influencing economic growth. To examine this role of policies, it is necessary to show the channel through which they effect growth. Using a choice-of-techniques model of endogenous technological change, this research argues that policies have both a direct effect on productivity, which works through resource allocation, as well as an indirect effect which works through resource accumulation.

Yair Mundlak is a member of the Institute for Policy Reform's Advisory Board

ON INTERMEDIATE RUN GROWTH

by

Yair Mundlak[1]

ON POLICIES AND GROWTH

One way to think of economic growth is to view it as an autonomous process, which in spite of some shocks, proceeds at a pace which is pretty much determined by the time preferences of the individuals and their attitude toward risk. The engine of growth is the change in technology and this is determined by the amount of resources that are allocated to activities which change the technology, referred to as human capital. This view of the process yields a consistent paradigm of sustainable growth where there is no need to rely on exogenous technical change. This theory is useful as far as it goes but in its present form it is insufficient, at this stage, to confront the data and explain cross-country, and within-country, differences in the growth rates.

In studying variations in growth rates, the length of the time period used in computing the growth rate is important. If the growth rates are written in the stars and the country will eventually achieve its starred rate, short term variations of a decade or two can be termed "shocks" and be ignored. The implication is that the growth is path independent.

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Trying to explain data, doubt is built up that this is a good methodological strategy. This is not an esoteric theoretical issue and its implications are important. A ten or twenty years of growth loss can have a dramatic effect, and particularly for those who spend their productive life in a period of lost opportunities. Their loss per se is not a reason to change the theory but it provides a strong incentive to examine closely its causes, implications and the scope for policies. In so doing, we take a modest posture and think of a foreseeable future, say a decade or two. For those who want to think beyond that period it can be reminded that the longer run consists of a sequence of decades. It makes a good sense to concentrate on the more immediate ones.

The scope for policies to increase the growth rate when the economy is on its long term growth path, is rather limited. However, policies can make things worse off and this is a sufficient reason not to ignore them. The common case is that of countries which do not fully utilize their potential and the problem at hand is that of a transition to a more productive path. Looking at policies in a more realistic settings, the question of whether or not policies matter in this case is basically an empirical question and it cannot be decided on axiomatically. There is plenty of evidence on the effect of policies, often negative, on growth. I assume that every one in the audience can bring illustrations from his own experience in the field. I will bring some illustrations from my own research.[2]

A good example for a starter is Chile, as can be seen from Figure 1 which shows the growth of per capita income over the period 1936-90. Two things are striking: First, the steady growth over a relatively long period of 1936-70. The "envelope" line reflects a fairly stable growth at an annual

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[2] Throughout, the examples from Chile are based on two studies by Coeymans, J.E, and Y. Mundlak, "Endogenous Technology and Sectoral Productivity, Chile 1962-82" (mimeo, 1991) and "Sectoral Growth in Chile" (forthcoming). The examples from Argentina are taken from Cavallo, D and Y. Mundlak (CM 1982) *Agricultural and Economic Growth in an Open Economy: The Case of Argentina*, Washington, D.C.: IFPRI, Research Report #36, 1982, and Mundlak, Y. D. Cavallo and R. Domenech (MCD, 1989) *Agriculture and Economic Growth, Argentina 1913-1984*, Washington, D.C.: IFPRI, Research Report #76, 1989. Examples for the Punjab are taken from McGuirk, A. and Y. Mundlak *Constraints Incentives and the Transformation of Punjab Agriculture: 1960-1980*, Washington, D.C.: IFPRI, Research Report #(87), 1991.

compounded growth rate of 1.6 percent. Second, the consequences of the shocks to the economy introduced by the Allende government (1970-73) and the difficulties of returning to normality, by whatever definition of normality one wishes to use. Basically, there are two periods of catching up, 1974 to 1981 which was followed by a deep recession in 1982, and the subsequent period up to date of a continuous growth. Both, the fall off the envelope line and the partial return to it are results of policies, some of course with negative effects.

The second example is given in Figure 2, showing the growth path of Argentina in the period 1913-1984 in comparison to that of Canada and Australia, two countries which like Argentina are well endowed in land and were open to immigration. These countries lagged behind Argentina in their economic growth in the period 1880-1920 but the wheel of fortunes was turned around in the post war period. The shocks that caused the deterioration in the performance of Argentina were initially the Big Depression of the thirties, but more importantly, the Peronists policies which the country has recently begun to discard. These policies, even when they were well meaning, are notorious for their time-inconsistency, as well as internal inconsistency. Perhaps, more important, they did not only damaged the natural comparative advantage of the country but also ruined the competitive structure of the economy by generating monopolies in key industries.

If growth depends only on human capital, then perhaps the effect of the policies should not have been as strong as the data show. After all, the level of education, if anything, has not declined, neither in Chile nor in Argentina. Or for, that matter, it is not low in Russia. It thus appears that human capital is not the only factor determining growth. To examine the role of policies in the growth process it is necessary to show the channels through which they affect growth. We will argue that policies have a direct affect on productivity as well as an indirect one which works through the resource accumulation, physical as human capital. Before taking up this issue, we need to examine the meaning of technology in the context of this discussion.

We begin with the observation that at any point in time countries do not use all the advanced techniques that are available in the market. In the IPR-IRIS conference in Prague in March 1991 we visited a compressor factory that was doing very well in producing for the East Block market. Recent events force them to compete in the global market. To do this, they have to purchase the techniques that will improve their product and to renovate the factory. In the closing session of the conference, it was suggested that there may be no advantage for a foreign firm with the up to date technique to join this firm to produce a new product. The argument was that it may be cheaper to simply start a new firm. This extreme view discounts the specific human capital that is embedded in the existing firm. This discussion illustrates vividly prevailing economic issues that affect growth and need more attention in research.

On the way to this meeting I read an interview with Hilmar Kopper, Head of the Board of Managing Directors, Deutsche Bank, (Barron's November 18, 1991), which contains the following:

> Question: "A study by your own bank's economic department indicates ...., and that productivity there (in eastern Germany) now is only one-third of what it is in the western region."
>
> Answer: " ...If you give eastern Germans modern tools, materials, plants and logistics, their skills will allow them in a very short time to become 100% as productive as people in western Germany. Within our bank, I'd guess that the efficiency of our eastern workers is, on average around 75% of that of our western workers. And increasing."

Both of the above examples indicate the role of physical capital as a constraint to the introduction of modern technology. More generally, it is noted that the *available technology*, a term we use to refer to the collection of all the known techniques of production, is richer than the collection of all the techniques which are actually used, to be referred to as the *implemented technology*. The reason is of course economic, it is costly to introduce a new technique, and therefore there must be some incentives to do so. In general, new techniques are, and expected to be, more capital intensive than the existing ones and if capital is scarce, its availability will restrict the pace at which such new technique can be implemented.

THE GREEN REVOLUTION AS AN EXAMPLE

To descend from the clouds to reality, I want to bring an illustration from the Green Revolution, a term used to describe the impact of the introduction of high-yielding varieties of cereals which had a dramatic effect on the production of wheat and rice, as well as other crops. It emerged from CYMMYT in Mexico in the early 1960s and spread all over with a considerable impact on cereal production in the densely populated countries of Asia. It is also mentioned prominently in the *World Development Report 1991*. This case is interesting on its own and it can also be used to illustrate some general propositions.

On the surface, an innovation of a new and more productive variety should be very simple to implement. The fact of the matter is that even though these varieties were introduced in India in the mid 1960s, they are still not fully used and some area is devoted to traditional varieties.

The pace of adoption of new varieties is not a new research topic. It has been widely recognized that when new crop varieties appear, they are not immediately implemented to their full potential. In fact, it usually takes a long time before they reach their full capacity. The same is true for other new (at their time) practices, for instance the mechanization of agriculture or more recently, cultivation under plastic. Several explanation are given for this delayed response. There is the question of information; producers have to learn to grow the new varieties, or more generally to use the new techniques. More sophisticated techniques require some human capital to implement and therefore farmers with inadequate schooling will be unable to quickly adapt them. At the stage of learning, there is uncertainty as to the performance of the new techniques and as such they are considered to be risky and therefore caution is taken in their implementation.

All these explanations are interesting and sound but they fall short of explaining the case of the Green Revolution. The shift in the Indian Punjab to modern varieties of wheat and rice was initially very fast. The first year the modern wheat varieties were introduced, they were sown on 30 percent of the total wheat area. This proportion increased to 70 percent by the third year. The experience in rice was similar, once suitable rice varieties were introduced. Thereafter, the progress was more gradual. This time path of adoption is inconsistent with the aforementioned explanations. The speed at which the new varieties were initially implemented suggests that from the outset their superiority was recognized and that on the whole the farmers were willing and able to take the risk involved in making the shift.

What, then, were the main factors which determined the pace of the transition to the modern varieties? The modern varieties of wheat and rice were much more productive than the traditional varieties. However, to fully utilize the yield potential of the modern varieties, it was necessary to apply considerably larger doses of fertilizers and water per unit of land in comparison to the quantities used in the traditional varieties. For historical reasons, the Punjab had well developed irrigation system which made it possible to have initially a strong response to the introduction of the new varieties. Eventually, a further increase in the area planted to modern varieties required an expansion in the supply of fertilizers and irrigation facilities, as well as, an expansion in complementary inputs such as electricity needed for the operation of wells and roads needed to integrate the remote areas within the market. For this reason the speed at which the new varieties were implemented was largely determined by the productivity of the modern varieties relative to the traditional varieties and the availability of the inputs which the modern varieties used intensively. The possibility to expand such inputs in a short time period was restricted by the scarcity of capital. Thus, it is the scarcity of physical capital that controlled the pace of the transition to the modern varieties.

How are these explanations derived? The techniques of production analyzed in the study are those of the major crops grown in the Punjab. The production decisions are formulated by assuming that, in the short-run, farmers simultaneously allocate their resources between the various techniques (inter-technique allocation) and decide on the level of intensity of technique implementation (intra-technique allocation) so as to maximize their value added from production. These decisions are made subject to the following constraints: availability of cropped area, irrigation capacity by source (private tubewells and government canals), and fertilizer. The economic performance and, therefore, decisions are also influenced by the availability of infrastructure, such as roads, as well as by the local physical environment. Consequently, the decision on area allocation to the various crops is a function of prices, the constraints, environmental factors and the available technology.

The role of those variables in affecting the share of the techniques in the sown area is shown in the attached table. Note that the increase in irrigation facilities, fertilizers and roads increase the share of the modern wheat at the expense of the traditional wheat. Also, private irrigation, largely tubewell irrigation, is biased in favor of wheat at the expense of rice. Otherwise, the modern rice varieties also responded favorably to the increase in these quasi fixed inputs.

The coefficients of the price variables are allowed to depend on the implemented technology. The premise is that a shift to the new more productive varieties or techniques generates higher returns to land when compared to the existing varieties, and, as such, a given change in prices will have a stronger effect on area allocated to the more productive variety than to the traditional lower yielding variety. The yields of the various crops are determined by the composition of techniques planted and the intensity of their implementation.

Changes in the constraints require investment. As resources are scarce, they have to be attracted from other sectors. A distinction is made between investment decisions taken privately by farmers, and those taken by the government. It is postulated that the private sector chooses levels of investment which maximize the present value of the future stream of income. As technical change occurs, the flow of income increases and investment becomes more profitable. As such, agriculture's share in total investment should increase.[3] This is simply to say that farmers respond favorably to incentives not only in their area allocation, as the table indicates, but also in expanding the quasi fixed inputs that restrict them to take a full advantage of the new opportunities. The results from equations which explain the variations in the quasi-fixed inputs indicate that the decisions made by farmers regarding irrigation, and indirectly regarding net cropped area, were responsive to the increase in profitability spurred by the introduction of the modern varieties. The elasticities of area irrigated by private resources with respect to prices and the availability of roads and fertilizers were particularly large.

The results are summarized by deriving both short-run and long-run elasticities which depend on the productivity of the implemented technology; the more productive the implemented technology, the greater are the elasticities. The short-run area elasticities by technique indicate that changes in the availability of quasi-fixed inputs have very significant inter-technique effects. In particular, the pace of the transition to the modern varieties of both wheat and rice is positively influenced by the availability of all quasi-fixed inputs. Further, given fixed levels of the quasi-fixed inputs, changes in incentives lead to important changes in the composition of techniques. Increases in the expected revenue of the superior varieties of all crops, whether due to an increase in expected price or yield, accelerated their adoption.

Even though the response to incentives was important, the magnitude of the elasticities suggest that inter-technique effects due to changes in the availability of quasi-fixed inputs are several fold larger than the same elasticities due to changes in the incentives (in absolute value). The availability of private irrigation and roads appears to have been particularly important in the transition process.

The short-run aggregate output elasticity with respect to a change in all (real) prices increased from nearly zero before the onset of the Green Revolution to a high of 0.18 in 1979, when the transition

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[3] The government's decision to invest is more complicated and is not captured in this study. However, it is apparent that the government also mobilized resources as the profitability of agriculture increased. The supply of fertilizers, electricity, roads, and to a lesser extent, public irrigation all increased over the period of the study.

to the modern varieties of wheat and rice was largely complete. Thus, conditional on the availability of quasi-fixed inputs, aggregate agricultural output does not respond much to a change in price. On the other hand, the long-run output elasticities with respect to prices are all large relative to their short-run counter parts. These elasticities reflect the strong response of private irrigation and, the somewhat more moderate response of net cropped area and fertilizers as incentives changed. The long-run aggregate supply elasticity, although negligible before the onset of the Green Revolution, reached a high between 1.3 - 1.5 in the late 1970s.

Given the results of this study, one can conclude that as long as expansions in irrigation facilities and fertilizers are possible and lead to further adoption of the more productive techniques, aggregate agricultural output will continue to respond significantly to changes in economic incentives. However, once the transition to the new varieties is fully played out, stagnation will occur. Once stagnation occurs, further substantial growth in agricultural output will require the introduction of new higher valued techniques/products. If these new techniques are more capital-intensive than the previously implemented techniques the rate of capital accumulation will continue to play a critical role in the growth of agriculture.

SOME GENERALIZATIONS

The analysis of the Green Revolution illustrates some general propositions. The technical change was instigated by the appearance of the new varieties, or more generally, by the change in the available technology. The innovation of the new crop varieties took place in a public experiment station and was made available free of charge. Thus, the problem was that of implementation. The main reason for the delayed response was the constraints imposed by some capital goods. This constrains were gradually relaxed by investment, the rate of which depended on the expected rate of returns on such investment.

The rate of returns reflected both demand and supply environment, which in the general case are both affected by policies. With this analogy, we can now address the main problem, to assess the quantitative effects of these components on growth. This is a major empirical undertaking but not free of conceptual problems. What we can do here is to review some important issues supplemented by some illustrations.

Technology: As an empirical proposition it can be said that investing in research and development increases knowledge and improves the available technology. It is beyond the scope or the ability of economics to say fundamentally much about the productivity of this process except to assume that the monotone relationship between investment in the production of knowledge and output of knowledge will continue and will improve the available technology. Whether the production function of knowledge is concave or a convex we do not know, although this type of information would be very valuable to have. Apparently we manage without it, sometimes empirical rules are sufficient and useful.

The term human capital refers to knowledge embodied in people, as well as disembodied knowledge generated by people. Conceptually, we can measure directly the inputs of variables such as schooling which reflect the component embodied in people. What we can not measure directly is the disembodied component which includes the accumulated knowledge found in libraries and which, most significantly, determines the path of new research. This knowledge component is internationally available and countries have access to it, in one form or another, perhaps with some delay, even without investing in its development. As we do not have a direct measure of the disembodied human capital, its value has to be derived indirectly from the production function after allowing for the contribution of the various inputs which can be measured, including measures of education. The result is similar in spirit, but not in details, to the Solow residual and as such it is subject to similar limitations. We return to this below.

New knowledge is translated to new techniques which appear, on the whole, to be more capital intensive. This again is an empirical observation which, however, can also be argued on the basis of general principles. The increase in capital intensity makes it possible to preserve the rate of return on capital as the capital labor-ratio increases. A similar argument can be applied to the embodied human capital, but not without some complications. New techniques generate demand for new skills. For instance, the development of the computer created new subjects such as programming. Those who acquired the skill early realized good returns to their investment and this in turn attracted more workers and talent to this field. At the same time, new techniques may decrease the demand for other skills. Skills like machines may become obsolete. But unlike machines, people with obsolete skills are retained. The upshot of this is that the implemented technology, which is determined by the available technology, the availability of physical capital and the incentives determine the demand for skills. This of course has an important effect on income distribution. The winners are those with the demanded skills. The losers do well if they succeed in maintaining their employment at a constant wage.

There is nothing like an extreme exaggeration to demonstrate a point. In this spirit, we can imagine sending the graduate class in physics or engineering to remote villages in developing countries. This will increase the level of human capital in these villages but its effect on productivity will be rather small if any. A long list of conditions for the increase in the level of productivity in these villages will have to be drawn and this list will also include physical capital. This forces us to be more specific in relating human capital to growth.

Constraints: The term capital used here is general. In the case of the Punjab example, it included irrigation facilities, capacity of fertilizer production, electricity and roads. At the general level of aggregation we can speak of physical and human capital. Physical capital is constructed by aggregating past investment, after allowing for depreciation and under some conditions, it measures the value of foregone consumption. Defining human capital is more difficult as the foregoing discussion suggests.

When the new technique is more capital intensive than the one in use, the appearance of the new capital intensive techniques will increase the demand for capital, and when the supply of capital is inelastic in the short run, the transition to the new technique will take time. In the process the old and the new techniques coexist. The length of the transition period depends on the speed at which resources flow among techniques as represented by the factor supply functions. To quantify the importance of the rate of return in this transition we can study the determinants of the proportion of the various techniques in total investments. At a higher level of aggregation, we can measure the relationships between the share of sectors of production in total investment and their differential rates of returns. This was done for Argentina for the share of agriculture in total investment and for Chile at a lower level of aggregation, where the sectors are agriculture, manufacturing and services. The results indeed indicate that the share of a sector in total investment increases with its expected rate of return. Thus the moral of all this is that if policies affect incentives, they affect investment allocation and thereby the rate of implementation of new techniques.

A similar analysis applies to the rate of total investment. In an open economy, the competition for capital is with the rest of the world and as such investment increases when domestic prospects improve and look promising. Hence, the competitive position of the country depends on current and past policies and institutions to the extent that they affect the rate of return. The empirical analysis for Argentina shows the importance of the rate of return in determining the level of overall investment. There is no point in discussing the same issue for the closed economy; the main consideration here should be to open it up. But if we think about the world as a whole, the rate of return will affect the total quantity of resources available for investment. The opening up of many economies, as we now observe, should have a positive effect on the supply of capital goods and as well as a change in the global distribution of capital. This, in turn, is expected to have an important effect on growth through the introduction of techniques which are both capital intensive and productive.

Incentives: In a world of many techniques, the aggregate productivity is determined by the techniques used and the level of their intensity. The choice of the implemented techniques, conditional on the available technology and resources, depends on the incentives which in turn reflect economic policies as well as the rules of the game, or the competitive structure of the economy, and other institutions. To illustrate, Figure 3 shows the positive response of fertilizers, tubewell irrigation and electricity in Punjab agriculture to the introduction of the modern varieties in the mid 1960s. The increase in the rate of return attracted resources which in turn facilitated the transition to the advanced techniques.

Figure 4 shows the differential growth of crop yields between Argentina and the U.S. in the period 1913-84. In the late 1920s, crop yields were similar, but after 1930, yields in Argentina were always below the U.S. levels. Comparing the average yields for the periods 1913-30 and 1975-84, agriculture in the U.S. tripled its yields. In Argentina they did not even double.[4] The reason for the slower progress in productivity in Argentinean agriculture is a direct consequence of the taxation of agriculture. The taxation was direct, through export tax, and indirect through the protection of non agriculture and macro policies which resulted in low real exchange rate. The indirect tax was by far more important as can be seen from Figure 5. The tax affected the returns to the farmers, or simply the incentives, and thereby the choice of techniques and their yields. It also affected the flow of resources into agriculture and thereby the investment needed to take advantage of the new technology that became available.

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[4] The weights for the Divisia index are those of Argentina.

Productivity: A major task is to capture the effect of the various factors under consideration on productivity. For instance, in the case of the Punjab, how do we allocate the growth in production to the change in the available technology and the investment in capital goods? What is the technical change here, that of the available technology or the gradual increase in productivity? What is the residual in each of these alternatives and what is its meaning?

We are not going to answer these questions directly, but rather indicate an approach which was followed to deal with this problem in the studies mentioned above. Total factor productivity depends on the choice of techniques, or the implemented technology which in turn depends on the available technology, the capital stock, and other possible constraints, and incentives. It can be shown that although strictly speaking in this case the aggregate production function does not exist, it can be approximated by a Cobb-Douglas like function where the coefficients themselves are functions of the state variables. This is not the place to be technical, but it is important to bring this point up because it demonstrates the channels through which policy affects productivity, and its time path or simply growth. The application of this analysis requires the identification of the state variables and introducing them directly into the analysis. This is done in the studies quoted above. Figure 6 illustrates the residuals from the production function derived using this approach for three sectors in Chile for the period 1962-72 compared with Solow residuals. It is apparent that the residuals obtained by this method are smaller. The difference between the two methods are due to the fact that we take into account the effect of the state variables on production.

To show the potential of this analysis, we return to Figure 2 which presents an alternative growth trajectory for Argentina which was obtained by assuming alternative, more restrained, macro policies and trade liberalization. This was obtained by estimating a structure which takes into account the effect of policies on sectoral incentives, the effect of such incentives on intersectoral allocation of labor and investment, and the direct and indirect effect of all these on productivity. It appears that had Argentina followed a different course in its economic policies, it could have performed like Australia. As this is a very timely example, it can be added that no explicit account was taken in this exercise of the elimination of the monopolistic structure of the economy. Current policies deal with this issue head on and if continued should produce a still better trajectory.[5]

DISCUSSION

The group of policies which affect productivity naturally also includes policy reforms. In the Chile study we examine the effect of the land reform that was instituted during the period 1965-73. The literature suggests that initially the reform had a positive effect on productivity.[6] At that time the inefficiency in farm operation was used as a criterion for expropriation of farms and this induced an improvement in productivity. As the reform progressed, the procedures used to expropriate had less to do with efficiency considerations and more with the sole objective of land redistribution. This increasingly aggressive expropriation led to farm labor unrest aimed at expropriating the farms in which they worked, disregarding the general criterion that might have existed at the time. The process eventually led to quasi paralyzation of the commercial farm sector in 1973, the last year of the Allende government. The approach outlined here makes it possible to incorporate the land reform as a state variable. This we do by incorporating the proportion of expropriated land in the analysis. As a result we get smaller productivity residuals for the period under reform as seen in Figure 6.

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[5] It is difficult to resist the temptation of indicating that the political history of Argentina might have been completely different had it not faulted in its economic performance. A more stable and prosperous economy might have prevented the recurring military control and thereby further improved the growth performance.

[6] Departmento de Economia Agraria, Universidad de Chile, "15 anos de Reforma Agraria en Chile." in *Panorama Economico de la Agricultura*, No.2, 1979.

A broader issue which is both the result of growth as well as affecting growth is income distribution. As indicated above, the demand for labor in general and for specific skills in particular are affected by the introduction of new techniques. A similar situation arises in different phases of the business cycle. As Chile tried to recover in 1975 and the demand for labor was increasing, it was largely absorbed in an increase in real wages rather than in a decline in unemployment which was quite high for a long period of time starting at the end of the Allende government. This is the case of the insiders benefiting from the changing environment at the cost of growth. I do not find a satisfactory explanation for this except to note that during the recovery wages were returning to their pre recession level, and that this was socially accepted. Be the case what it may, this demonstrates that policy reforms which should produce growth may run into serious bottlenecks.

CONCLUSIONS

The main message from the foregoing discussion is that the implementation of new techniques, or technical change, is largely tied up with the process of capital accumulation. Policies which reduce incentives reduce the growth that the country can achieve given its own environment. Capturing the effect of incentives on resource flow and growth is not a straightforward matter and this is the reason for disbelief in its existence. This whole issue is related to supply response which has been an active subject in agricultural economics. Elsewhere, I review the literature and indicate, as I also tried to sketch here, that the supply response is sizeable, but because it is related to mobility of resources, it takes time to complete. Being impatient by itself is not a productive alternative.

The emphasis in the discussion has been on the implementation of available technology, because this is largely the problem of the developing countries. They do not have to invest in moving the frontier. This is why they can grow faster. There is another reason. If the countries start with a very distorted set of policies, reforms should help resources to flow to the higher returns activities. This is obvious, but sometimes neglected when the issue of differential growth rates is addressed.

Finally, assuming that we know more about growth and the consequences of policies, will past mistakes disappear? They may be reduced but not necessarily disappear. The reason is that governments, as pure as they come, are not the social planners of the kind that the theory often assumes. They differ in one fundamental respect from the community which they suppose to serve, in the time horizon. It is not productive to ignore political survival as a major consideration in government decisions. You do not have to be predator to want to survive. In this sense, there is no overlapping generation and altruism in the government utility functions and this may lead to decisions which are inconsistent with what we might think is conducive to long term growth. This is also the source of variations in the data that facilitate some economic analyses.

Table

Punjab: Estimates of Area Allocation Equations

Variables*	Irrigated Wheat MV	Irrigated Wheat Trad.	Dry Wheat
Incentives			
MV Wheat	0.00123	-0.00089	
	(6.15)	(-6.20)	
IT Wheat	-0.00089	0.00041	
	(-6.20)	(2.81)	
I Gram	-0.00005	-0.00008	
	(-1.12)	(-1.59)	
D Wheat			-0.00077
			(-3.04)
D Gram			0.00009
			(0.53)
Constraints			
IRR Priv	0.74701	-0.73056	0.12686
	(6.24)	(-8.59)	(1.68)
IRR Govt	0.23259	-0.17860	0.88662
	(1.55)	(-1.63)	(7.28)
E Fert	0.00125	-0.00090	-0.00177
	(3.3)	(-3.08)	(-4.57)
Roads	0.02376	-0.00590	-0.00272
	(2.35)	(-0.75)	(-0.33)
Environment			
JS	0.00123	-0.00095	0.000749
	(3.16)	(-3.30)	(2.58)
R-Square	0.949	0.8097	0.9261

Variables	Irrigated Rice MV	Irrigated Rice Trad.	Dry Rice
Incentives			
MV Rice	0.00020	-0.00012	
	(3.36)	(-2.80)	
IT Rice	-0.00012	0.00011	
	(-2.80)	(1.64)	
I Maize	-0.00004	0.00001	
	(-1.24)	(0.21)	
I Cotton	0.000085	-0.00002	
	(3.35)	(-0.89)	
D Rice			0.00021
			(3.79)
D Maize			0.00003
			(0.97)
D Cotton			0.00004
			(2.05)
Constraints			
IRR Priv	-0.17733	0.03924	0.04272
	(-3.06)	(0.91)	(1.68)
IRR Govt	-0.11958	-0.13078	-0.00294
	(-1.79)	(-2.69)	(-0.09)
E Fert	0.00053	0.00018	0.00010
	(3.55)	(1.49)	(0.96)
Roads	0.05195	-0.01477	-0.00097
	(11.16)	(-3.69)	(-0.45)
Environment			
May	-0.00083	0.00014	-0.00007
	(-1.00)	(0.23)	(-0.14)
Jun	-0.00051	0.00093	0.00067
	(-1.13)	(2.64)	(2.49)
R-Square	0.9621	0.8759	0.9058

*The incentive variables are expected revenues per thousand hectares deflated by wage for the indicated variety. MV, IT, I, and D indicate whether the particular crop variety is modern, irrigated traditional, irrigated, or dry. IRR Pvt and IRR Govt are net irrigated area by private and government sources deflated by net cropped area ('000 ha.). E Fert is expected fertilizer available (nutrient kgs. per 1,000 ha. of net cropped area available in previous year). Roads measures km. of roads in district/1,000 ha. JS (June-Sept.), May and June are pre-planting rainfall variables (.01) mm.). District intercept shifters and a pre-green revolution intercept shifter are in the estimated equations but not included in the table. The Kharif irrigated and dry area equations (including rice) are all adjusted to correct for positive first-order autocorrelation following Parks (1967). T-Statistics are in parentheses.

Figure 1—Chile: Log per capita GDP, 1936-90

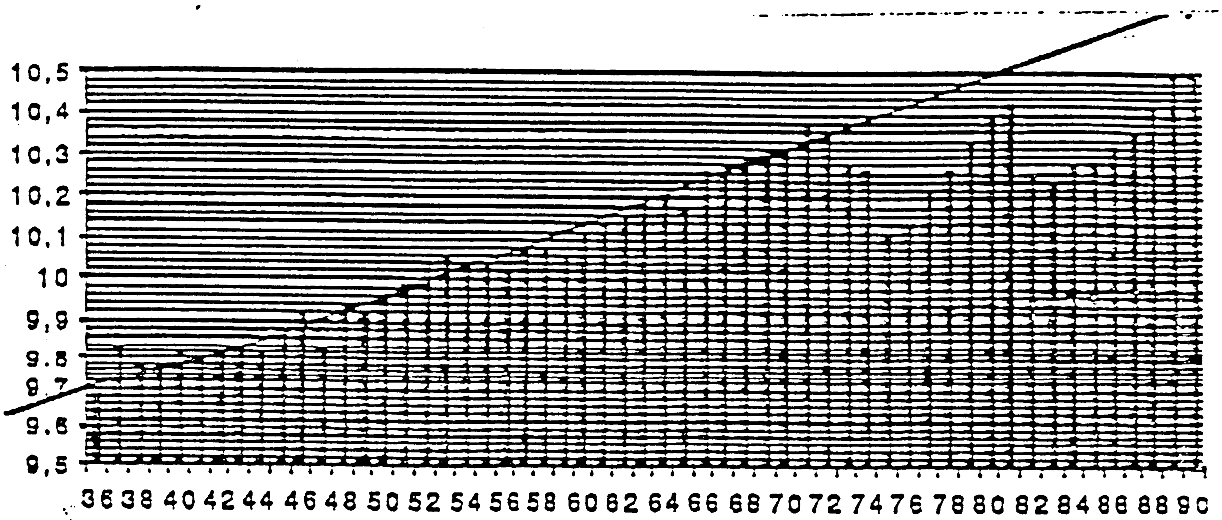


Figure 2—Growth trends in Argentina, Australia, and Canada, 1929-84

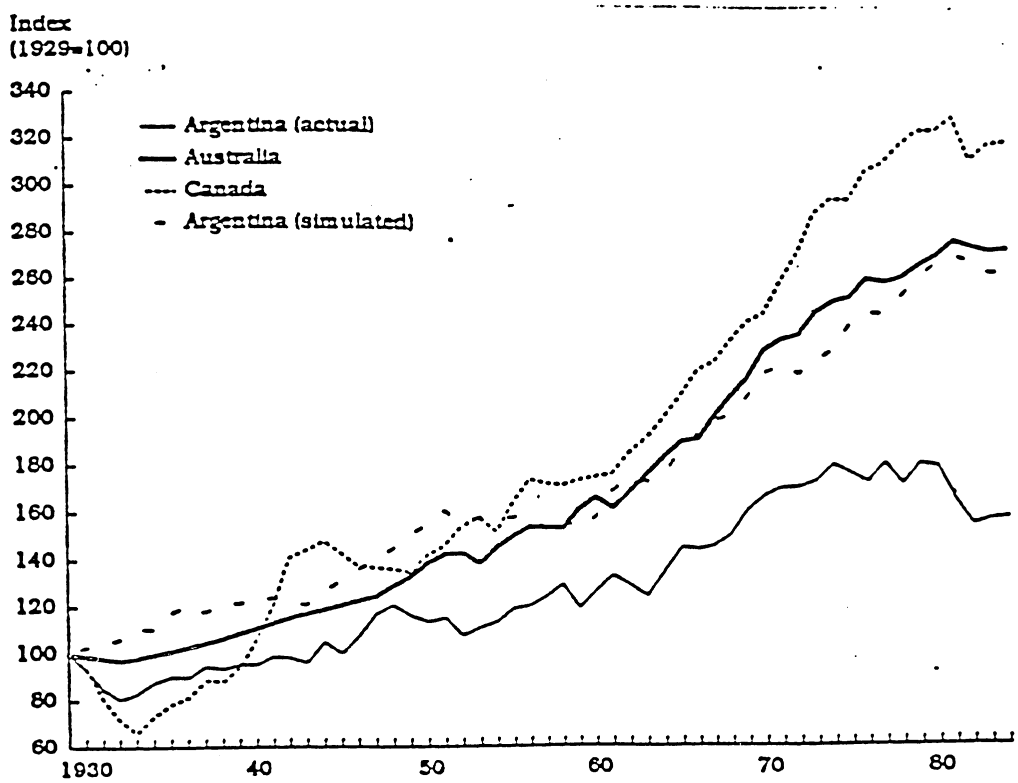


Figure 3—Punjab, India: Selected inputs, 1960-80

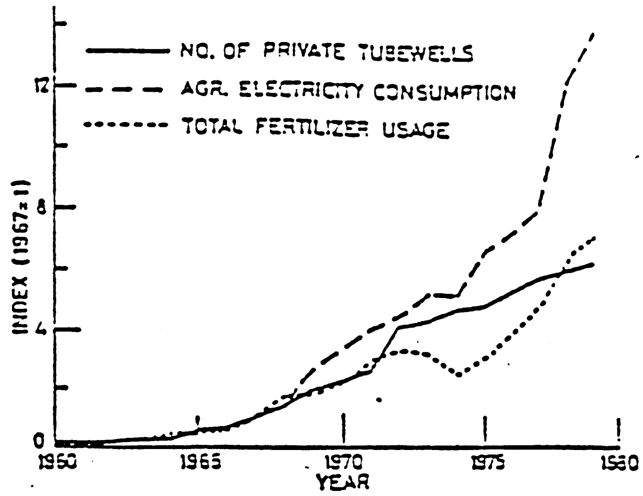
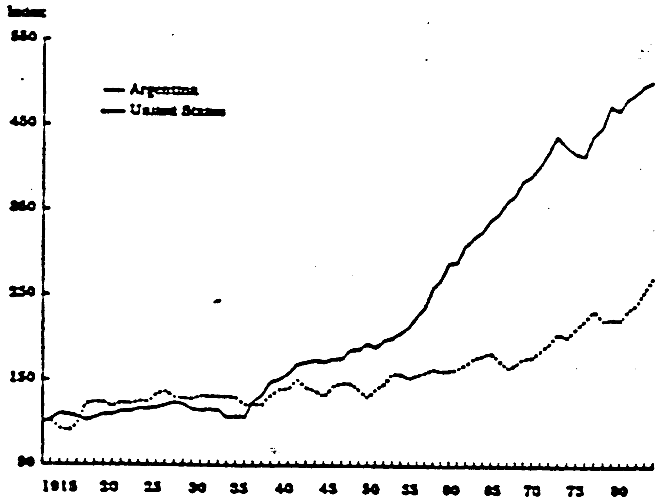


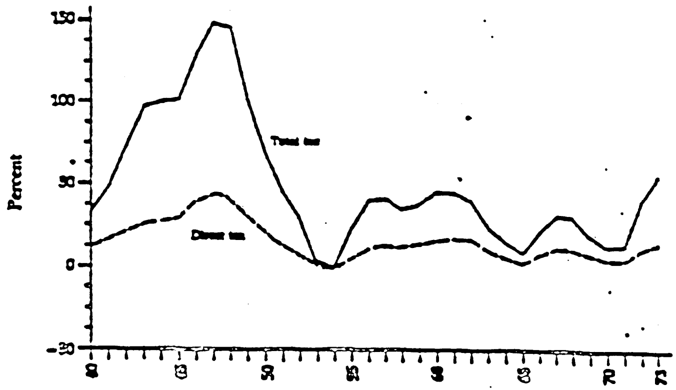
Figure 4—Crop yields, Argentina and the United States, 1913-84



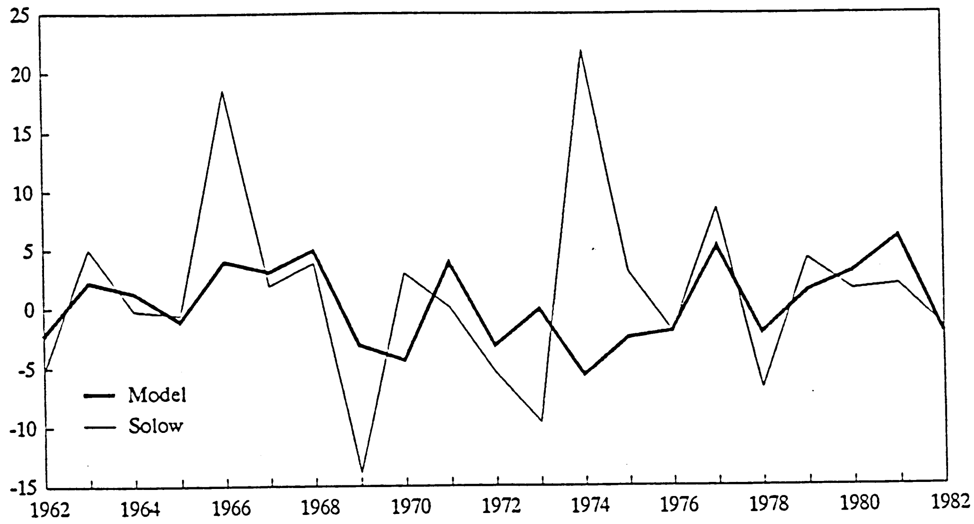
Notes: This figure is based on a Divisia index of yields in 14 crops in Argentina and the United States. Base year 1913 = 100.

Argentina

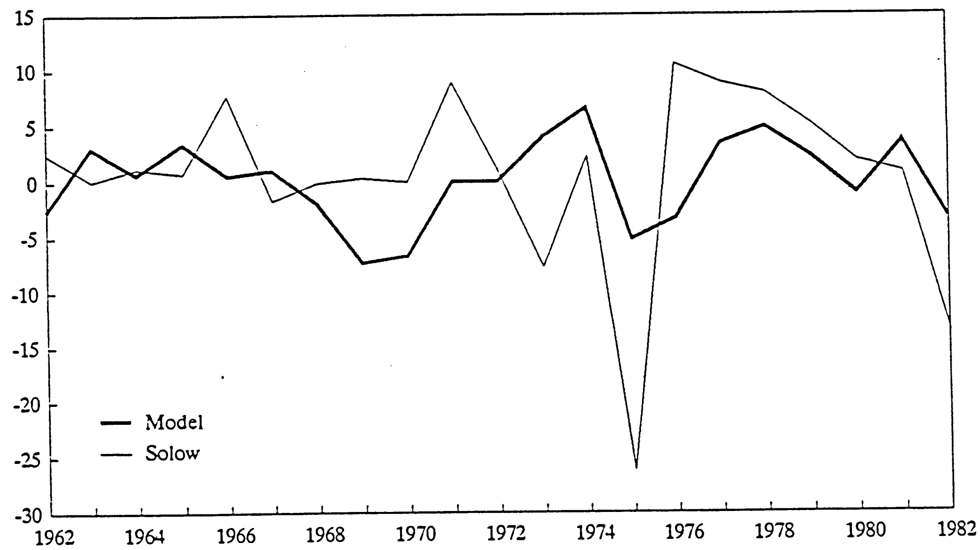
Figure 5—Extraction of agricultural output as a proportion of agricultural output at factor cost, 1940-73



Unexplained Productivity in Agriculture, percent of output



Unexplained Productivity in Manufacturing, percent of output



Unexplained Productivity in Services, percent of output