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Working Paper No. 9903

A Cross-Country Database for Sector Investment and Capital

by

Donald Larson, Rita Butzer, Yair Mundlak, and Al Crego

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Introduction

Measures of sectoral investment and capital stocks are fundamental to empirical research in economics, and yet cross-country panels have not been readily available for countries outside of the OECD. In this paper we document a new database of investment and capital for the agricultural and manufacturing sectors and for the economy as a whole for 62 developed and developing countries for the years 1967-1992. In addition to the large country coverage, our data are also extended in other ways. First agricultural capital from earlier studies generally comprises stock in structures and equipment -- fixed capital -- whereas we also report capital of agricultural origin in orchards and in livestock. Second, we modify somewhat the methodology for integrating investment to obtain the capital stock. Third, we use the same methodology to compute the capital stock in the manufacturing sector and in the economy as a whole, so that we can compare the evolution of capital in agriculture to that in manufacturing and the whole economy. Fourth, we provide a description of selected economic characteristics of the data set. Fifth, we present a sensitivity analysis to place the methodology in perspective.

Capital stock – two measures

Following Ball et al. (1993), we note there are two concepts of capital of immediate interest in most empirical analyses: physical productivity and value. The first conveys the contribution of capital to ongoing production. As such it is the relevant concept in the estimation of production functions where *current* output is regressed on physical capital and other inputs. The decline of this productivity with time and use is evaluated by comparing the current productivity with the productivity at the time of the acquisition of the asset. Holding the technology and inputs constant, the difference between the initial and the current productivity is the accumulated physical depreciation. Dividing the depreciation by the initial productivity gives the accumulated productivity depreciation in relative terms -- with the initial productivity set at unity.

The present value of the asset is the discounted expected flow of net value output emanating from the use of the asset from the present to the end of its life. The accumulated depreciation is the difference between the initial value at the time of acquisition and the current value. Dividing the depreciation by the initial value gives the accumulated value depreciation in relative terms with the initial value set at unity. The value concept is pertinent to decisions on the ownership of the asset because it allows the comparison at any time of an asset's value in production with its market value. When the latter is higher, it is profitable to sell the asset (or not to acquire it). This is the essence of capital theory, and it applies to a machine as it applies to the time of selling stored wine or the cutting of a tree.

The time path of the productivity and the value of an asset are in general quite different because the productivity is related to the performance in a given period, whereas the value covers more than one period. This is best illustrated in Figure 1 for the case of a "one hoss shay" capital asset, such as a light bulb. In this figure, the relative productivity remains constant at the initial value for the lifetime of the asset. Once the asset reaches the end of its lifetime (after L units of use), the productivity drops to zero. Plotting the asset's productivity versus its time in use yields a concave path, ADL. We return to this issue and more carefully state what we mean by productivity and value depreciation below.

The structure of the series

We deal with three components of agricultural capital: fixed capital, livestock, and orchards. These components account for most of agricultural capital.[1] National accounts usually report fixed capital investment, which does not include direct investment in livestock or trees. Therefore, we compute each of these components separately. In addition we present a series for fixed capital in manufacturing and for the economy as a whole. Data sources along with the computer program used to calculate the capital series are documented in Crego et al. (1998)[2].

The construction of the fixed-capital series is based on national-account investment data, using a modification of the perpetual inventory method developed in Ball et al. (1993). This construction requires the integration of the investment data to obtain capital stocks. For livestock, the initial data is the number of animals, and the only calculations needed are to value the herds and then to aggregate the individual components to obtain a measure of the value of the stock of animals. For orchards, we use the present value of future income, as explained below. We turn now to describe the methods followed for each type of capital.

Fixed capital

Let I_t be the investment made during year t, K_t be the capital stock at the *end* of year t, and δ be the depreciation rate. Then, the capital formation is given by

$$K_t = (1-\delta)K_{t-1} + I_t \tag{1}$$

Substituting back in time to an initial period, 0, we obtain

$$K_t = (1-\delta)^t K_0 + \sum_{i=1}^{t}(1-\delta)^{t-i} I_i \tag{2}$$

---

[1] Other components are not covered by the series such as changes in inventory or on-farm land improvements.

[2] The paper can be downloaded by visiting http://www.worldbank.org/html/dec/Publications /Workpapers/wps2000series/wps2013/wps2013-abstract.html.

To construct the series $\{K_t\}$ we need data on investment, $\{I_t\}$, the initial capital stock, K_0, and the depreciation rate. The initial capital stock is not available when there is no series of capital stock for the country. The depreciation rate is an unobservable parameter. Thus the construction requires coming up with these two unknown parameters.

Initial value

Several different techniques of fixing, or seeding, the initial value have been proposed. In practice, researchers often are forced to choose among competing seeding techniques based on whether the methods generate negative initial values. (See for instance Nehru and Dhareshwar, 1993). We choose instead to generate a lengthier time series of investment data, which allows a selection of a natural initial value. We do this by regressing the investment-output ratio (in logarithms) on time for the study period. We then used the estimates to "backcast" past values of this ratio, and used the output data to generate the needed missing investment values. When the output values were not available, they were also backcasted from a regression of output on time. Later we discuss the sensitivity of our results.

Depreciation and productivity

The rate of change in the productivity of capital goods with use or age will vary. This has to be taken into consideration when capital goods with different patterns and age are aggregated to yield the measure of effective capital. In our analysis we adopt the formulation of Ball et al. (1993).

Let S_j be the relative productivity of a capital good of age j, L its lifetime, and β a curvature parameter bounded from above by one in order to restrict the productivity to be nonnegative.[3] Then

$$\begin{aligned} S_j &= (L-j)/(L-\beta j),\ 0 \le j < L \\ S_j &= 0,\ j \ge L \end{aligned} \qquad (3)$$

When new (j=0), the asset has a relative productivity of unity. The asset is discarded at age L, at which time its relative productivity becomes zero. To analyze this expression, we note that for $0 \le j < L$, $dS_j/dj = L(\beta - 1)/(L - \beta j)^2 < 0$, indicating that the productivity falls with age (use). With a "one hoss shay" asset, β is unity, the productivity is unchanged for $j<L$, and when $j=L$, the derivative is undefined. The speed of the change in the depreciation with age depends on the sign of curvature parameter β:

$$d^2S_j/dj^2 = 2L\beta(\beta-1)/(L-\beta j)^3. \qquad (4)$$

When β is positive but less than unity, $d^2S_j/dj^2 < 0$, the depreciation accelerates with time (use), and the productivity curve is concave. Conversely, when β is negative,

[3] The productivity is a somewhat vague concept. It is understood to be a measure of performance with the use of a given technology and a given bundle of resources.

the productivity curve is convex. The lifetime of the asset is taken as a random variable with a normal distribution truncated at two standard deviations on both sides. Figure 2 illustrates the dependence of the productivity patterns on the parameters in question. It is drawn for the parameters used by Ball et al. (1993): β=0.75, L=38 years for buildings, and β=0.50, L=9 years for agricultural machinery[4].

The application of this formulation shifts the decision on the depreciation rate to a decision on the curvature parameter and the life span of the asset. Practically speaking, this is not very helpful when the ignorance about these parameters is similar to that of the depreciation rate. We return to this in the sensitivity analysis below. Hopefully, future research will focus on these parameters since this can be of particular importance when the reported investment is disaggregated into goods with different aging patterns. The data sources that we used do not provide any information on the components of fixed capital, and we had to choose one set of parameters.[5] Judging the available evidence we used the parameters reported in Table 1.

Depreciation and value

The value of capital is determined by: (1) the physical productivity of the asset and the expected price of the asset's net product at each point in time for the remaining life, (2) the discount factor, and (3) the number of remaining years of service left for the asset.

In what follows, expected prices are taken to be constant, and thus the time path of the value depends on the decline in future performance due to the passage of time and the expected length of the remaining life. To illustrate, assume an asset of life length L that produces x dollars a year. Ignoring discounting, the value of the asset depreciates by x dollars with each year of use, and after j years of use the value is (L-j)x dollars. This value falls linearly with time along the line segment AL in Figure 1. When we also discount the future returns from the asset, the value path changes to the graph ABCL, which falls below the path AL of the undiscounted value. The depreciation along this path reflects the decline in the discounted future returns. Consequently, the path ABCL can be convex even when the productivity path is not. Another possible source for the decline in the value is the decrease in productivity with the age of the asset. In this case, the segment AD of the productivity curve will be declining and concave.

To trace the behavior of the value over time, let the discount rate be α and the value of capital at the *end* of period 0: $V_0 = \sum_{i=1}^{L} \alpha^i x_i$. To simplify, assume $x_i = x$ for all i and write:

---

[4] Figures 1 and 2 are based on an early draft of Ball et al. (1993).

[5] Different capital goods have different curvature parameters and different lengths of service life. Also, within each group, these two parameters may be stochastic. To aggregate such assets with different parameters, their distribution has to be established or, less desirable but more practical, to be assumed. The aggregation is then based on the assumed distribution. We do not have investment figures by disaggregated goods and will therefore ignore the topic of aggregation.

$$
\begin{aligned}
V_0 &\equiv \alpha x + \alpha^2 x + \ldots + \alpha^L x \\
&\equiv \alpha x + V_1 \\
&\equiv \alpha x + \alpha^2 x + V_2
\end{aligned} \tag{5}
$$

where V_j is the value, taken *at period 0,* of the income stream after j periods of use, or simply of an asset of age j. We can draw the value path to trace V_j as a function of j (the time use of the asset). For nontrivial discounting (α <1), we obtain $V_1 - V_2 < V_0 - V_1$ so that the value path is convex, as illustrated by the curve ABCL. In the extreme case of no discounting, α =1 and the path follows a straight line. This is an upper bound for the value curve, implying that, unlike the productivity path, it cannot be strictly concave.

To summarize, we use a modified perpetual inventory model to construct fixed capital stocks, where the stock of capital is equal to a weighted sum of past investments. In turn, the weights represent the asset's efficiency as of a given age, and their construction is based on the assumption that the asset's lifetime is a random variable with a truncated normal distribution.

Livestock Capital

A considerable amount of agricultural capital is embodied in livestock herds. FAO reports the quantities of all farm animals -- cattle, sheep, pigs, poultry, etc. The value of these individual components is aggregated to obtain the livestock. Ideally observations on live animal sales prices would be used to value local herds, but these data were not consistently available. In their stead, we used regional export unit values, based on FAO trade data, to value domestic herds. Separate prices were calculated for each region by dividing regional dollar export values by regional export quantities. These unit prices were then applied to national herd statistics for each category of livestock.

Orchard or Tree Capital

Standing orchards, plantations, and smallholder trees represent another important category of investment in agriculture. For instance, palm oil, rubber, and coconut trees comprise a significant portion of agricultural capital in Indonesia. Similarly, coffee trees represent a large share of agricultural investment in Uganda.

Still, a lack of price and quantity data precludes the use of the methods used for deriving fixed capital or livestock, and we are forced to use the value method. For these we use two pieces of available information: the value of production and land area. The FAO maintains data that cover, for countries' major tree crops, area harvested by crop. The value of a tree in any period is computed as the discounted stream of future revenues that it will yield through production, less production costs. Yield, in terms of revenue, is available by crop from the FAO. So, therefore, is yield per acre. The net revenue associated with each acre of tree crops is imputed forward in time (with discounting) and, when aggregated, taken as the value of capital in the form of trees.

For some countries and some crops, it is possible to use historical planting data to discern the age of different cohorts of trees. (For example, the International Rubber Studies Group recently established a remarkable series on rubber plantings spanning the current century.) For our work, however, a simplifying assumption is made that at any point in time the average tree is halfway through its assumed lifetime. A crucial assumption is necessary to move from revenue per acre to rent per acre. The value of an acre of trees, of course, hinges on the rent that the acre will generate. There are no known, widely applicable estimates to account for per-acre production costs of countries' various types of tree crops. Thus it is assumed that production costs represent about 80 percent of export value.

Total agricultural capital

Raw data on livestock and treestock were reported in nominal US dollars, while data on investment in fixed capital were generally reported in nominal local currency units. The aggregation of fixed capital with livestock and treestock was done in nominal US dollars. For this purpose, fixed capital in nominal local currency units was converted to nominal US dollars using the relevant exchange rates. This was added to the nominal dollar values of livestock and treestock, resulting in total nominal agricultural capital. Finally, US GDP deflators were used to convert the data into 1990 US dollars.

Country and time coverage

The countries included in the investment data set are: Argentina, Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czechoslovakia (former), Cyprus, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, France, Greece, Guatemala, Honduras, Indonesia, India, Ireland, Iran, Iraq, Iceland, Israel, Italy, Jamaica, Japan, Kenya, Luxembourg, Morocco, Madagascar, Malta, Mauritius, Malawi, Netherlands, Nicaragua, Norway, New Zealand, Pakistan, Peru, Philippines, Poland, Portugal, South Africa, South Korea, Sri Lanka, Sweden, Syria, Trinidad & Tobago, Tunisia, Turkey, Taiwan, Tanzania, Uruguay, United Kingdom, United States, Venezuela, West Germany (former), and Zimbabwe.

Sample coverage for fixed investments varies from year to year and series to series. The investment series from Argentina begins in 1948, although most series begin in the 1960s. Figure 3 provides a frequency count for the fixed investment components. All series on livestock and orchards begin in 1961 and end in 1992.

In turn, the varying sample coverage affects the coverage of the estimated capital series. For most of the countries, the data were deemed sufficiently complete to estimate capital stocks for 1967 to 1992. The number of series is summarized in Table 2.

The evolution of the capital stocks

We turn now to summarize some of the information in the data set. Unless indicated otherwise, the discussion refers to fixed capital. Figure 4 shows the frequency distribution of growth rates of capital in agriculture, manufacturing, and total for the economy. On the whole, capital accumulation was positive in most of the countries. However, there is sectoral variability: more than 15 percent of the countries had negative growth in agriculture, and 10 percent had negative growth in manufacturing. The whole distribution of agriculture is to the left of that in manufacturing and the economy as a whole, indicating a much smaller growth rate in agriculture. The median rate growth of capital is 4.6, 4.1, and 2.1 percent in the economy, manufacturing, and agriculture, respectively.

Agriculture has done better in the growth of the ratio of capital to labor as shown in Figure 5. In general, the distribution of the growth rates of fixed capital to labor in agriculture is to the right of that of the economy. The median rate of this ratio is 2.9 and 2.2 percent respectively in agriculture and the economy as a whole. This indicates a faster capital deepening in agriculture. The reason for the difference in the pattern of the growth in the total capital and in the capital-labor ratio is the off-farm labor migration.

Within the agricultural sector, fixed-capital growth generally exceeded the growth of total capital, indicating a smaller growth rate in capital of agricultural origin (livestock and orchards). This is seen in Figure 6, which shows the growth in the shares of the agricultural components and in Figure 7 that shows the share of fixed capital in total agricultural capital.

The changes in the capital stock reflect the changing composition of investment. Figure 8 shows how agriculture's share of annual investment declined in most countries between 1970 and 1990.[6] Figure 9 shows the same information for manufacturing, where the investment share has declined less dramatically. By implication, for most countries, investments have been growing faster in services, including transport and construction.

How informative is the capital series? To answer this question, we need to relate the series to other economic variables that are not part of the series or its derivation. We do it by plotting the average labor productivity (output-labor ratio) against the capital-labor ratio in Figures 10 and 11 for the economy as a whole and for agriculture respectively.[7] This scatter diagram traces the production function in intensity form. It is done without allowing for the effects of other pertinent variables. Nevertheless, it is clear that the capital series is indeed informative and relevant. A more detailed analysis of the production function using this data appears in Mundlak, Larson, and Butzer (1997). These data was used also in Martin and Mitra (1996) and Mundlak, Larson, and Crego (1998).

Sensitivity analysis

We have used a fairly elaborate method to calculate the depreciation rate. Two questions come up in this connection: first, how sensitive is the result to the choice of parameters, and second how much is gained by this method compared to simpler conventional methods? We answer the two questions by presenting results obtained, using our data, with a different choice of parameters.

---

[6] The figures show the cumulative frequency distribution of the sectoral shares of investment in 1970 and in 1990. They are not one-to-one mappings over time for each specific country. Thus, the figures indicate that for each share x, the number of countries of a share smaller than x is larger in 1990 than in 1970.

[7] In Figures 10 and 11, the capital measures include livestock and orchards.

In what follows, we label as the base calculation the results reported above, which were obtained with the parameter values in Table 1. Table 3 presents the mean ratios of alternative computations of the capital stock for the years 1970, 1980, and 1990, relative to the base calculation. The first five columns were obtained with the same parameters of the base calculation except for the changes that appear in the column heading. The results range from 0.59 with β of −1 to 1.37 with β of 1, indicating that the lower is the initial depreciation (high value of β), the higher is the level of the capital stock. This reflects two effects. First, more recent investment values carry a higher weight in the integration of investment to stock, and second, there is a positive trend of investment which again increases the relative importance of the more recent terms.

The choice of parameters affects the level of the stock, but it has only a slight effect on the growth rate of the capital stock. This can be seen from Table 4, which reports the growth rates of agricultural and total capital for the sample as a whole, and for specific time periods.[8] Again, the first six columns were obtained with the parameters reported in Table 1 except for the values that appear in the column heading. The growth rates are only slightly affected by the choice of the curvature parameter. Essentially, the growth rate of the capital stock is largely determined by the investment rate. This is seen from the low growth rates in the period 1975-1984 as compared to the other two subperiods. This difference is sizable, and it is detected by all the alternative calculations. Another indication is the sensitivity of the growth rate to the lifetime of the investment. A reduction of the lifetime mean from 20 to 10 years, (keeping the coefficient of variation constant) makes the capital stock more sensitive to the fluctuations in the investment

Why is it that the choice of parameters affects the level but not the growth rate? The outcome is related to the level of disaggregation of the capital goods, the time profile of their productivity, and the changes in their composition. When there are several components of capital with different time profiles, a change in the composition of investment will affect the growth rate in addition to the level. This is not detected in our calculations because, due to data limitations, fixed investment could not be decomposed into components.

As to the method itself, do we gain by refining the computation of the depreciation rate? To answer this, we calculate the capital stock by varying only one parameter, the depreciation rate. We present results in Tables 3 and 4 for two alternative values of δ, 0.04 and 0.06. The latter produces capital level and growth rates that come close to the values obtained in our base calculation.

Next, we also examine the sensitivity of the results to the choice of the initial value of capital. We consider two alternatives described in Nehru and Dhareshwar (1993). The first is the procedure used by Harberger (1978) which is based on the assumption of a constant capital to output ratio, which leads to the following equation:

$$K_{t-1} = I_t / (g + \delta) \qquad (6)$$

[8] The growth rates were calculated through ordinary least squares regressions of the log of capital on time.

where g is the growth rate of output. Harberger uses three-year averages of the growth rate of output and investment to reduce the effects of short-term variations. Applying this method to our data shows that the results with $\delta=0.06$ are similar to our results. The second is a modification of the Harberger approach proposed by Nehru and Dhareshwar (referred to in the table as N-D). Rather than use the three-year average of investment to estimate the initial stock of capital, the initial level of investment is fitted using a regression of the log of investment on time. Thus the estimation is less sensitive to initial period conditions. The investment series used in the regression was truncated in 1973. The results do not differ much from those obtained using the Harberger approach.

In Table 5, we report the correlation of the capital stock obtained by the alternative calculations with our results. The correlation is high for most of the series. This is particularly so for the various choices of the curvature parameters. This is consistent with the results of Tables 3 and 4, that although the choice of parameters and aggregation and seeding techniques may affect the levels of capital stocks, the movements in the capital stocks are quite similar. However, the correlation is affected by the choice of the initial value of capital used in the integration. Obviously, it is lower for the N-D methods, as compared to our choice, which is based on more information.

Finally, Table 6 presents alternative calculations of the share of agriculture in fixed capital for three years for the sample as a whole. Using the base series, the share declines over the years, from 10 percent in 1970 to 7 percent in 1990. The results vary somewhat with the method, reflecting the variations observed in Table 3. Differences between the series tended to remain the same across time. Consequently, capital stock growth rates varied more by subperiod than by method or parameter choice.

Conclusion

This paper reports a new time series on investment data for agriculture, manufacturing, and the economy as a whole. A common method is applied to derive sector-level capital stock estimates for 62 countries for the period 1967-1992. The database fills a long-standing need for a sectoral measure of one of the basic components of economic production and a key determinant of the process of growth.

The capital stock for agriculture consists of three components, fixed capital, livestock, and orchards, whereas that of manufacturing and the economy as a whole consists of fixed capital alone. The integration of the fixed investment to capital stock requires a selection of the depreciation rate and an initial value of the series. The choice of the depreciation rate is based on an aging pattern determined by a curvature parameter and the lifetime of the asset. Simulations based on our data show that the level of the capital stock is sensitive to the choice of the parameters. However, the growth rate of the stock is fairly robust to the choice of the curvature parameter, and somewhat sensitive to the assumed lifetime. On the other hand, the results are more sensitive to the choice of the initial value of the series. We suggest a procedure for determining the initial value that utilizes the country specific investment rates. In passing we note that the robustness of the growth rate to the curvature parameters may disappear when the investment data will be available at a lower level of aggregation.

There is a caveat and a note of hope to this effort. The definition of fixed investment, as well as the definition of agriculture and manufacturing, may differ from country to country and possibly within countries over time. In addition, reporting errors are likely as well, and this may affect the cross-country comparison. On the positive side, we obtained our data through a library search of country publications. We suspect that this search has not been exhausted, and specifically, that census data and other national sources can be found and used to augment the country and time coverage. It is our sincere hope that further research can extend and improve upon our initial work.

Collectively, the data suggest that as economies grow, capital stocks accumulate, but the composition of capital changes. Together and individually, capital stocks in agriculture and manufacturing constitute a smaller share of the total capital stock than they did twenty years ago. Agriculture has become more capital intensive for most countries even though capital stocks have declined in about 30 percent of the countries. The composition of agricultural capital has changed in most countries as well. Capital from fixed investments in machinery, irrigation, and buildings has become increasingly important while capital of agriculture origin such as livestock and treestock has declined.

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Table 1: Parameters used to generate capital stocks from investment data

Parameter	*Agriculture*	*Manufacturing*	*Total Investment*
Curvature	0.70	0.70	0.70
Mean service life	20 years	15 years	20 years
Standard deviation	8 years	6 years	8 years

Table 2: Number of countries included in capital stock estimates, by period

	1967-1969	1970-1992
Agriculture	56	57
Tree stocks	52	52
Livestock	57	57
Agricultural fixed capital	56	57
Manufacturing	53	55
Total fixed capital	56	57

Table 3: Comparison of Series Means for 1970, 1980, and 1990

								Harberger	Harberger	N-D	N-D
	β=1	β=0.5	β=0	β=-1	L=10	δ=0.04	δ=0.06	δ=0.04	δ=0.06	δ=0.04	δ=0.06
						ratio to base calculation					
Agricultural Fixed Capital											
1970	1.34	0.91	0.77	0.62	0.58	1.52	1.11	1.41	0.99	1.21	0.94
1980	1.31	0.91	0.77	0.62	0.60	1.51	1.09	1.29	0.99	1.26	0.99
1990	1.37	0.90	0.74	0.59	0.53	1.61	1.11	1.34	1.00	1.44	1.10
Total Fixed Capital											
1970	1.28	0.92	0.78	0.64	0.62	1.22	0.99	1.13	0.93	1.27	0.99
1980	1.26	0.92	0.79	0.65	0.64	1.18	0.97	1.14	0.95	1.18	0.96
1990	1.31	0.91	0.76	0.61	0.58	1.22	0.98	1.19	0.96	1.24	1.00

Table 4: Growth Rates under Varying Parameters and Methods

% per annum, period average									Harberger	Harberger	N-D	N-D
	β=0.7	β=1	β=0.5	β=0	β=-1	L=10	δ=0.04	δ=0.06	δ=0.04	δ=0.06	δ=0.04	δ=0.06
Agricultural Fixed Capital												
whole sample	2.92	3.04	2.86	2.76	2.62	2.38	3.08	2.90	3.10	3.01	3.92	3.61
1967-1974	5.74	5.51	5.81	5.92	6.06	6.29	5.67	5.65	4.98	5.21	6.49	7.34
1975-1984	1.40	1.53	1.31	1.14	0.89	0.72	1.41	1.21	1.70	1.60	2.29	1.47
1985-1994	3.95	4.35	3.86	3.75	3.69	3.03	4.80	4.49	4.06	3.58	5.86	5.82
Total Fixed Capital												
whole sample	5.23	5.34	5.17	5.08	4.96	4.80	5.23	5.14	5.34	5.24	5.29	5.24
1967-1974	8.26	8.04	8.33	8.46	8.61	8.83	8.07	8.16	7.50	7.69	8.19	8.44
1975-1984	3.90	4.02	3.83	3.67	3.45	3.34	3.77	3.68	4.05	3.94	3.86	3.81
1985-1994	5.79	6.14	5.71	5.63	5.61	5.12	6.38	6.18	5.90	5.54	5.72	5.35

Table 5: Correlations of Alternative Capital Series with Base Series

								Harberger	Harberger	N-D	N-D
	β=1	β=0.5	β=0	β=-1	L=10	δ=0.04	δ=0.06	δ=0.04	δ=0.06	δ=0.04	δ=0.06
Agricultural Fixed Capital											
	0.9923	0.9973	0.9934	0.9837	0.9576	0.9909	0.9962	0.9232	0.9467	0.8753	0.8842
Total Fixed Capital											
	0.9980	0.9997	0.9981	0.9942	0.9831	0.9970	0.9986	0.9918	0.9936	0.9482	0.9555

Table 6: Comparison of Agricultural Shares in Fixed Capital Stock for 1970, 1980, and 1990

									Harberger	Harberger	N-D	N-D
	β=0.7	β=1	β=0.5	β=0	β=-1	L=10	δ=0.04	δ=0.06	δ=0.04	δ=0.06	δ=0.04	δ=0.06
1970	0.10	0.11	0.10	0.10	0.10	0.09	0.14	0.12	0.12	0.11	0.11	0.10
1980	0.08	0.08	0.08	0.08	0.08	0.07	0.10	0.09	0.09	0.08	0.09	0.08
1990	0.07	0.07	0.07	0.07	0.07	0.06	0.08	0.07	0.07	0.07	0.08	0.07

Figure 1: "One hoss shay" Capital Assets

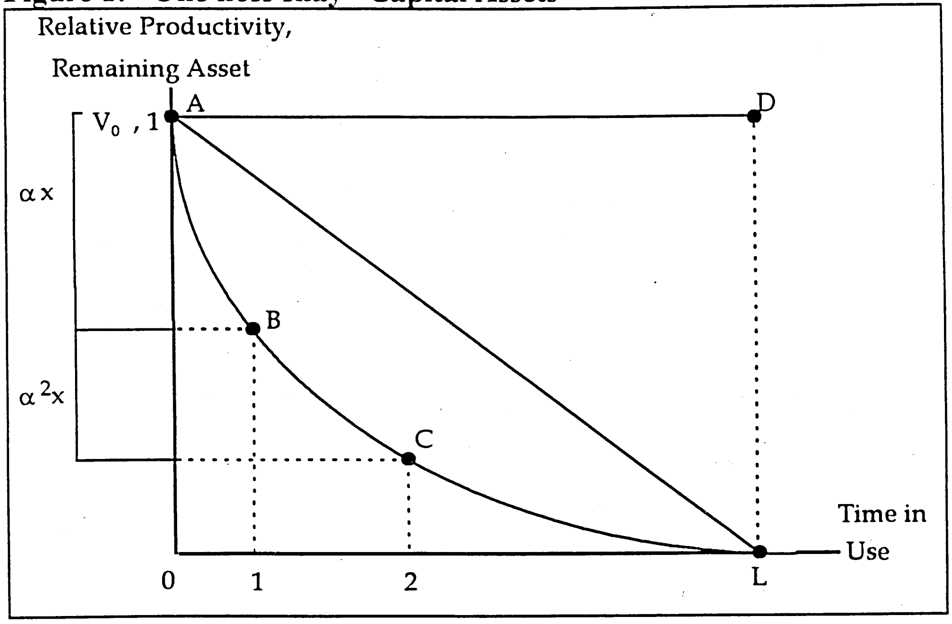


Figure 2: Examples of Relative Productivity Paths

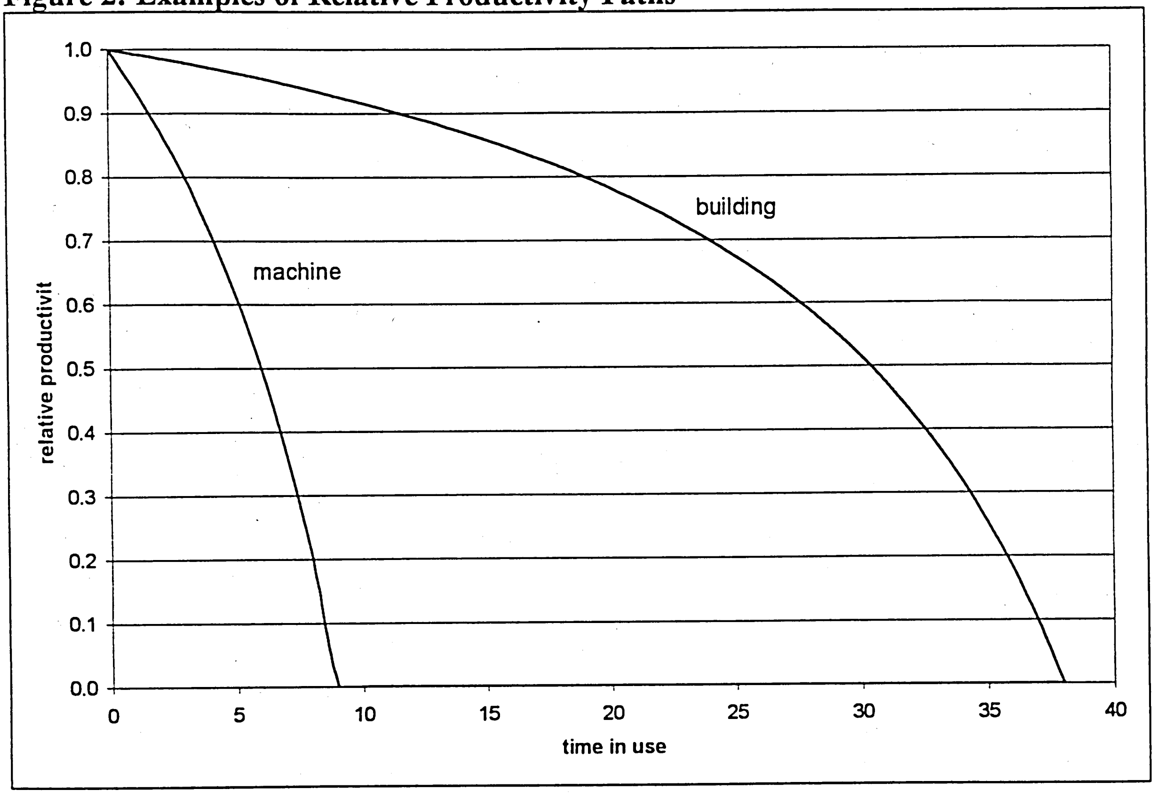


Figure 3: Sample Coverage for Fixed Investment

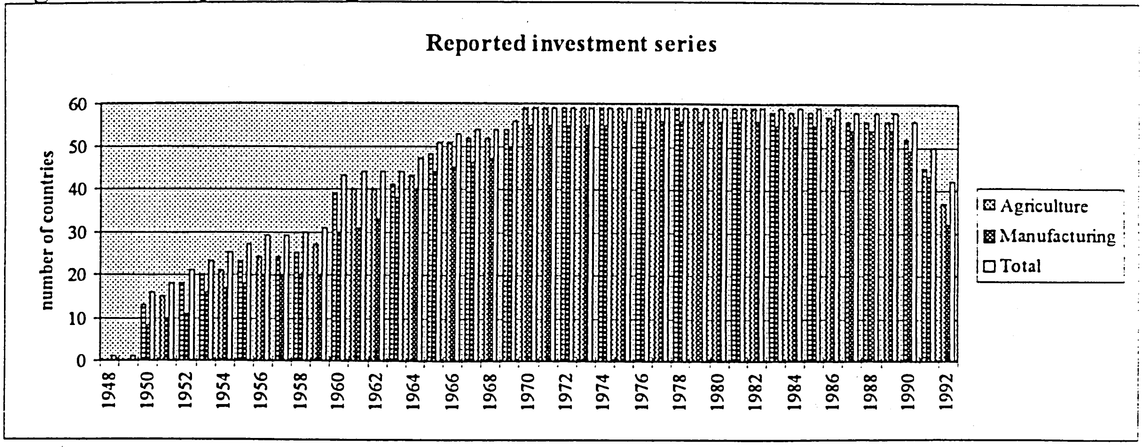


Figure 4: Growth of Fixed Capital Stocks, 1967-1992

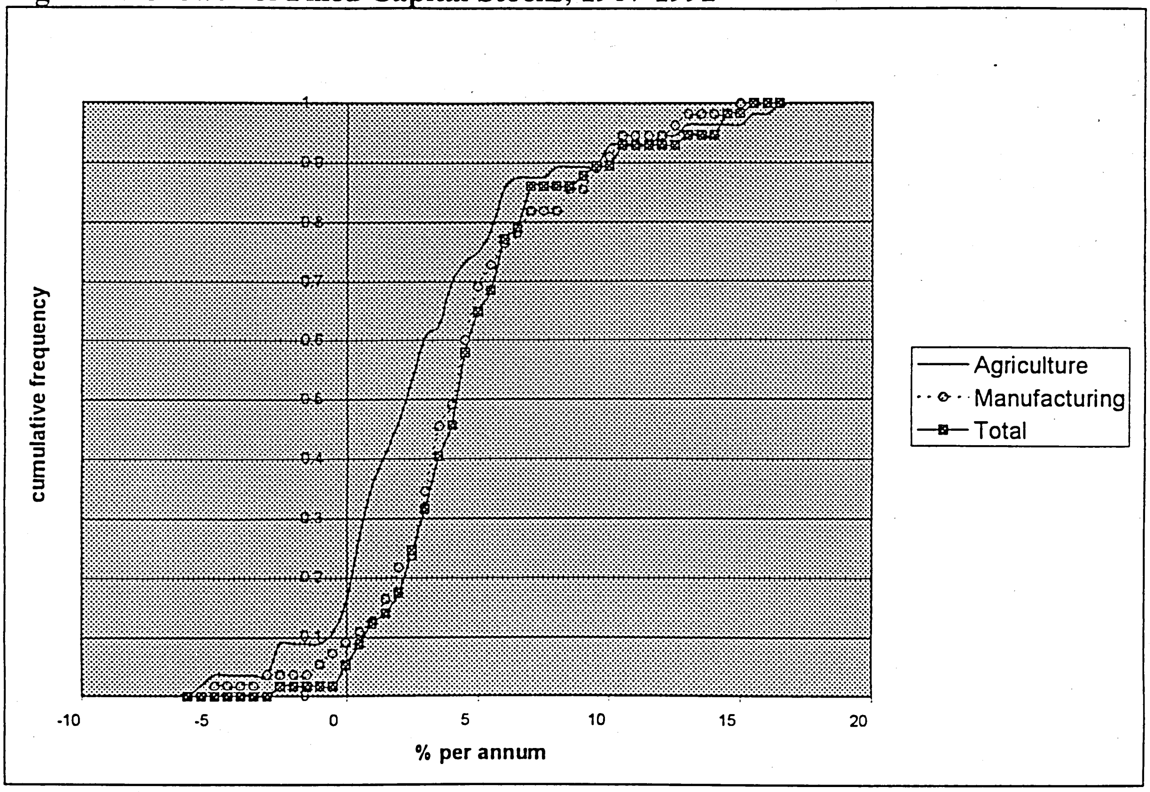


Figure 5: Changes in Capital to Labor Ratios, 1967-1992

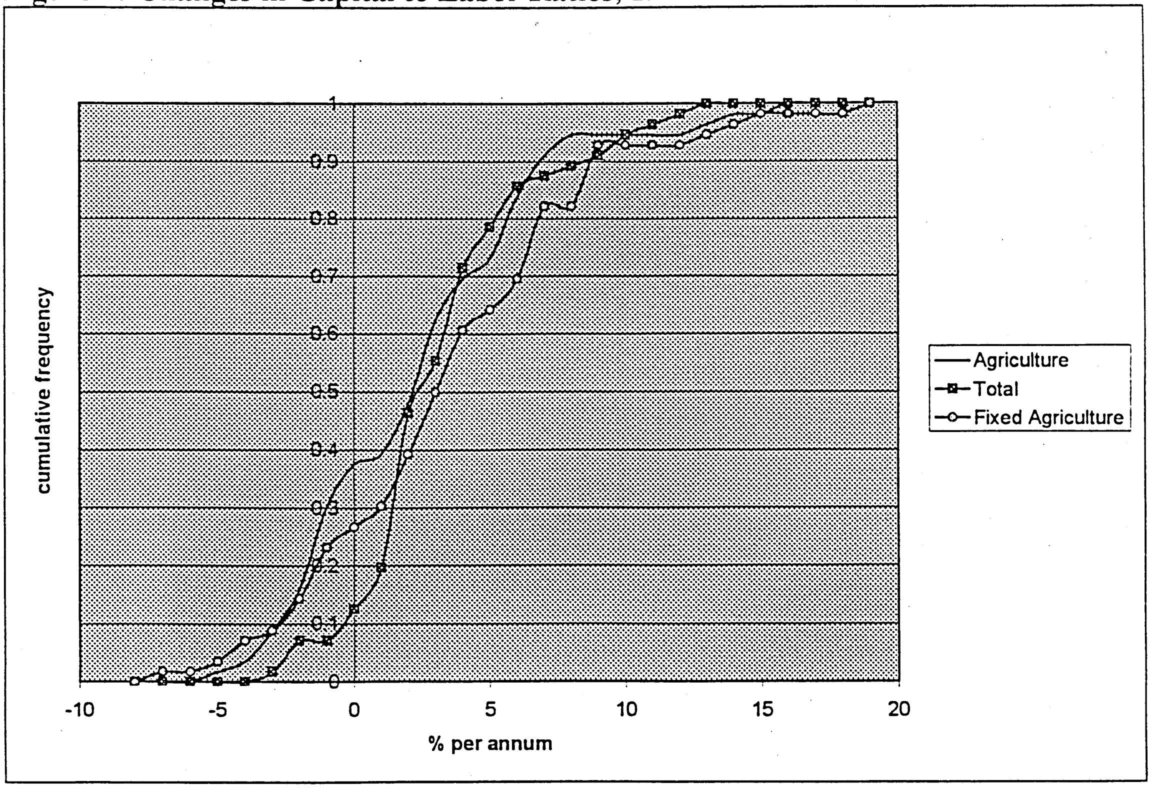


Figure 6: Changes in Component Shares of Agricultural Capital

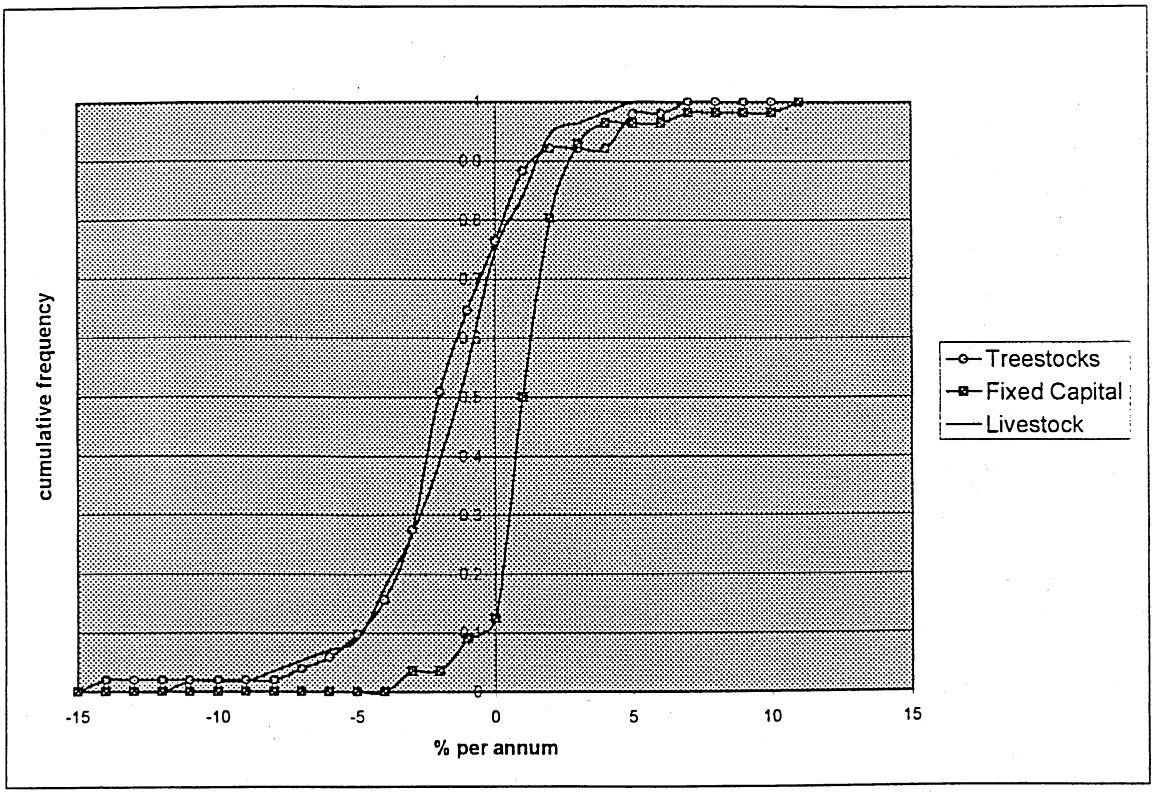


Figure 7: Fixed Capital's Share of Agricultural Capital, 1970 and 1990

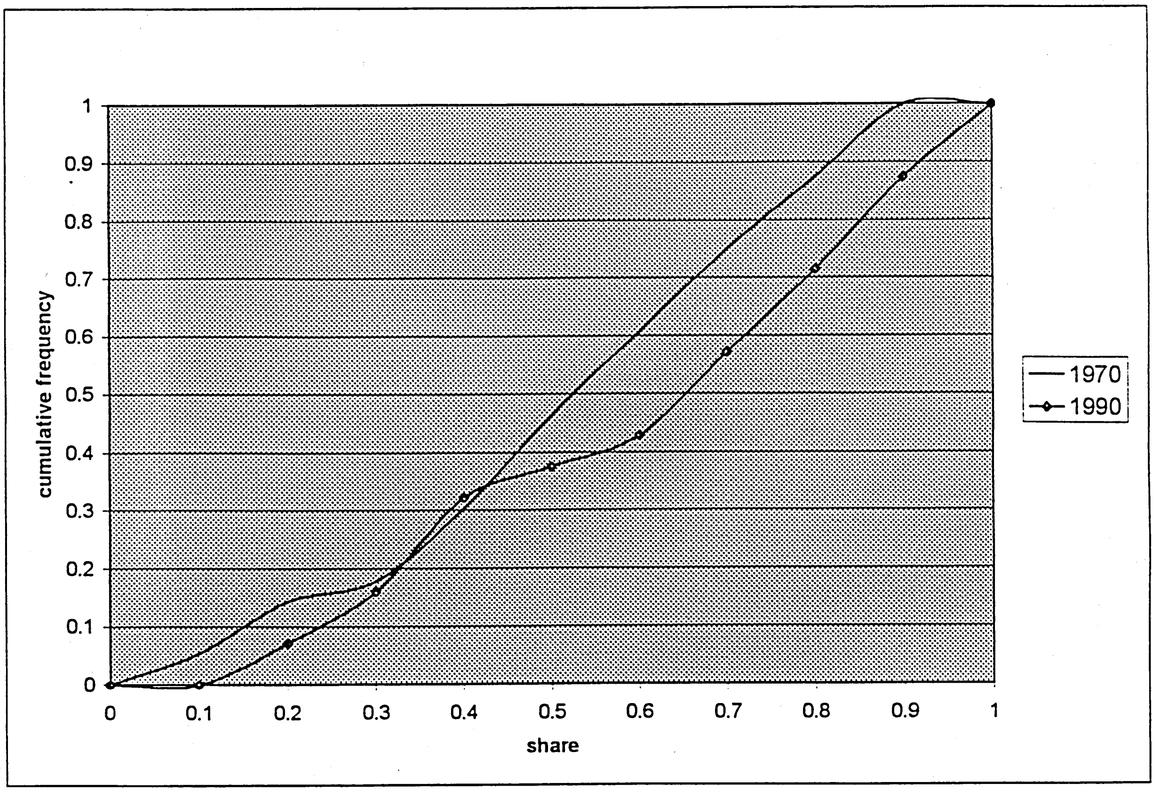


Figure 8: Agriculture's Share of Investment, 1970 and 1990

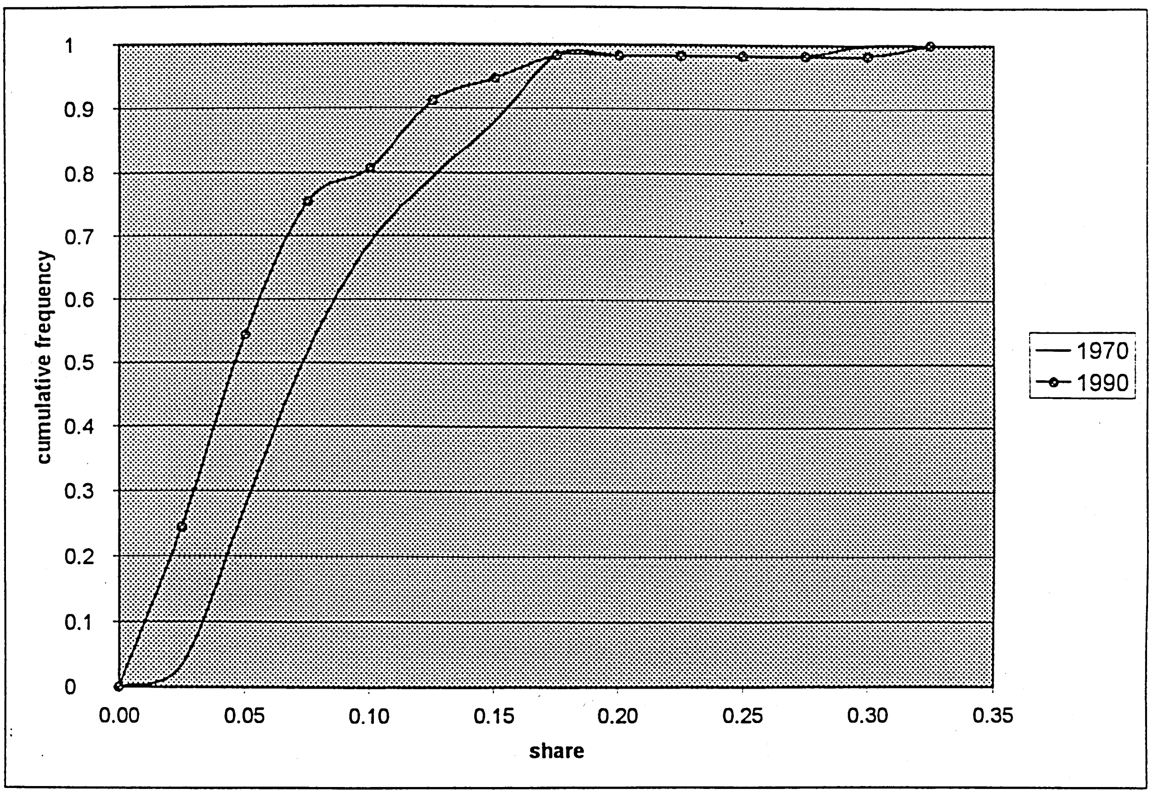


Figure 9: Manufacturing's Share of Investment, 1970 and 1990

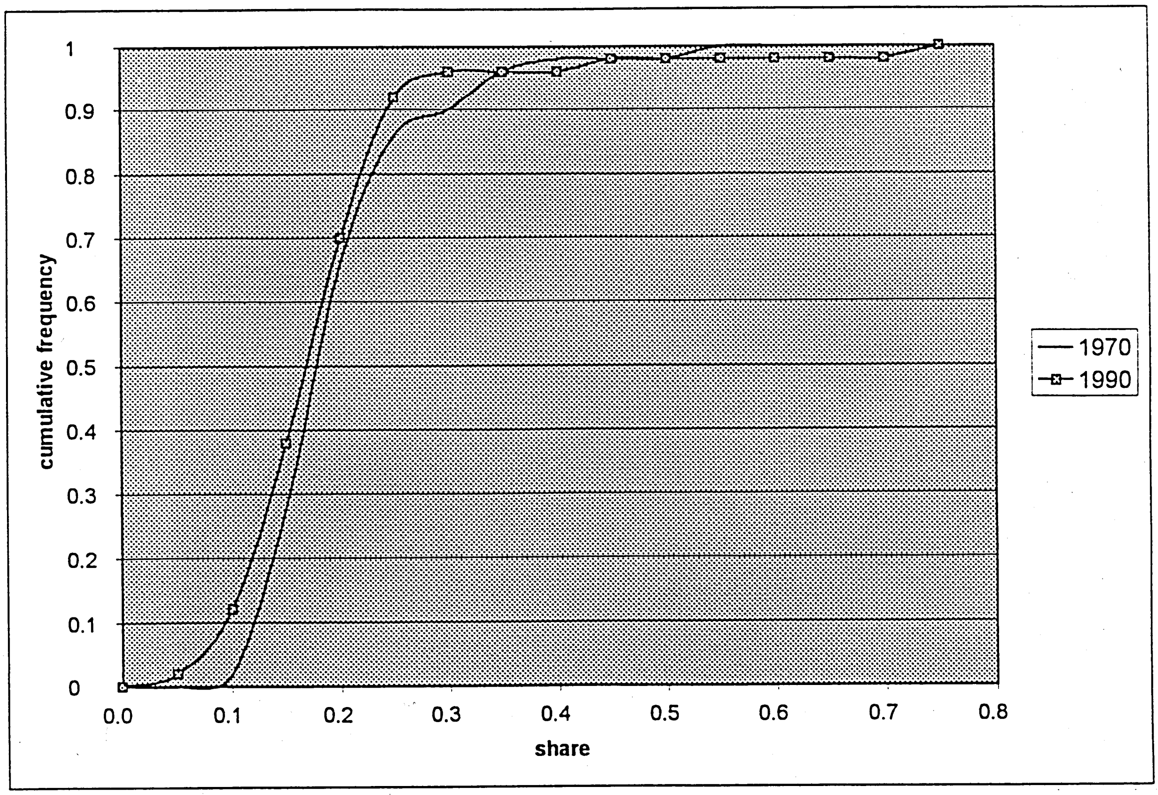


Figure 10: Economy-wide Output per Worker and Capital per Worker for Sample Period

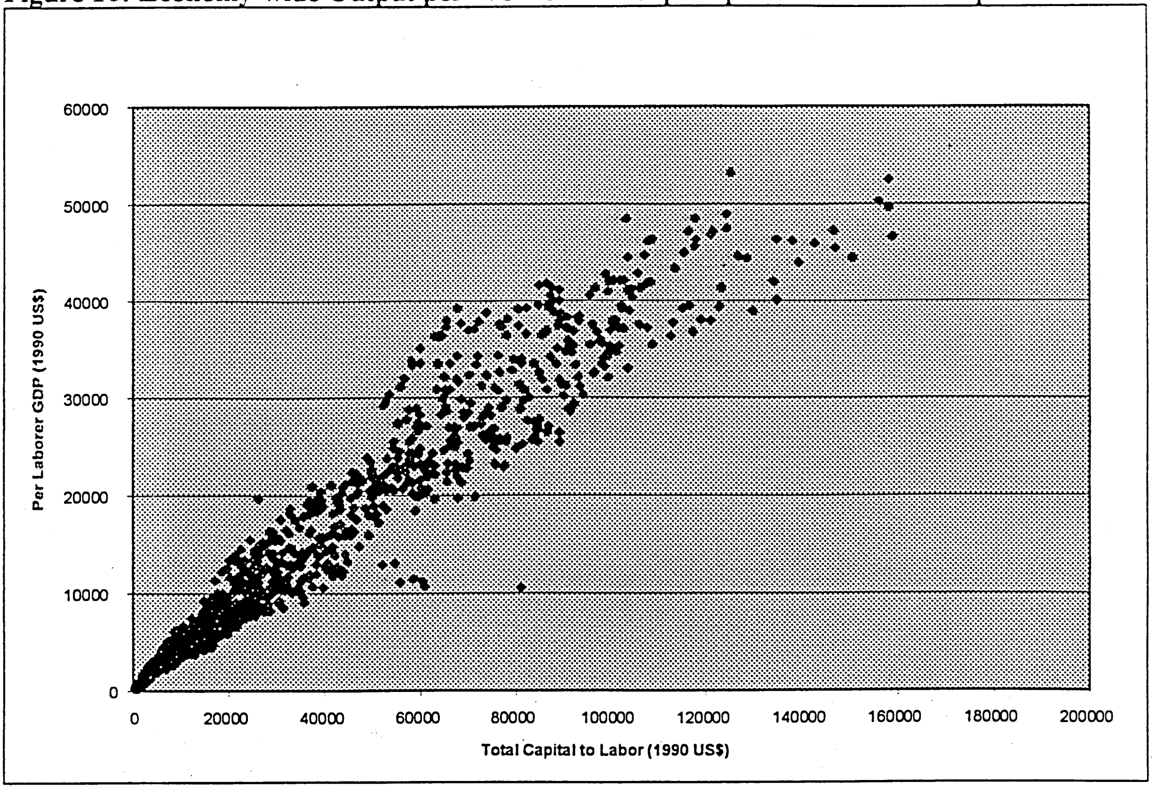
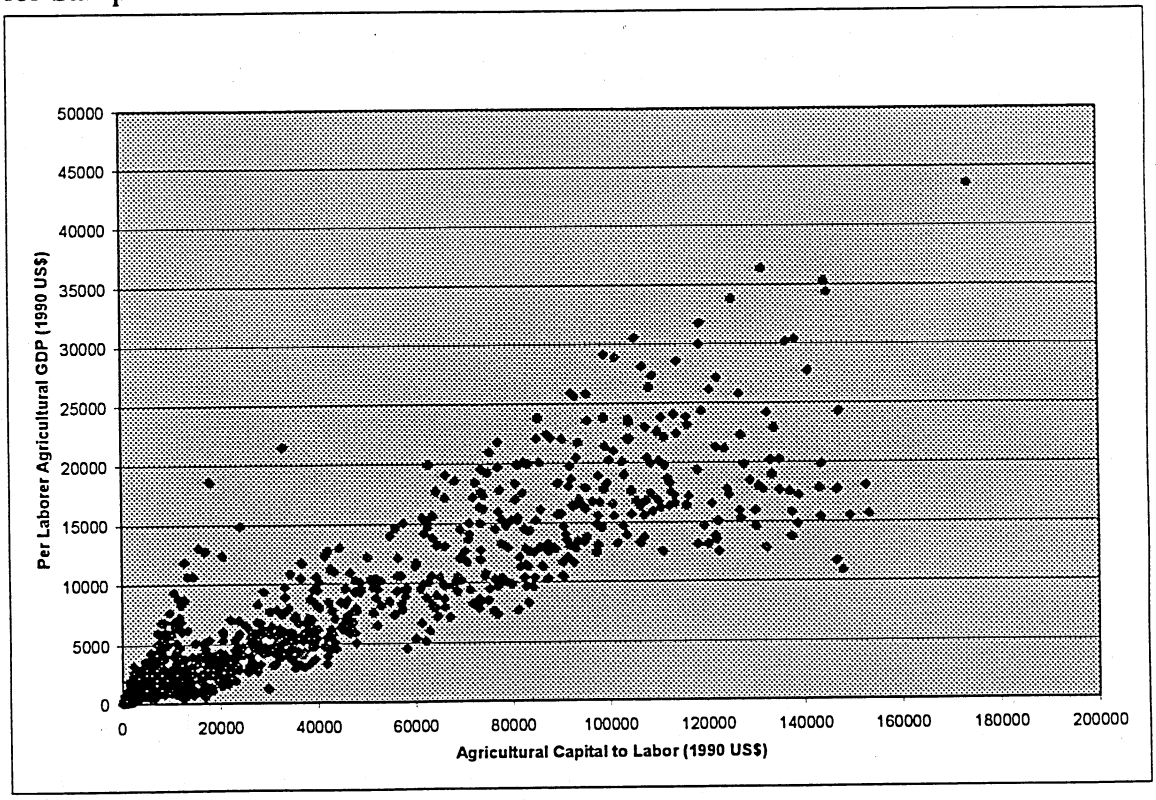


Figure 11: Agricultural Output per Worker and Agricultural Capital per Worker for Sample Period



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