MODERNIZATION PATHS AND EMPLOYMENT IN THE BRAZILIAN AGRICULTURAL SECTOR, 1985 - 1996

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Abstract

Using multiple factor analysis, this paper describes the path of agricultural modernization followed by the Brazilian states between 1985 and 1995/6. It also tries to identify the relations between this path and the evolution of employment in the Brazilian agricultural sector. Multiple factor analysis is a technique that provides a description of a complex phenomenon by weighing the different groups of variables in a uniform way, thus avoiding the error of allowing a particular group to alone determine the first principal direction of the global analysis. The results indicate that there are five different modernization paths, and all have a very limited capacity to improve the level of employment in Brazilian agriculture.

Key-Words: Brazil, agriculture, modernization, employment, factor analysis.

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1. Introduction

The methods of multivariate analysis are suited to the study of complex phenomena that can be described only by relatively big sets of variables. In this type of study, the researcher cannot depend on a "balanced" initial table of data. The data may not represent the different aspects of the object being studied with an equal number of variables or may not use variables with the same level of importance or structure of correlations. In practice, either due to data gathering problems or a natural bias toward topics that have a pronounced political or social appeal, the initial table of data usually contains more variables or a disproportionate number of correlated variables for some aspects.

This paper illustrates the application of a multiple factor analysis (MFA) to study the modernization of Brazilian agriculture between the last two Agricultural Censuses. Historically, agricultural modernization occurs as a transformation from a traditional base of manual labor to a mechanized process, scientifically controlled and highly productive. Modernization allows a large-scale production of homogeneous products to attend to the internal market and to compete internationally with similar or alternative products.

Evaluating whether a given type of agriculture is modern or not, let alone whether it can be considered more modern or less modern, is a complex task. The evaluation generally ends up being reduced to a study of some particular aspect of the process. It is usual to describe agricultural modernization in relation to some specific technical feature, such as chemical inputs application systems and level of mechanization, or, more commonly, by considering its result and measuring productivity increases. The examination of important elements that reflect agricultural modernization, for example an increase in monetary transactions or new worker qualifications and responsibilities, are usually beyond the scope of available data.

The use of agricultural census data allow a more thorough evaluation of the technical components of modernization, but the census's productivity and jobs data are restrictive. In classical analyses of modernization, there is also an unintentional tendency to overweigh the technical components, narrowing of the concept of "modernization" to "technological modernization." The MFA technique allows a less biased description of agricultural modernization, more properly weighing different groups of variables.

Our goals in this paper are: a) to define the types of agricultural modernization paths employed in the 27 Brazilian states according to their agricultural modernization patterns between 1985 and 1995/96; b) to look for the relation between this evolution and the agricultural employment market in that period.

2. Methodological Procedures

This study's initial table was designed by duplicate the number of observations, identifying them according to the year of reference (RO85, AC85, AM85...RO96, AC96, AM96...) while keeping the 13 chosen variables in the columns. The table has 54 lines (27 states x 2 years) and 13 columns divided into 4 groups. The factors are derived from linear combinations of variables linked with the 54 observations so that each factor or main component has "mixed" information from the two years (1985 & 1996) for each state.

Hoffmann (1992), in a classical principal components analysis, also used the "piling up" method of observations when studying agricultural modernization of 157 Brazilian micro regions between 1975 and 1980. He argues that the variation of factor values for each observation in 1975 and 1980 can be taken as a measure of the speed of the modernization process and permits construction of the micro regions' modernization paths over the 5 year time period.

The groups of variables chosen for this paper were as follows:

Group 1: size indicators
average size of the farms (hectares)
area with hired administrator (ratio)

Group 2: technical modernization indicators
number of farms affiliated to cooperatives (ratio)
number of farms making use of technical assistance (ratio)
number of farms using fertilizers (ratio)
number of farms using defensives [vegetal and animal] (ratio)
number of farms using soil preservation techniques (ratio)
number of farms using tractors (ratio)

Group 3: productivity indicators
value of agricultural production per hectare of total area[2]
value of agricultural production per worker

Group 4: employment indicators
number of farms using contracted labor ("empreitada")
number of permanent workers among the total number of personnel on the farm
number of temporary workers among the total number of personnel in the farm

The employment indicators comprising Group 4 were considered supplementary to the analysis, which is to say that Group 4 is projected over the factorial axes but does not interfere in the calculation of these axes. The reason for this is that employment is a variable to be "explained" by the evolution of modernization and is not

[2] The 1985 data were shown in 1996 reais (R$). To convert the original cruzados to reais, six zeros were eliminated and values were divided by 2750. A 1996-based deflation index was applied. The December 1985 IGP based on July 1996 (Census reference data) is 1,149932E-07.

to be absorbed by the same factors used to describe it. The technique of keeping variables or individuals as either supplementary or illustrative is commonly used in factor analysis so as to facilitate interpretation.

MFA is based on Principal Components Analysis (PCA) applied to a multiple table, where each group of variables has its relative importance in the total inertia of the multiple table balanced by a weighing process. This means that the values of all the variables of each group are divided by its first eigenvalue; a value obtained from the analysis of the principal components separately over the variables of each group. The variables of a given group then remain with the same weight, respecting the internal structure of each group, whereas each group suffers standardization, i.e., the maximum inertia of each weighted group is equal to 1 and the sum of the inertia of the variables of the same group on any axis of the space is inferior or equal to 1. This method guarantees that when searching for common factors within the group of variables, the relative importance of the groups is weighted so that no particular group can per se determine the first principal direction of the global analysis[3]. In the case of this research, the PCA technique applied separately to each active group of variables provided a first eigenvalue of 1.440 to the group formed by the two size variables, Group 1; a first eingenvalue of 4.880 to the group formed by the six variables of technical modernization, Group 2; and the first eingenvalue of 1.529 to the group of productivity variables, Group 3. Hence, in the MFA, the weights of the variables of each group were 0.695, 0.205, and 0.654 respectively[4].

Geometrically, the individuals are represented by a cloud of points on the k-dimensional space R^k, where each dimension represents a variable. Symmetrically, the variables are represented by a cloud of points in the n-dimensional space R^n, where each dimension represents

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[3] Global analysis is the generation of common factors by the FMA's application to the set of active groups, i.e., those groups that participated of the calculation of the common factors.
[4] For the application of the FMA technique the SPAD-TM from Cisia, France was used.

an individual. It is also possible to imagine a cloud of points representing the individuals on the R^k space by projecting on this space a set of partial clouds, overlapped, each one being made up by a group of variables. This is equivalent to the graphic representation of a PCA made separately for each group. The simultaneous overlapping of partial clouds and the projection of each one on R^k allows the existence of a common group structure to be checked and the position of the same individuals in different clouds to be compared.

The simultaneous representation of different clouds on the R^k space is guaranteed by the possibility of decomposition of this space on a sum of orthogonal subspaces, two to two, and isomorphus to each partial cloud. The quality of representation of each partial cloud depends on the magnitude of its inertia and is calculated as the ratio between the projected and total inertia. The comparison of the same individual through several clouds is possible by introducing another cloud, a "medium cloud", in which average individuals represented are nothing more than the gravity centers of the same individuals in the different clouds[5].

This representation falls into the classic problem of multivariate analysis: the search for a new referential or subspace in R^k of minor dimension (for example, the plan) in which there is a projection of the points referring to the average individuals in a way that all the existing deformations in the process are minimized, resulting in maximization of total inertia (of the set of clouds) and minimization of inertia within the clouds. The directions that originate this subspace of minor dimension in R^k are named global factors. The directions obtained with the application of PCA separately to each group of variables are named partial factors.

[5] Mathematical developments of these procedures can be found in Escofier and Pagés (1992), Lebart et al. (1995), Crivisqui and Villamonte (1999), Cisia (1997).

3. Results and Discussion

3.1. The interpretation of common factors

The first two global factors are responsible for 79.46% of the data's total inertia, indicating that the study can be limited to the first factorial plan. The first eigenvalue of 1.88 means that the first factor of the global analysis corresponds to an inertia direction important to the set of groups of variables as well as for each one individually, since the maximum reach of this eigenvalue is 3 (number of active groups). The interpretation of the two selected global factors depends on how the inertia of each one of them decomposes according to the groups.

The measures concerning the relations between the global factors and the groups of variables are shown on Table 1. The coordinates, which take values between 0 and 1, result from the inertia projection of each group (the sum of the inertia in each group of variables) on the global axes. The contributions supply the relative weights correspondent to the inertia of each group in relation to the total inertia of each axis. It can be noticed that Groups 2 and 3 are the ones that contribute the most to the total inertia of the first global axis, 49.3% and 50% respectively, whereas Group 1 contributed the most to total inertia of the second axis, 78%. The high square cosines show that Groups 2 and 3 are well represented on the first axis, whereas the Group 1 is well represented on the second axis. The Group 2 variables represent technological modernization and Group 3 represents productivity, which leads to the conclusion that the first global axis captures the simultaneous effect of technological modernization and productivity, and the second axis represents aspects related to farm size (Group 1). In the same table, it can be observed that all the groups have weight equal to 1/3 (the inverse of the number of active groups). The distances to the origin are meant to be an indicator of multidimensionality; and since the values are close to unity, this suggests that the three active groups each conform to only one dimension, although each is comprised of several variables. Group 4, which refers to the employment structure, participated in an illustrative way and is only feebly associated to the first global axis.

Table 1 - Coordinates and help for the interpretation of active groups

	Weight	*distance to*	*Coordinates*		*Contribution*		*square cosine*	
group		*origin*	*axis 1*	*Axis 2*	*axis 1*	*axis 2*	*axis 1*	*axis 2*
Group 1	0.33	1.15	0.01	0.96	0.7	78.0	0.00	0.80
Goup 2	0.33	1.01	0.93	0.05	49.3	4.2	0.86	0.00
Group 3	0.33	1.09	0.94	0.22	50.0	17.8	0.81	0.04
Total					100.0	100.0	0.54	0.30
Group 4*	0.33	1.15	0.47	0.15	24.8	12.4	0.19	0.02

Obs. * Illustrative group.

To judge the similarities between the projections of the three partial clouds on the same global axis, i.e., the truly common feature of the global axis for the groups, one must calculate the coefficients of correlation among the partial factors of each one of these projections and the global cloud factors. Table 2 confirms the common feature of the first global axis for Groups 2 and 3, technological modernization and productivity respectively. The high values of the coefficients of correlation (0.97 in both groups) indicate that there is an almost analogous direction between the two groups. Axis 2 is a dimension that reveals the size indicators from Group 1, but it also shows a common dimension with productivity (Group 3).

Table 2 - Correlation for the first two MFA axes between projections of global clouds and three partial clouds.

Groups	Correlations between the global factors and the groups	
	1	2
Group 1	0.11	**0.98**
Group 2	**0.97**	0.45
Group 3	**0.97**	0.83

Synthesizing, the first global factor represents an important direction of inertia for Groups 2 and 3, which cover the variables related to technological modernization and productivity. The second global factor represents an important direction of inertia for Group 1, variables related to size, although this second axis is also reflecting the productivity dimension in some instances.

Table 3 shows the coordinates (correlations) of each variable of the four groups in relation to the first two FMA factorial axes. It also shows the relative contribution from each variable, as well as the total contribution of each group to the total inertia of the axes.

The contribution from Groups 2 and 3 to the formation of the first axis was balanced. Although having a much higher number of variables, Group 2's contribution is the same as that of Group 3, in spite of the latter having only two variables. This shows the balance achieved by FMA. However the variables show very uneven contributions when examined individually, as shown in Table 3. In the second axis, Group 1 contributed 78% of the total inertia, Group 3 contributed 17.8%, mainly due to the production value per hectare variable, and Group 2 showed an insignificant contribution.

Table 3 - Coordinates and contributions of active variables on the first factorial plan

Variables	*coordinates*		*contributions (%)*	
	axis 1	*axis 2*	*axis 1*	*axis 2*
GROUP 1			*0.7*	*78.0*
ensemble				
size	-0.1	-0.9	0.3	45.7
% area admin.	-0.1	-0.8	0.4	32.2
GROUP 2			*49.3*	*4.2*
ensemble				
% coop.	-0.8	0.2	7.2	0.9
% tech. assist.	-0.9	0.0	8.9	0.0
% fert.	-0.9	0.3	8.5	1.7
% defens.	-0.8	0.0	6.6	0.0
% soil presev.	-0.9	0.2	8.7	0.8
% tractor	-0.9	-0.2	9.4	0.8
GROUP 3			*50.0*	*17.8*
ensemble				
PV/ha	-0.8	0.5	21.8	10.8
PV/worker	-0.9	-0.4	28.2	7.0
GROUP 4			*24.8*	*12.4*
ensemble				
% contract. labor	-0.5	-0.4	6.2	7.1
% perm. workers	-0.8	-0.4	16.2	5.3
% temp. workers	-0.3	0.0	2.4	0.0

The first common axis is strongly associated with the indicators aligned with technical modernization and productivity. It is an inertial axis important for these groups, summarizing the effect of all the modernization indicators on land and labor productivity. It can be seen as a *scale factor* that organizes the states according to the number of modern and highly productive farms they contain.[6] A scale factor measures the intensity of a single phenomenon from the reaction of several variables and is considered to be a very effective tool for detecting synthetic indications (for instance, it is known beforehand that agricultural

[6]Escofier and Pagés (1992, cap.9) evoke 7 types of factors that are commonly found in multiple factor analysis and help its interpretation: outliers factor; opposition factor; group evidence factor; partition-associated factor; scale factor; size-effect factor and Guttman effect.

modernization can be expressed by a set of associated variables that vary in the same direction).

The second axis separates the states according to the average area of the farms and whether or not they employ an administrator.[7] On the second axis, the coordinates related to the variable of land productivity stand out but show a reverse signal to the average farm size and the employment of an administrator. This leads to hypothesizing that the second axis puts into opposition states with extensive agriculture, characterized by large areas of low production per hectare and usually not directly worked by the owner, against states characterized by the use of the intensive agriculture typical of family farming, i.e. small areas with high production value per hectare. Therefore, a state that moves simultaneously in relation to the two axes is likely to be absorbing the technical elements of modernization to increase land productivity while possibly increasing characteristic farm size and improving labor productivity.

The same table shows the coordinates and projections of Group 4's illustrative labor related variables on the first factorial plan. Only permanent workers show a high association with the first axis while the use of contracted work ("empreitadas") is lightly associated. Temporary workers are not correlated to any of the factorial axes, not even the fifth axis. Between 1985 and 1996, agricultural employment, mainly the use of temporary workers, can only be feebly "explained" by factors such as modernization and intensive land use.

3.2. The States' paths

To identify the patterns of modernization from 1985 to1996, one can use the variation of factors values for each state as indicators

[7] Between the two Censuses there is a drastic fall in the proportion of farms with hired administrators in states like Tocantins and Goiás, which in turn, have high average size farms. We cannot discard the possibility of errors in the data.

of the direction and intensity of change. The states can then be grouped according to these variations. Five groups of states were obtained when cluster analysis was applied to the variations of the two first factors' values (Table 4).

Table 4 - Paths of agricultural modernization of the Brazilian states, 1985 to 1996. (Differences between values of the states' common factors: positive values indicate increase; negative values indicate decrease; 0 indicates stability)

Paths	*States*	*modernization and productivity*	*area and hired administrator*
Type 1 path	SC	0.8	0.0
	RS	0.5	-0.1
	MS	0.8	0.1
Type 2 path	RR	0.1	-0.9
	AP	0.5	-0.5
	TO	0.2	-0.8
	RJ	0.4	-0.4
	GO	0.5	-0.9
Type 3 path	RO	0.4	0.6
	AC	0.3	0.0
	CE	0.2	0.1
	RN	0.2	0.1
	PE	0.0	0.2
	AL	0.1	0.3
	SE	0.0	0.2
	MG	0.2	0.2
	SP	0.2	0.3
	PR	0.2	0.2
Type 4 path	AM	0.2	-0.1
	PA	0.0	-0.3
	MA	0.1	-0.1
	PI	0.1	-0.1
	PB	0.2	0.0
	BA	-0.1	0.1
	ES	-0.4	0.1
Type 5 path	MT	0.9	0.5
	DF	1.4	0.6

The characteristic of the Type 1 path is significantly increased modernization and productivity while Factor 2 remained stable, i.e., average farm size and hired administration stability, or intensive agriculture practices stability. The three states exhibited this type of development (SC, RS and MS) demonstrated high levels of modernization

The Type 2 path is also characterized by increased technological modernization and productivity, though followed by heavy reductions in the average area devoted to agricultural use. The states that follow this path (RR, AP, TO, RJ and GO) were the ones that most intensified production over the study period.

The Type 3 modernization path is found in ten states, representing all the Brazilian regions except the Midwest. The huge agricultural states of SP, PR, MG, PE, and RO are in this group, the evolution of which has been characterized by little growth of all indicators. These states, the main agricultural states in Brazil, have demonstrated little improvement relating to technological modernization and productivity over the study period.

The Type 4 path is found in Brazil's North and Northeast and in the agriculturally important states of BA and ES. This path is one of stability, exhibiting few small magnitude variations both in modernization and in area used for agricultural production, exception being made for the slightly more significant reduction of modernization in ES.

Finally, MT and DF followed modernization paths very distinct from the other states. Both states showed significant increases in modernization, productivity, and scale in relation to the base-year. It can be seen that the patterns of modernization in these two states are completely distinct: in MT, extensive agriculture based on huge properties predominates; whereas in DF intensive agriculture on small areas is the norm. Some typical paths of selected states are shown in Figure 1.

Between the two agricultural censuses, the number of people employed in Brazilian agriculture was severely reduced. From 1985 to

1996, the number of permanent agricultural employees declined from 2.19 million to 1.84 million, and the number of temporary employees directly contracted by farm owners[8] declined from 2.77 million to 1.83 million.

Table 5 shows the participation of states grouped according to their previously identified modernization paths in the change of Brazil's agricultural employment level between 1985 and 1996. Over 50% of the country's agriculture payroll is in states exhibiting only a small increase in the average area under cultivation and weak modernization and productivity performance (Type 3). The Type 5 states, which demonstrated rapid modernization and area expansion, participated the least in total agricultural employment due to peculiarities: DF is very small and urban, while agriculture in MT is focused on cattle ranching, an activity with minimal labor demand.

Table 5 - Participation of states, grouped according to paths, in the agricultural job payroll.

Paths	*% perm. ag. workers 1996*	*% temp.ag. workers 1996*	*% farms with "empreitadas" 1996*	*Variation in the number of perm. workers 1985 - 1996*	*Variation in the number of temp. workers 1985 – 1996*	*variation in the no. of farms with "empreitadas" 198 - 1996*
Type 1	12.0	7.2	13.6	-19,674	-73,201	+9,842
Type 2	10.1	6.1	10.7	-18,388	-59,977	-40,457
Type 3	56.9	52.0	43.5	-226,815	-598,806	-62,185
Type 4	17.2	32.5	28.7	-105,065	-201,214	+8,027
Type 5	3.8	2.2	3.4	+17,526	+324	+5,073
TOTAL	100.0	100.0	100.00	-352, 416	-932,874	-79,700

Type 5 states were the only group that made a positive contribution to the agricultural payroll, although on a small scale. This group showed a strong tendency toward modernizing and cultivated

[8] There is a considerable contingent of temporary workers hired by contractors who do not appear in census statistics.

area expansion (MT and DF). The per state data show that this growth only occurred in the number of permanent (around 18,000 people) and temporary employees (563 people) in Mato Grosso while the agricultural payroll in DF decreased. The number of contracted workers ("empreitadas") has also grown some in the Type 4 group, a group constituted basically of poor North and Northeastern states.

Substantial agricultural job reductions can be observed in states following all the other paths, an indication of the agriculture sector's inability to generate jobs between 1985 and 1996. Agricultural job losses occurred even in those states that exhibited intensified agricultural production.

It is clear that variation in agricultural employment is highly dependent upon combinations of activities besides those analyzed in our analysis. Further study is needed to identify the reasons for this strong agricultural payroll retraction in Brazil.

4. Conclusion

This paper addresses a problem found in Brazil's rural economy using Multiple Factor Analysis, a statistical technique.

We have shown that in recent years agriculture modernization of the Brazilian states has followed two distinct paths. On the one hand, change in production has been driven by technical modernization combined with organizational elements (affiliation to cooperatives) and the more efficient use of land and labor; on the other hand, change in production has been based the change of farm size and variation in administrative type (owner operator or hired administrator). States that follow the path of intensive agriculture are then differentiated from states in which extensive agriculture is the norm. Though we did identify several sub-paths, these two main types of agricultural land use correspond to the production-oriented agriculture ("productivism") that, to a great extent, still predominates in Brazil. Some states on Brazil's frontier (Mato

Grosso, Mato Grosso do Sul and Rondonia) and in its extreme south (Santa Catarina and Rio Grande do Sul) demonstrated significant modernization and productivity growth; however, it can be concluded that the modernization dynamic in most states was very weak between 1985 and 1995/6.

This weak dynamism combined with possible changes in productive activity are associated with the strong decline of the agricultural payroll in practically all Brazilian regions. We consider that the almost total inability of current agricultural patterns to keep the labor force in rural areas will cause serious future social problems. It also leads us to think that the possibilities foreseen in distinct organizations and recent phenomena, such as family farms and pluriactivity, are the new paths and that they require the support of future policies for the rural area.

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Appendix 1

Raw data: 1985 agricultural modernization indicators.

States	*V11*	*V12*	*V21*	*V22*	*V23*	*V24*	*V25*	*V26*	*V31*	*V32*	*V41*	*V42*	*V43*
RO	74.8	22.3	2.3	3.6	2.3	26.0	0.4	1.1	57.06	1061.02	17.4	2.1	5.0
AC	149.4	24.8	2.1	1.5	1.2	11.4	0.7	0.4	23.02	1041.70	6.6	1.9	2.7
AM	50.4	22.5	0.4	1.2	1.4	9.3	0.3	0.3	79.76	857.45	6.1	1.2	2.9
RR	336.4	47.5	1.7	5.3	2.7	28.7	0.6	1.5	22.00	2175.17	36.2	8.5	5.7
PA	97.7	44.4	1.2	1.7	4.9	20.3	0.4	1.1	59.06	1206.68	10.1	3.8	5.4
AP	250.8	63.8	0.9	15.4	5.0	42.2	0.6	1.1	29.51	1662.02	6.5	6.6	3.5
TO	366.7	29.2	3.6	4.2	10.1	63.0	1.6	6.1	26.19	1898.07	43.0	9.5	11.7
MA	29.3	31.0	0.6	0.5	1.0	17.7	0.2	0.3	59.11	549.41	5.7	1.1	5.6
PI	43.7	29.1	1.5	1.7	2.0	23.7	0.5	0.4	31.44	454.30	2.4	1.3	6.5
CE	33.9	21.5	8.0	3.0	9.4	49.4	3.3	0.9	99.00	857.02	5.8	3.7	14.8
RN	37.9	26.4	9.5	3.2	12.8	57.7	3.7	1.8	97.72	990.75	2.9	5.4	12.2
PB	24.0	21.8	5.5	1.7	10.4	51.6	3.0	1.0	140.79	897.85	5.1	3.8	10.6
PE	18.8	23.1	5.9	2.4	17.0	43.3	3.1	0.9	256.66	1315.51	2.6	9.9	11.6
AL	16.6	35.9	3.3	2.4	16.7	19.9	1.5	1.3	396.63	1501.04	5.2	12.6	16.8
SE	16.6	18.2	2.8	4.4	41.6	68.0	0.6	1.3	192.66	1061.92	6.6	4.0	10.8
BA	45.2	32.0	2.9	3.6	19.9	51.8	2.4	1.4	121.89	1272.38	15.2	8.1	13.6
MG	83.1	24.8	18.7	11.9	56.8	78.3	19.6	7.4	196.90	3392.82	28.2	14.8	18.9
ES	56.3	19.6	16.4	15.8	63.1	69.5	45.4	9.9	420.32	4103.26	27.0	13.3	13.4
RJ	35.8	33.7	20.8	10.6	36.2	50.3	7.8	7.4	317.21	3216.44	23.2	21.4	11.3
SP	71.8	39.6	30.5	25.5	74.8	78.9	39.4	32.7	604.22	9013.65	24.7	30.2	17.7
PR	35.8	29.6	37.9	24.0	53.2	73.0	32.1	14.7	470.80	4238.04	22.6	9.0	13.7
SC	31.6	18.2	42.4	36.0	67.0	85.8	26.2	16.2	461.40	3858.28	16.6	4.8	7.0
RS	47.9	17.3	48.9	29.6	70.0	89.9	35.3	18.6	310.47	4231.24	6.2	7.0	6.1
MS	569.4	47.1	24.0	22.7	27.9	83.2	15.1	30.4	66.90	8193.80	43.4	29.4	14.6
MT	485.6	60.2	9.8	8.9	12.7	47.2	4.8	12.3	32.92	3467.55	25.1	12.9	10.5
GO	227.3	32.9	14.9	13.1	54.6	82.9	16.0	15.8	87.76	4252.20	59.3	17.7	17.2
DF	91.8	36.4	19.6	56.6	93.2	88.0	35.6	38.0	373.12	6816.51	40.7	37.8	14.2
média	123.3	31.6	12.5	11.5	28.4	52.3	11.1	8.3	186.46	2736.52	18.3	10.4	10.5
desv. pad.	147.9	12.0	13.6	13.2	27.4	25.3	14.3	10.7	167.81	2267.83	15.2	9.4	4.8

Source: Agricultural Census 1985 (Vij = variable i in group j)

Raw data: 1995/6 agricultural modernization indicators.

States	*V11*	*V12*	*V21*	*V22*	*V23*	*V24*	*V25*	*V26*	*V31*	*V32*	*V41*	*V42*	*V43*
RO	115.5	33.5	6.6	10.1	7.2	83.6	1.2	3.3	37.6	1097.5	20.8	5.0	5.3
AC	133.8	26.9	5.0	7.2	2.9	37.7	1.1	1.2	33.7	1145.5	15.5	3.8	3.9
AM	39.9	22.4	1.7	6.1	5.5	15.7	0.0	0.4	110.3	1045.8	6.5	1.8	4.3
RR	398.2	20.5	6.0	8.1	13.8	55.3	1.6	3.2	20.9	1802.5	23.7	8.8	4.2
PA	109.1	36.1	3.3	3.8	11.2	32.9	0.6	1.7	45.6	1161.5	13.6	4.2	7.3
AP	209.0	54.4	3.0	17.8	12.4	34.1	0.2	1.3	98.4	4133.9	6.2	12.7	7.2
TO	373.3	7.9	3.2	12.8	14.7	81.0	2.4	10.3	21.3	1834.8	27.6	14.5	9.8
MA	34.1	29.4	0.8	1.8	2.7	23.5	3.6	0.6	55.6	524.2	9.6	2.1	16.9
PI	46.4	25.6	1.9	1.7	4.0	41.4	0.7	0.7	35.4	513.5	6.5	2.0	5.0
CE	26.4	25.4	5.2	3.8	12.5	54.3	23.7	1.0	102.5	785.1	5.8	3.9	13.6
RN	40.9	29.3	12.2	5.8	18.4	63.0	3.8	2.8	95.3	1070.4	7.3	7.9	15.8
PB	28.0	22.3	6.7	4.8	19.1	68.4	6.9	1.6	114.0	975.8	4.1	5.9	5.1
PE	21.6	25.8	2.9	5.1	26.3	58.0	4.6	1.5	220.3	1260.6	2.6	8.9	13.1
AL	18.6	39.4	6.2	5.3	30.3	43.6	5.4	1.8	305.6	1515.1	8.0	10.0	13.9
SE	17.1	22.4	2.1	8.6	49.7	63.8	2.2	2.4	160.6	873.1	9.4	4.7	12.2
BA	42.7	34.3	2.2	4.5	23.2	55.5	3.0	2.3	70.4	838.0	17.0	6.4	8.4
MG	82.2	28.5	25.1	24.7	61.8	81.8	21.2	11.9	157.0	3204.5	22.6	16.2	15.2
ES	47.6	16.3	17.3	20.4	71.4	68.7	41.3	12.0	310.3	3080.0	15.8	12.4	6.5
RJ	45.0	19.8	28.2	33.1	51.1	76.5	12.1	11.5	260.9	3617.5	26.2	23.4	7.4
SP	79.7	40.3	35.2	46.8	71.3	92.5	50.7	41.9	484.3	9194.3	22.4	37.6	7.9
PR	43.1	29.9	32.8	40.3	65.6	88.2	48.5	22.0	348.8	4320.2	26.6	11.1	9.2
SC	32.5	17.3	45.1	65.4	84.6	95.2	41.1	25.2	494.6	4550.6	15.2	5.9	6.5
RS	50.7	16.0	65.2	47.8	81.8	94.0	44.8	24.2	283.0	4480.6	13.8	7.7	4.7
MS	626.1	40.6	21.0	40.0	31.4	91.1	28.1	39.3	70.5	10763.3	26.6	35.4	10.1
MT	632.9	55.3	11.8	28.1	15.3	85.9	7.4	20.0	39.8	6018.4	31.9	19.6	11.6
GO	245.8	5.7	21.4	32.1	53.0	95.5	23.4	22.8	94.0	5476.1	47.6	23.6	16.5
DF	99.6	50.6	22.7	83.9	89.0	93.9	42.7	53.2	552.6	9641.9	35.3	41.1	15.7
média	134.8	28.7	14.6	21.1	34.5	65.7	15.7	11.9	175.8	3229.3	17.3	12.5	9.5
desv. pad.	171.1	12.3	15.5	20.1	27.8	23.7	17.5	14.3	157.6	2943.4	10.8	10.8	4.2

Source: Agricultural Census 1995/96 (Vij = variable i in group j)

Figure 1. Some typical modernization paths.