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ABSTRACT

This study examined the predictive factors of demand for degrees and academic performance at the University of the Basque Country (Spain). The study followed two cohorts of university students from secondary education to the completion of the third year of higher education. The data analyzed included secondary school qualifications, selectivity and registration, and completion of the third year. At the first stage bivariate descriptive analysis was carried out. Once the variables with greater predictive strength had been selected, the relationships among variables were analyzed through multivariate procedures. Data were displayed using a graphic representation in factorial planes of the different kinds of variables to facilitate comprehension and direct and global insight on the main aspects. With regard to the demand for various types of degrees the study found that employment status of the student's father and the student's previous academic performance were the strongest predictive factors. For predicting academic performance in higher education, previous performance in secondary school was the strongest predictor variable. Six figures show data and findings distributions. Contains 20 references. (JB)

14th EAIR Forum

Paper:

"DEMAND AND ACADEMIC PERFORMANCE IN HIGHER EDUCATION"

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Introduction

This paper presents the most important results of a series of studies (APODAKA et al. 1986, 1990, 1991) on predictive factors of Demand and Academic Performance at the University of the Basque Country (Spain).

The research has a double purpose:

- On one hand, analyze the characteristics of students that are capable of predicting their demand for higher education Degrees. That is, the factors which differentiate among students that opt between the university Degrees on offer.
- On the other hand, analyze the variables and characteristics with greater predictive value of student performance during the first three years of higher education.

It is not the aim of this paper to formulate causal hypothesis of a predictive nature, but only describe the variables most closely associated with the demand and the academic performance.

Thus, two cohorts of university students were followed up from Secondary Education to the completion of their third year of higher education. The cohorts included the students admitted to the University of the Basque Country the 83-84 and 84-85 academic years. The data analyzed range from Secondary School Qualifications, through Preregistration, Selectivity and Registration (Access to University) to completion of third year (Performance).

Some clarifications about the scope and characteristics of the research may be useful:

- the study does not work on samples, so problems related to generalizability and random error are on the most part not present.

- the study is done on the basis of administrative records which are highly correct in most cases.
- the group of students undergoes a longitudinal followup for a period of almost eight years (DE MIGUEL, 1985).

Methods

At a first stage, descriptive analyses of a bivariate type, crossing the variables to be predicted with each of those variables which might be relevant, were carried out. Subsequently, once the variables with greater predictive strength had been selected, the relationship among variables was analyzed through multivariate procedures. This paper will only deal with this second stage of analysis and will omit the previous ones (APODAKA, GRAO et al. 1991).

The specific procedure of factor extration employed for the multivariate analysis is multiple correspondence analysis (BENZECRI, 1980), capable of working with multiway contingency tables. This sort of analysis is carried out by the SPAD Statistical Package, developed by the French Center of Applied Computer Science, CESIA (LEBART, 1977, 1981).

The procedures of factor extration simplify and synthesize the information in a way that makes easier to analyze the main conjunction-opposition among variables. The graphic representation in factorial planes of the different kinds of variables facilitates the comprehension of the information and a direct and global insight on the main aspects to be taken into account.

I.-PREDICTIVE FACTORS OF DEMAND OF HIGHER EDUCATION DEGREES IN THE UNIVERSITY OF THE BASQUE COUNTRY.

After a review of the literature, previous academic achievement was considered to be the most extensively recognized predictor of demand for university studies (HERNANDEZ, 1986; SALVADOR Y GARCIA VALCARCEL, 1989). Some authors specifically mention the self-selection on the basis of their previous academic performance observed in students faced with placing a demand for higher education degrees (DURU-BELLAT, 1989).

In order to analyze the predictive strength of this variable, the whole of qualifications obtained in Secondary School went through factor extraction. Working with each mark is not feasible and obtaining sums and averages was not considered the best solution.

After performing a Correspondence Analysis, a first factorial plane, Figure 1, was obtained. The first factor (abscissa axe) allows for a straightforward explanation. It shows the progression from just "pass" to excellent marks (*Suficiente* "F", *Bien* "B", *Notable* "N", *Sobresaliente* "S"), properly scaled as expected for a variable which is in fact ordinal. As it can be seen, the intervals between abscissas of consecutive qualifications are not equivalent. This fact suggests that the academic qualifications do not behave as an interval scale. The scarce distance between Fs and Bs is followed by a slightly greater distance between Bs and Ns, and markedly increases between Ns and Ss.

The second factor (ordinate axe) has no entity in itself. The progression N-B-F-S makes no immediate sense. However, it gets all his meaning in relation with FACTOR 1 as can be seen in Figure 1. The vertical axe (FACTOR 2) increases the discontinuity between consecutive qualifications that FACTOR 1 (horizontal axe) advanced.

Both factors give a sufficient explanation of the basic factorial structure of qualifications in Secondary Education (**BUP & COU**). Nevertheless, it might be useful to go deeper in the interpretation of those factors.

In the graphic representation what first calls for attention is that qualifications (for any subject of study) group separately. The Fs are gathered very much together, Bs are slightly more dispersed and, as for Ns and Ss, only a few of the courses are away from the cluster.

This suggests that the factorial structure represents a **general dimension of academic performance**.

The role that academic performance in core subjects of study play in the election of university Degrees is now analyzed. Figure 2 shows the different qualifications in each of the subjects of study. Each cluster includes Fs, Bs, Ns and Ss respectively. It is just a way of simplifying the interpretation of the figure and keeping the necessary information to characterize the different Degrees.

A superficial analysis suggests the important role of previous academic performance in the demand for higher education Degrees. Final registration is closely linked to it. Extreme cases

are Medicine and the group of technical-scientific studies: Technological (Engineering & Architecture), Sciences (Physics, Chemistry & Mathematics) and Computer Sciences. These are the to which students with very good qualifications (*Notable* and *Sobresaliente)* gain access.

Another group of Degrees (Geology, Philology, Economical & Business Studies, Biology and Nursing) is chosen by students with qualifications around *Notable*. The rest of degrees is selected by students with less bright qualifications (*Suficiente* and *Bien*).

These are general tendencies or global characterizations of demands for university Degrees according to academic performance in Secondary Education. There are of course discrepant groups. For instance, it is not uncommon to find very bright students, according to their achievement, in Degrees such as Philosophy or Philology.

As a subsidiary product of this analysis, the unidimensionality of the different qualifications of Secondary Education can be inferred. This permits working with an average of same. Such an average is in fact used by University Administrations to calculate the final mark which will eventually determine access to a certain Degree. The use of a unique measure of previous academic performance facilitates the carrying out of analyses that include a greater range of explanatory variables of Demand for Higher Education Degrees.

Further to the review of the literature (LATIESA, 1989; MORA, 1989; DURU-BELLAT Y MINGAT, 1986; ...), to our knowledge of the subject and the empirical results already obtained, the following variables were chosen to undergo factor extration:

- Mean of the academic qualifications in Secondary Education.
- Professional Status of Father.
- Sex.
- Type of Secondary School attended.

Other variables could have been also included (Mother's level of education, geographical area of Secondary School, ...). Simplicity has prevailed, and variables closely linked to those already selected (mother's level of education with father's profession) or introducing a higher level of heterogeneity (geographical area) were avoided.

Factor extraction results in fewer variables which represent the ones originally included in the analysis. This way, the most interesting components have been drawn out from the information. Figure 3 shows the versatility of this method.

In Figure 3, the horizontal axe corresponds to the first factor. The categories such as Fathers of High Professional Status and Private Secondary Schools appear in the right upper corner. Fathers of Low Professional Status and State Secondary Schools are placed at the other extreme of the horizontal axe. The variable Sex is not located at the extremes but there is a tendency to have Men at the right and Women at the left. These oppositions show the character or information obtained from this factor. It appears as a "Level of Status" type of factor. As it can be seen, the categories Profession of Father and Type of School are properly ordered along this factor.

With regard to the second factor or vertical dimension, the high (**7.5-8**) and very high (**8-10**) levels of Academic Performance are at the upper extreme of the Figure. The lower levels (**5-6**) of Academic Performance are placed at the low end of the Figure. The variable Qualifications at Secondary School is properly ordered from low to high along the vertical axe. It is evident that the vertical dimension represents a component of Previous Academic Performance.

In conclusion, the factors obtained from the variables compile fundamental aspects to predict the demand for higher education Degrees. Such dimensions are:

- HORIZONTAL DIMENSION - STATUS
- VERTICAL DIMENSION - PREVIOUS ACADEMIC PERFORMANCE

The third factor gives much less information and it is difficult to interpret. It will be left out of this discussion.

To test the versatility of this factor analysis solution as predictive of demand, the different Degrees have been superimposed over both factors.

Figure 4 presents the categories of variables which have generated the axes and several university Degrees, only those which appeared as minimally related to the axes. The Degrees with a more defined categorization can thus be observed.

Medicine is clearly defined by extreme levels of the first factor (previous academic performance). These are students with very high qualifications in secondary school. With regard to the second factor, these students are of high status but it does not reach such extreme values as qualifications.

"Long technological" Degrees follow a similar pattern. In this case, however, stat is reaches extreme high values whereas academic performance is high but not extremely so.

Nursing deserves special attention. This shorter Degree is characterized by medium-high levels of academic performance and extreme low levels of status.

At the other end, "shorter technological" Degrees attract students of medium-high status but low or very low previous academic performance.

The rest of Degrees do not show well defined characteristics so prudence is advisable before extrapolating the results to the description on reality.

II. PREDICTIVE FACTORS OF ACADEMIC PERFORMANCE IN THE UNIVERSITY OF THE BASQUE COUNTRY

From the review of the literature it is evident that the group of factors linked to performance in Higher Education is very extensive (LATIESA, 1986a y 1986b; GONZALEZ TIRADOS, 1986; FURNEAUX, 1986; JUSTICIA Y GARCIA, 1990, ...). This study only deals with those variables included in administrative records.

Out of the several possible conceptualizations of Academic Performance, coefficients of delay were chosen for the purpose of this research. These refer to the delay that a student experiences in relation to the official curriculum. Weighted coefficients of delay have been also used in order "to weigh" the qualifications in each subject of study. Finally, global coefficients of the first three years, instead of the coefficients of each year, are used. They greatly simplify the structure of analysis and do not imply a noticeable loss of relevant information.

Under these coordinates the first performance indicator used is:

- **Weighted ratio of delay in the first three years of studies**: Obtained by dividing the weighted addition of the number of courses passed in the first three years of studies by the number of courses in the whole curriculum of the Degree. The passes are weighted by assigning the following values: *Sobresaliente* -3, *Notable* -2, *Aprobado* -1. The number of courses is multiply by 3 so that, when used as divisor, the indicator obtained reaches a maximum rating of 1. The indicator, thus, will have a

minimum of 0 (when the students has not been able to pass any course) and a maximum of 1 (when they have passed all the courses with an *Sobresaliente*).

Nevertheless, this indicator is not free of problems. There are many levels of difficulty among the university Degrees. That is, there are Degrees with a very low level of fails whereas some others have a very high percentage of fails. This fact renders indicators as the one we have just proposed of relative value when the comparison of performance of students from different Degrees is intended.

To solve this problem, the above indicator of performance has been standardized considering the average and variability of each Degree. The indicator that results guarantees a more accurate comparison of the ratings of delay of students from different Degrees.

So the second performance indicator employed is:

- **Standardized Weighted Ratio of Delay in the first three years of studies:** Being a standardized score, the mean is 0 and the standard deviation 1. Its range goes from -3 to +3.

As with the characterization of Demand, several variables are selected and factorially extracted in order to characterize performance in higher education. Three criteria are used to select the variables:

- availability in the administrative database of the University.
- predictive value justified by the research in this field.
- previous bivariate analysis have proved a highly strong relation with performance indicators.

The variables selected are:

- Mean of secondary school qualifications
- Professional Status of Father
- Sex
- Type of Secondary School
- Actual registration in the Degree originally preferred.

Notice that the variables selected are practically the same that the ones used for the characterization of Demand. The only difference is "Actual registration in the Degree originally preferred", variable considered of interest in this case. Consequently, the factor analysis solution is of a very similar nature to the one previously obtained.

As expected, Figure 5 is very similar to Figure 3. The horizontal axe shows a continuum, left to right, from low to high Professional Status of Father and from State to Private Secondary Schools. It represents a dimension of Status. The vertical axe shows clearly the continuum from low to high Previous Academic Performance. (It is necessary to mention that students with the brightest qualifications (**EXP. 8-10**) are not placed in their coordinates (1.9) because they fall out of the figure, and this has been simplified). It is interesting to observe the two categories of the variable "Actual registration in the Degree originally preferred". They appear very consistently on the vertical axe. Students that follow originally preferred courses are placed at an intermediate level of the continuum of previous academic performance whereas those that follow non-preferred courses have very low previous qualifications.

In summary, the dimensions obtained could be conceptualized as follows:

- HORIZONTAL DIMENSION - STATUS
- VERTICAL DIMENSION - PREVIOUS ACADEMIC PERFORMANCE

Subsequently the performance indicators will be superimposed on the axes. They have been recodified in 6 intervals. Their identifications in Figure 6 are:

"REN" for **weighted non-standardized delay** categories.

"Z-REN" for **weighted standardized delay** categories.

All of them have an attached number 1 to 6, being 1 the lowest level of performance and 6 the highest.

It should be pointed out that titles HIGH QUALIFICATIONS-LOW QUALIFICATIONS; HIGH STATUS-LOW STATUS are not properly placed in the figure since once more it has been reduced by eliminating the extreme positions.

As it can be observed, the categories of performance at the university are placed in the most part along the vertical axe conceptualized as Previous Academic Performance. Only the lower levels of performance at university (REN-1, REN-2, Z-REN-1, Z-REN-2) show a slight tendency to the right in relation to the extreme positions of status on the axes.

This figure could be summarized as follows: Academic Performance in Higher Education could be mainly predicted by Previous Academic Performance in Secondary School.

Socioeconomical Status does not appear to be relevant for predicting performance at the university.

As any factor analysis solution, these conclusions have to be regarded with caution. The consistency of the latter results with those obtained from the bivariate analysis, however, renders them more trustworthy. It is also supported by the similarity between this solution and the one obtained to characterize Demand.

A final comment should be necessarily included. University students are a relatively homogenous group if compared to the rest of young people of similar age with regards to Previous Academic Performance and Socio-economical Status. The educational system is highly selective once a certain level has been achieved (HURRELMAN, 1986). This causes the students who reach higher education to be a "highly filtered" group. This fact should be taken in consideration when pondering the results presented since the lack of relationship between certain variables might be due to the diminished heterogeneity of the population studied.

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Figure 1

FACTORIAL DIMENSIONS OF QUALIFICATIONS IN SECONDARY EDUCATION

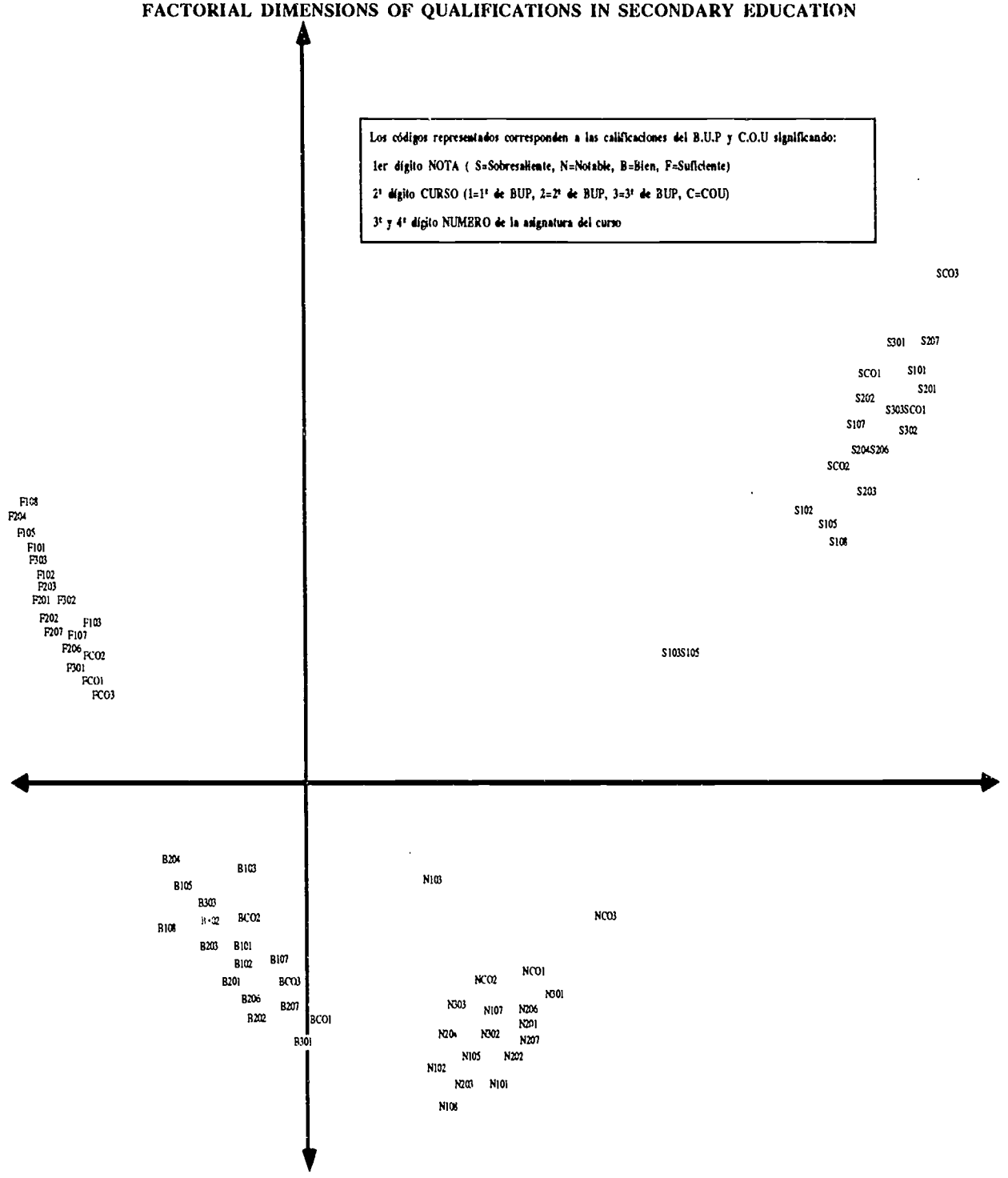

Figure 2

UNIVERSITY REPRESENTED OVER THE FACTORIAL DIMENSIONS OF QUALIFICATIONS IN SECONDARY EDUCATION.

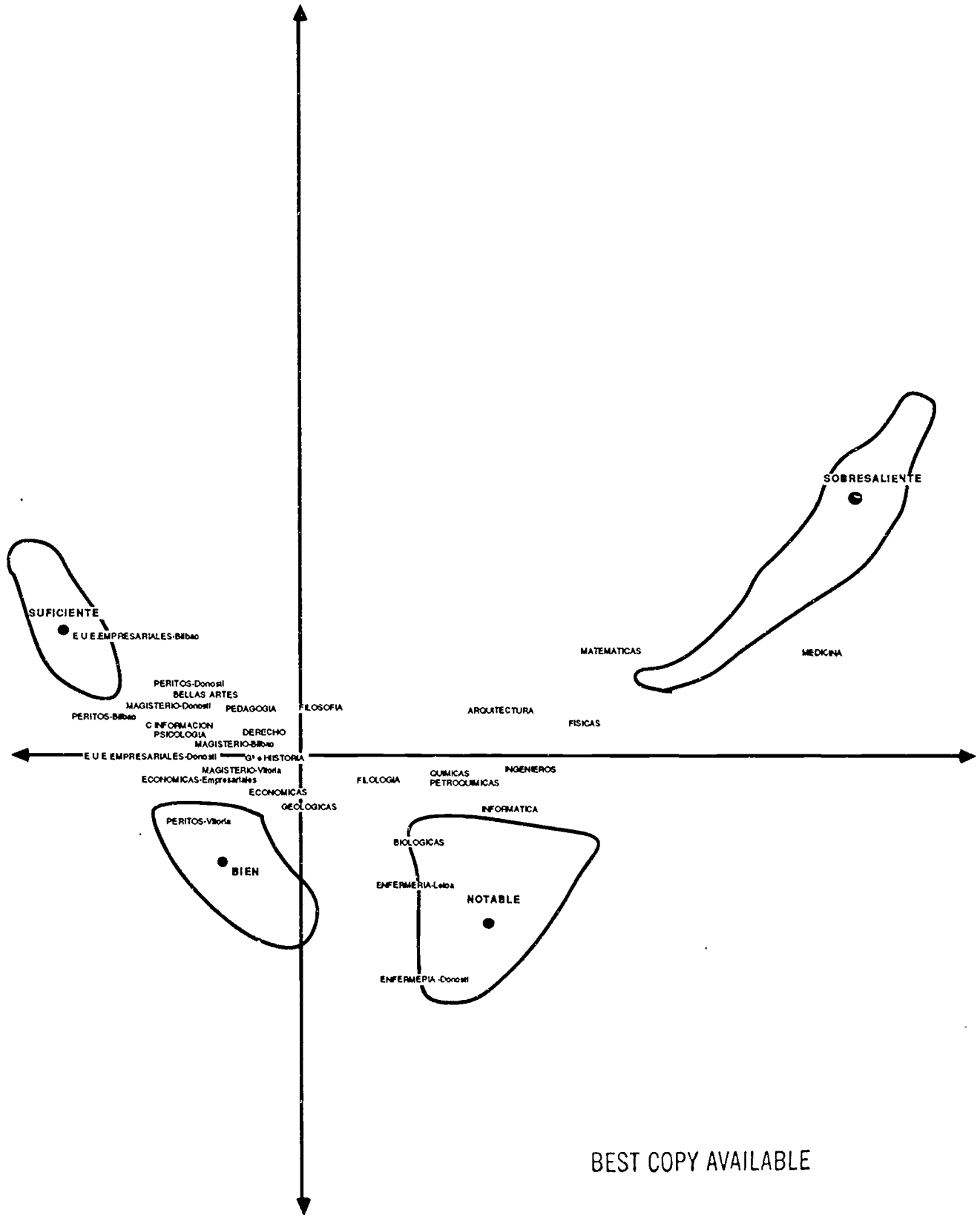

Figure 3

PREDICTIVE FACTORS OF DEMAND OF UNIVERSITY

GRAPHIC REPRESENTATION OF FACTOR ANALYSIS SOLUTION

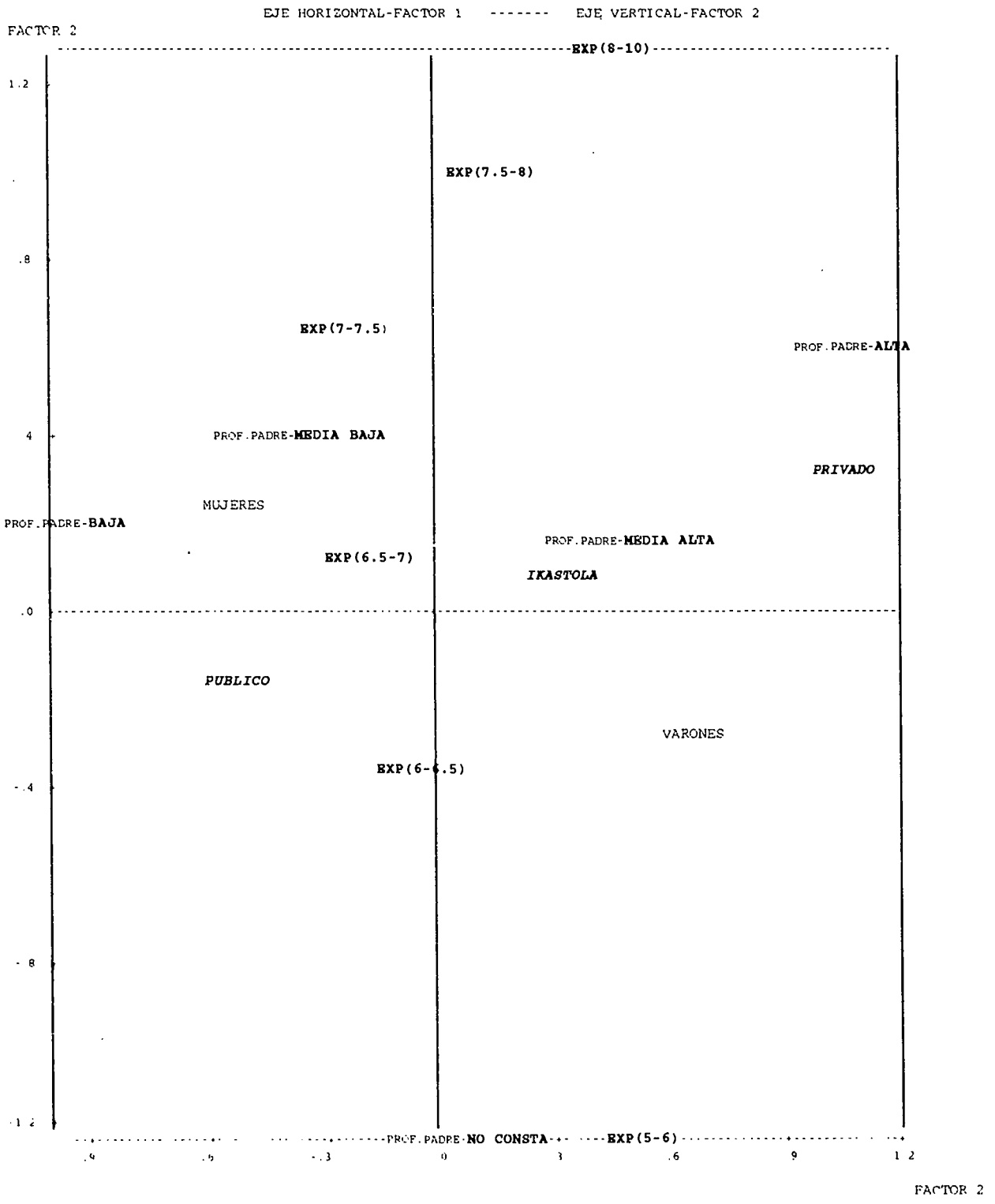

Figure 4

PREDICTIVE FACTORS OF DEMAND OF UNIVERSITY
POSITION OF OVER THE FACTOR ANALYSIS SOLUTION

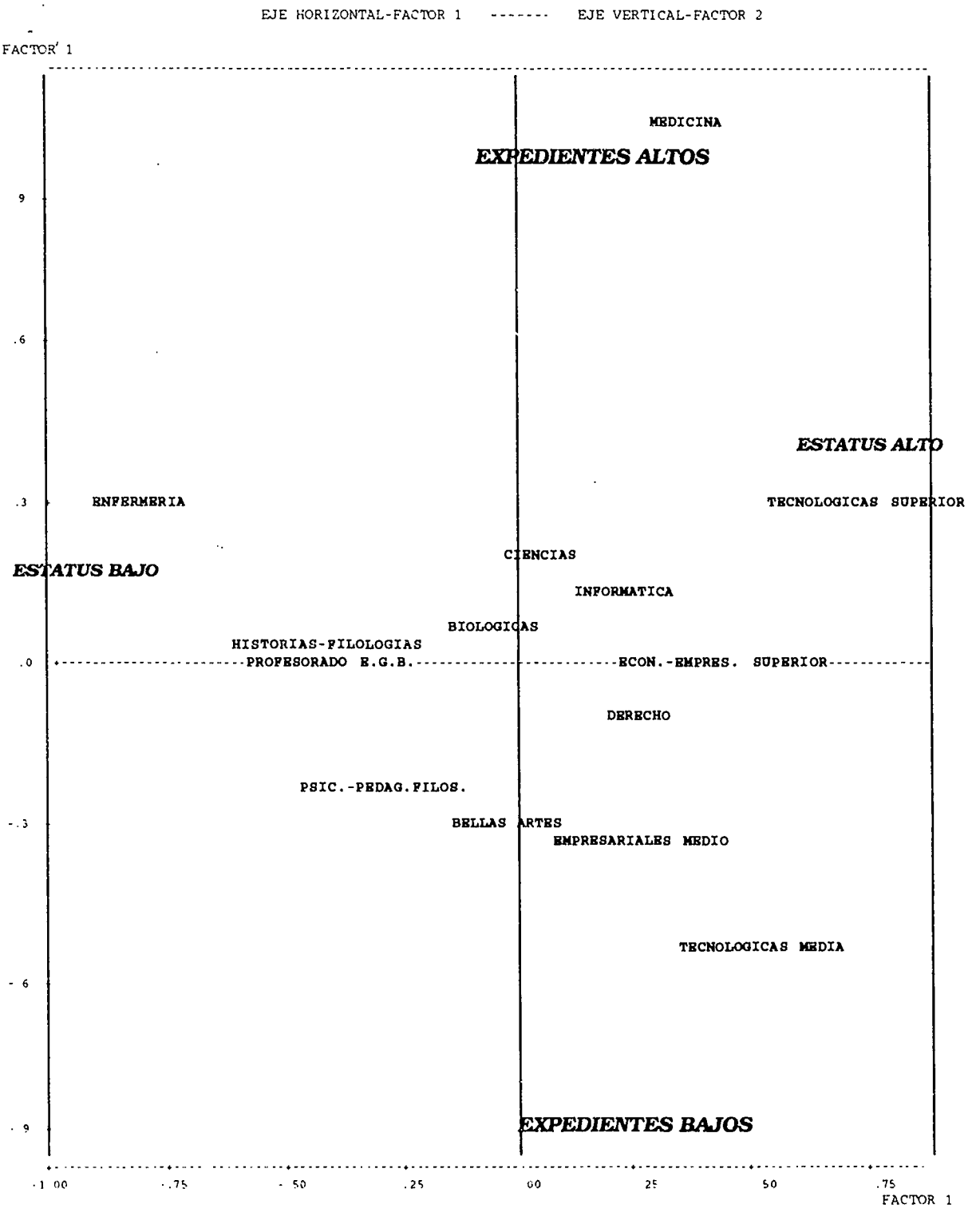

Figure 5

PREDICTIVE FACTORS OF PERFORMANCE AT UNIVERSITY
GRAPHIC REPRESENTATION OF FACTOR ANALYSIS SOLUTION

EJE HORIZONTAL - FACTOR 1 ---------- EJE VERTICAL - FACTOR 2

EXP (8-10)--FUERA DEL GRAFICO EN ORDENADA 1.9

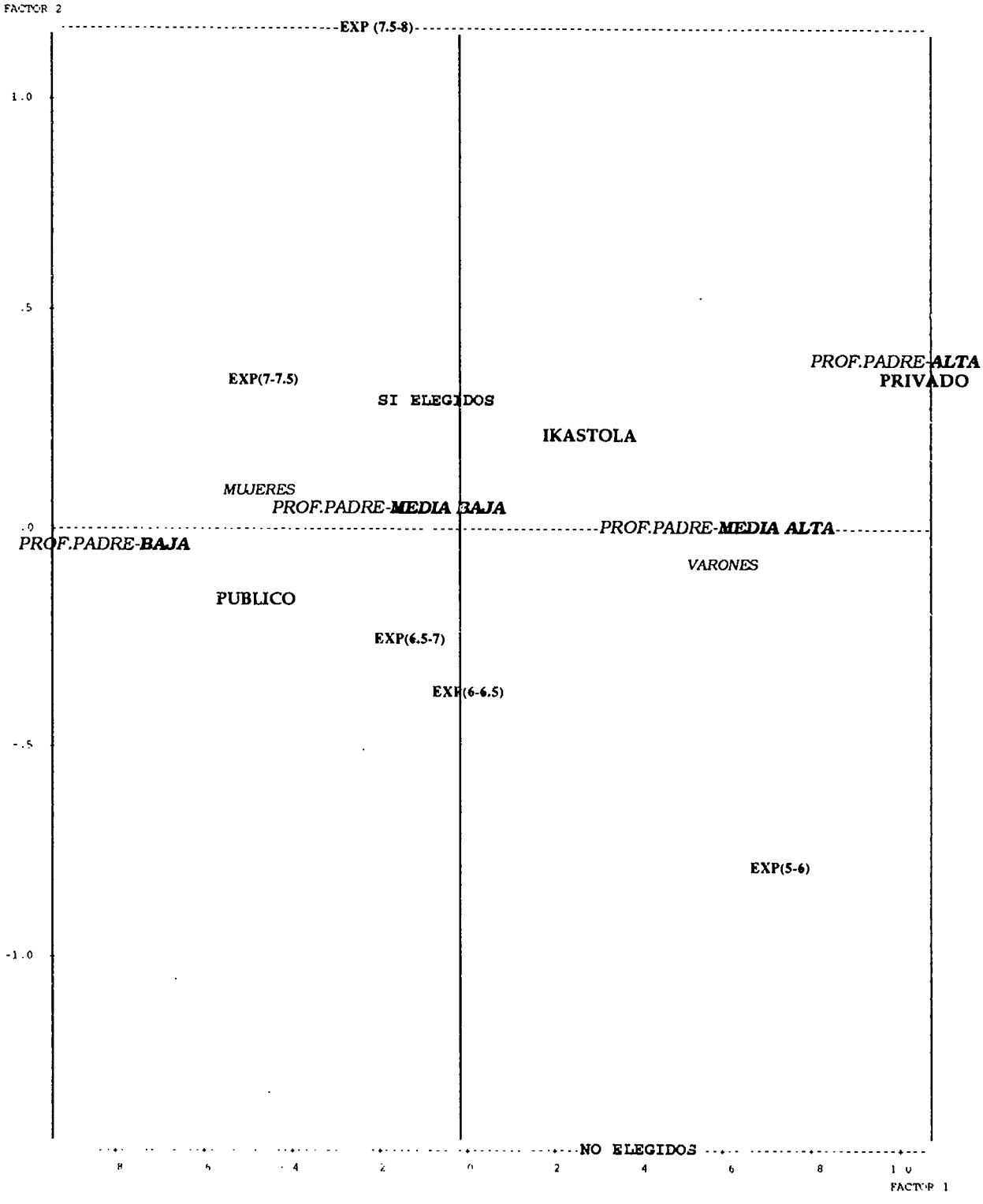

Figure 6

PREDICTIVE FACTORS OF PERFORMANCE AT UNIVERSITY
POSITION OF DIFFERENT PERFORMANCE INDICATORS OVER THE FACTOR ANALYSIS SOLUTION