

# A MATHEMATICAL MODEL FOR THE EXPORT DEVELOPMENT PROCESS OF FIRMS USING RELIABILITY APPLICATIONS

Arístides Olivares-Mesa<sup>1</sup>

University of Las Palmas de Gran Canaria (ULPGC)

Facultad de Ciencias Económicas y Empresariales. Módulo C

Campus Universitario de Tafira, 35017 Las Palmas de Gran Canaria

Spain

## ABSTRACT

The lifetimes of machine components in industrial reliability are considered failure times. For example, ball bearings are tested under cycles of different stresses and failure time is the number of cycles to failure. Failure time have the complicating feature of containing 'censored' observations. A right censored failure time for a ball bearing might arise if the ball bearing is still in operation at the end of the time period set aside for observation. A left-censored observation is one in which the unit is known only to have failed prior to some time. Meanwhile social scientists and economists are facing similar problems in analyzing data on the export development process of firms. In this case, 'failure time' is the length of time between the birth of the firm and the year of its first export (pre-export stage). If the firm has not exported yet (has not 'failed') at the end of the observation period, it will be referred as a right-censored observation. If the firm has already exported at the beginning of the observation period and the date of its first export is unknown, it will be referred as a left-censored observation. The object of the present paper is to fit a mathematical model to the export development process of Spanish manufacturing firms using reliability applications.

**KEYWORDS:** Reliability, right-censored observation, left-censored observation, export development process, psychic distance, entry mode, duration model, manufacturing firms.

**MSC:** 91B38

## RESUMEN

En fiabilidad industrial se estudia el tiempo que transcurre hasta que el componente de una máquina falla. Por ejemplo, los rodamientos de bolas se ensayan bajo ciclos de tensiones diferentes y el tiempo de fallo es el número de ciclos hasta que ocurre la rotura del mismo. Los tiempos de fallo tienen la característica de que contienen observaciones censuradas. Un tiempo de fallo censurado por la derecha para un rodamiento de bolas puede surgir si el cojinete se encuentra todavía en funcionamiento al final del período de observación. Una observación censurada por la izquierda es aquella de la que solo se sabe que ha fallado antes de una fecha determinada. En esta línea, los científicos sociales y los economistas se enfrentan a problemas similares en el análisis de datos sobre el proceso exportador de las empresas. En este caso, "el tiempo de fallo" es el tiempo que pasa entre el nacimiento de la empresa y el año de su primera exportación (fase previa a la exportación). Si la empresa no ha exportado todavía (no ha "fallado") al final del período de observación, se considera como una observación censurada por la derecha. Si la empresa ya ha exportado al comienzo del período de observación y la fecha de su primera exportación se desconoce, se considera como una observación censurada por la izquierda. El objeto del presente trabajo es ajustar un modelo matemático para el proceso exportador de las empresas manufactureras españolas utilizando herramientas de fiabilidad.

## 1. INTRODUCTION

Firms face three interlocking questions with regard to international expansion: what market to enter (entry location), how to enter (mode of entry), and when to enter (timing of entry). Earlier studies have focused on the first two questions. In contrast, research on the third question has received relatively little attention (Gaba, Pan and Ungson, 2002).

One of the first authors who studied timing of entry was Vernon (1966) in his 'seminal' article entitled 'International Investment and International Trade in the Product Cycle'. The argument of this article is that firms are highly stimulated by their local environment and are more likely to innovate when their immediate surroundings are more conducive to the creation of new techniques or products. For internationalization to occur these innovations must be transferable to other economies (Buckley and Ghauri, 1993). In adapting to its market, the firm moves through three stages according to the product development:

- Stage I ) Innovation (new product)

---

<sup>1</sup> aolivares@dede.ulpgc.es

- Stage II) Maturity (maturing product)
- Stage III) Standardization (standardized product)

In stage I, advanced countries (United States in Vernon's work) which have the ability and competence to innovate as well as high income levels and mass consumption become initial exporters of goods. Thus, they export initially to developed countries and subsequently to less developed countries (stage II) and eventually become importers of these goods (stage III). Vernon's hypothesis was an attempt to advance the trade theory beyond the static framework of the David Ricardo's comparative advantage and other classical economists.

Buckley and Casson (1981) sought to determine the optimal time to switch between entry modes, in order to minimize cost and to capitalize on market growth. Their analysis suggests that exporting, licensing and foreign direct investment (FDI) are in ascending order of fixed costs and descending order of variable costs. In a market subject to autonomous growth the theory then predicts that the firm will begin by exporting, switch to licensing as market size increases, and then finally switch to FDI. If licensing have a significantly higher cost than exporting, and a significantly higher cost than FDI, licensing stage may be omitted. The only firm prediction that can be made is that in an expanding market where two or more different modes of servicing are used, FDI will never precede licensing, licensing will never precede exporting, and FDI will never precede exporting.

In the preceding models, the firm's internationalization is explained as a sequence of stages that are the result of economic and environmental factors. But most of the internationalization process literature has relied on internal factors as the key driving forces of that process: Resource availability, market knowledge, psychic distance were included by Johanson and Wiedersheim-Paul (1975) and Johanson and Vahlne (1977), but also management attitudes and perceptions are considered by Simpson and Kujawa (1974) and Calof and Beamish (1995). From this resource-based perspective of the internationalization, it must be highlighted the Uppsala Model of Internationalization developed by Johanson and Wiedersheim-Paul (1975) and Johanson and Vahlne (1977, 1990); and its American counterpart with the innovation-based models; see e.g. Bilkey and Tesar (1977) and Cavusgil (1982). All these models deal exclusively with the development of the marketing side of the firm. They view the firm's involvement in foreign countries as an evolutionary and sequential process, based on (a) the interplay between the development of experiential knowledge of foreign markets and the increasing commitment of resources, in the case of the Uppsala Internationalization Model, and (b) managerial perceptions, beliefs and attitudes towards exporting, as it can be considered an innovation-adoption process within the firm; for a comprehensive review of the literature see Leonidou and Katsikeas (1996).

Among the above models we have decided to rely on the Uppsala Model for analyzing the timing of the internationalization process of Spanish firms because of three reasons. First, since the 1970s when the model was published, the subsequent debate, criticism and vigorous testing bear witness to its influence. Second, it is the model that has been more detailed developed at the operational level. And third, previous research has suggested that Spanish firms follow this model.

The model describes three patterns of internationalization. The first is the 'establishment chain' or entry mode sequence, this is, the path that would be followed by an enterprise as it internationalizes in individual foreign markets (entry mode sequence postulate). The second pattern is the geographical sequence pattern, this is, the extension of activities to new markets (geographical sequence postulate). And finally, the third pattern refers to the interrelationship between the first two patterns (combined sequence postulate).

However, when the purpose is to study the timing of the internationalization process it is a must to be conscious of the trends that are pointing to the acceleration of the internationalization process of firms. That is why we include a testing of the 'acceleration postulate'. The following paragraphs will develop the bases for testing the four aforementioned postulates of the internationalization process of firms.

### **The entry mode sequence postulate**

The basic assumption of the Uppsala Model is that the firm develops in the domestic market and that the internationalization is the consequence of a series of incremental decisions. It also assume that the most important obstacles to internationalization are lack of knowledge and resources. Thus, the Uppsala model proposes that the development of operations in individual countries follows a stepwise process composed of four different stages:

1. no regular export activities
2. export via independent representatives (agents)

3. sales subsidiary, and
4. production/manufacturing.

Thus, in accordance with these authors, we can postulate the following hypothesis.

Hypothesis 1: The development of the firm's internationalization is a gradual process that begins with stages demanding smaller resource commitments, market experiences and information, and advances towards stages requiring larger resource commitments, market experiences and information.

### The geographical sequence postulate

The second pattern described by the Uppsala model of internationalization is the geographical sequence of foreign country markets that the firm decides to enter. The model predicts that the firm will enter foreign markets with successively greater psychic distance. So, we can postulate the following hypothesis:

Hypothesis 2: The firm starts operations in countries with small psychic distance and then continues its activities in countries with larger psychic distance.

### The combined sequence postulate

Besides the two well-known patterns of the internationalization process that the Uppsala model describes, 'a third pattern which could be expected is that after the establishment of the first agency a phase follows when agencies are established in several markets. In the same way we could expect a separate phase dominated by the establishment of sales subsidiaries in several markets. Last, a phase with the establishment of production in several markets will follow' (Johanson and Wiedersheim-Paul, 1975).

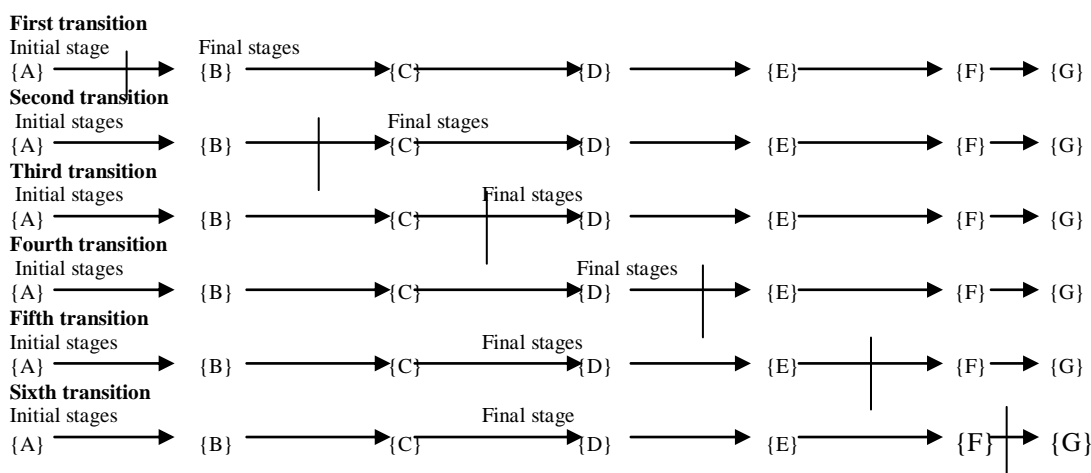
In spite of the explicit comment that Johanson and Wiedersheim-Paul have made about a third pattern in the internationalization process of the firm, we have not found any empirical work testing this postulate.

In fact, combining the two patterns described above, it can be obtained the full establishment chain or the sequence of stages followed by the firm in its process of internationalization. A firm can follow two generic paths if it decides to change destination of activities in the short run and entry mode in the long run (path 1) or *viceversa* (path 2). Figure 1 shows these two possible paths graphically.

**Figure 1** Sequence of events and stages according to both entry mode and destination of activities

Path 1: Destination of activities changes in the short run and entry mode changes in the long run

Path 2: Entry mode changes in the short run and destination of activities changes in the long run



Legend for path 1:

- A: Non Exporter
- B: Indirect Exporter to a psychic closer country
- C: Indirect Exporter to a psychic distant country
- D: Direct Exporter to a psychic closer country
- E: Direct Exporter to a psychic distant country
- F: Manufacturer in a psychic closer country
- G: Manufacturer in a psychic distant country

Legend for path 2:

- A: Non Exporter
- B: Indirect Exporter to a psychic closer country
- C: Direct Exporter to a psychic closer country
- D: Manufacturer in a psychic closer country
- E: Indirect Exporter to a psychic distant country
- F: Direct Exporter to a psychic distant country
- G: Manufacturer in a psychic distant country

From this, we can draw up the following hypothesis:

Hypothesis 3a: Firms will change destination of activities in the short run and entry mode in the long run (path 1 in Figure 1).

Hypothesis 3b: Firms will change entry mode in the short run and destination of activities in the long run (path 2 in Figure 1).

### **The acceleration postulate**

Axinn and Matthyssens (2002) highlight the effect of the significant reduction in trade barriers on the globalization of markets and, therefore, on the acceleration of firm's internationalization, both: (a) through continued tariff reductions negotiated via the GATT and more recently the WTO; and (b) through the creation of market agreements like NAFTA and MERCOSUR.

In the particular case of Spain, it gets into de EU (then European Community) in 1986. Since that date, an acceleration of the internationalization process of the Spanish firms should be expected, reinforced by the opening up of Central and Eastern European economies, and the economic boom of the 1990s. All these changes and the above trends led us to propose the following hypothesis:

Hypothesis 4: The internationalization process of the Spanish manufacturing firms has accelerated in the period under analysis: 1990-1998.

## **2. DATASET AND OPERATIONALIZATION OF STAGES**

We investigate the timing of the internationalization process of the Spanish manufacturing firms using data taken from the Survey About Business Strategies (*Encuesta Sobre Estrategias Empresariales, ESEE*), which is carried out annually by the Spanish Ministry of Industry since 1990. The survey collects information from a sample of about 2,000 manufacturing firms in fields related to their competitive behavior, economic environment, and management technology.

The information provided by the ESEE allows us to evaluate the internationalization process of the firms by means of the export activity, but the data on the mechanism for export and the geographical destination is recorded every four years. That is why our analysis can be considered pseudo longitudinal, as our data refer to 1990, 1994 and 1998, with 2,184, 1,876 and 1,776 surveyed firms, respectively.

The firm must indicate if, whether directly or through other firms of its own group, it has exported in the year of reference (1990, 1994 or 1998). This information allowed us to classify the firms in two groups: exporters and non-exporters. Moreover, the firm is asked to indicate the means employed to access foreign markets in that year, among the following five options: (1) own channel -agents, or sales subsidiary-; (2) parent company in a foreign country -foreign-owned firms-; (3) export intermediary located in Spain; (4) export collaborative agreement -exporters association, sectorial agreement or export consortium-; and (5) others -specify-.

Taking into account that the purpose of this paper is analyzing the internationalization process of the Spanish firms, we decided to exclude all foreign-owned firms, that is, those that exported through a parent company located in a foreign country (point 2 of the above paragraph). Foreign-owned firms excluded, the number of Spanish manufacturing firms analyzed in the present study is 2,015 in 1990, 1,670 in 1994 and 1,570 in 1998.

If firm answers 'yes' to option 1 we consider it exports directly; if it answers 'no' to option 1 and 'yes' to options 3 or 4 we consider it exports indirectly. This allows us to study first and second transitions in the Uppsala model. However, firms with production facilities in foreign countries are not reported in the survey, so we can not study last transition in that model.

With regard to the geographical destination of the firm's exports, we know if the firm exports to the EU countries (countries with small psychic distance), to the rest of OECD countries (countries with medium psychic distance) and/or to the rest of the World (countries with large psychic distance).

In relation with the third pattern of internationalization, legends in Figure 1 also change slightly because of the data. We still have six transitions, but the meaning of the stages is as showed in Table 1.

**Table 1** Operationalization of the stages for path 1 and path 2

|   |   |
|---|---|
| <p><i>Stages for path 1:</i><br/> A: Non Exporter<br/> B: Indirect Exporter to EU countries<br/> C: Indirect Exporter to rest of the OECD countries<br/> D: Indirect Exporter to rest of the World countries<br/> E: Direct Exporter to EU countries<br/> F: Direct Exporter to rest of the OECD countries<br/> G: Direct Exporter to rest of the World countries</p> | <p><i>Stages for path 2:</i><br/> A: Non Exporter<br/> B: Indirect Exporter to EU countries<br/> C: Direct Exporter to EU countries<br/> D: Indirect Exporter to rest of the OECD countries<br/> E: Direct Exporter to rest of the OECD countries<br/> F: Indirect Exporter to rest of the World countries<br/> G: Direct Exporter to rest of the World countries</p> |
|---|---|

### 3. METHODOLOGY

We have employed event history analysis for testing the hypothesis. Event history analysis or duration models has several advantages for analyzing duration time events (Allison, 2001). The most important one in the context of the present research is that it can handle sample selection biases such as censoring, so that information about firms that have not internationalized yet is included as right-censored cases. That solves the bias problem of estimating the time that takes a firm to start exporting looking exclusively at exporting firms, as most prior research has done; see e.g. Autio, Sapienza and Almeida (2000), Aspelund and Moen (2001), Bell, McNaughton and Young (2001).

A transition (or an event) is a change between an initial stage and a final stage. Transitions are represented in Figure 1 by means of arrows. Stages on the left of the arrow are initial stages and stages on the right of the arrow are final stages. Firms at initial stages have not made yet the transition and they are called right censored observations. Firms at final stages have already made the transition. If the date when the firm made the transition is known, the firm is a non-censored observation. If that date is unknown, the firm is a left censored observation. In our database, dates of transitions are unknown so we are forced to work with right and left censored observations.

Let be  $T$  a random variable representing the time that goes from the foundation of the firm to the date when the transition occurs and let be  $t$  the age of the firm. For right censored observations, transition have not occurred yet, and then  $T > t$ . Probability of obtaining such observation from a sample is  $P(T > t) = S(t)$ , where  $S(t)$  is the survival function.  $S(0) = 1$  and  $S(t) = 0$  when  $t \rightarrow \infty$ . For left censored observations, transition have already happened but in an unknown date, and consequently  $T \leq t$ . Probability of obtaining such observation from a sample is  $P(T \leq t) = F(t) = 1 - S(t)$ , where  $F(t)$  is the cumulative distribution function.  $S(t)$  can adopt a wide variety of forms. Among the survival distributions (exponential, Weibull, gamma, log-logistic, log-normal, etc.), we have chosen the Weibull function because it is widely used and provides flexibility as it depends on two parameters:

$$S(t) = \exp[-(\lambda t)^{1/\sigma}] \quad (1)$$

The two parameters are:  $\lambda$  or scale parameter and  $\sigma$  or form parameter. All we have to do is to find the values of the parameters that maximize the log-likelihood function for the right and left censored data:

$$\ln L = \sum \ln S(t; \lambda, \sigma) + \sum \ln F(t; \lambda, \sigma) \quad (2)$$

Once we have estimated the parameters, the median age of transition is obtained by resolving the equation

$$S(\text{Median}) = 0.5.$$

In the Weibull case we have

$$\text{Median} = (1/\lambda)(\ln 2)^\sigma \quad (3)$$

In general, maximum likelihood estimates of the parameters are asymptotically normal, meaning for large sample sizes that a distribution of parameter estimates from the same population would be very close to the normal distribution. Confidence bounds around the median value are calculated by determining the confidence intervals around  $\hat{\lambda}$  and  $\hat{\sigma}$  and substituting these values into equation (3). We use the LIFEREG procedure from SAS 8.0 version in our analyses.

### 4. RESULTS

**Table 2-A** Timing of Entry Mode: Event History Analysis (Weibull approximation)

|  | <b>Indirect exporting</b> |                  |                  |
|--|---------------------------|------------------|------------------|
|  | <b>1990</b>               | <b>1994</b>      | <b>1998</b>      |
| Intercept<br>(Standard error)                | 3.526<br>(0.095)          | 3.357<br>(0.101) | 3.000<br>(0.140) |
| Form Parameter, $\sigma$<br>(Standard error) | 1.899<br>(0.152)          | 2.298<br>(0.220) | 3.848<br>(0.600) |
| Log likelihood                               | -1289.32                  | -1095.19         | -1038.59         |
| No. of right-censored cases                  | 1,136                     | 823              | 638              |
| No. of left-censored cases                   | 879                       | 847              | 932              |
| Median Age (years)                           | 16.95                     | 12.36            | 4.90             |
| 99% confidence interval of the median        | [15.3,18.7]               | [11.7,13.0]      | [4.0,6.0]        |

In Table 2-A and Table 2-B we have the timing of entry mode. It can be seen that, in 1998, transition 1 occurs at a median age of 4.90 years old and transition 2 occurs at a posterior time, 20.56 years old. As we said earlier, transition 3 could not be studied because of lack of observations in the last stage. Similar results are obtained for 1990 and 1994 samples: transition 2 always happens later than transition 1. So, we can conclude that internationalization is a gradual and incremental stepwise process for the Spanish manufacturing firms, and accept hypothesis 1.

**Table 2-B** Timing of Entry Mode: Event History Analysis (Weibull approximation)

|  | <b>Direct exporting</b> |                  |                  |
|--|-------------------------|------------------|------------------|
|  | <b>1990</b>             | <b>1994</b>      | <b>1998</b>      |
| Intercept<br>(Standard error)                | 4.077<br>(0.122)        | 4.125<br>(0.151) | 3.929<br>(0.177) |
| Form Parameter, $\sigma$<br>(Standard error) | 1.456<br>(0.122)        | 1.754<br>(0.176) | 2.472<br>(0.316) |
| Log likelihood                               | -1012.37                | -881.85          | -910.65          |
| No. of right-censored cases                  | 1,286                   | 948              | 755              |
| No. of left-censored cases                   | 533                     | 508              | 618              |
| Median Age (years)                           | 34.59                   | 32.54            | 20.56            |
| 99% confidence interval of the median        | [28.3,42.2]             | [26.0,40.6]      | [17.5,24.1]      |

Table 3-A, Table 3-B and Table 3-C show the timing of geographical sequence. We can observe that in 1998, firms begin exporting to EU countries at a median age of 4.90 years old, to the rest of the OECD countries at a median age of 24.46 years old and to rest of the World countries at a median age of 38.19 years old. Similar results are obtained for 1990 and 1994 samples: transition 2 always occurs later than transition 1, and transition 3 later than 2. This confirms Johanson and Wiedersheim-Paul's assertion: '(...) because of lack of knowledge about foreign countries and a propensity to avoid uncertainty, the firm starts exporting to neighboring countries or countries that are comparatively well-known and similar with regard to business practices, etc.' (1975, p. 306). We accept, consequently, hypothesis 2.

**Table 3-A** Timing of geographical sequence: Event History Analysis (Weibull approximation)

|  | <b>Exporting to the EU</b> |                  |                  |
|--|----------------------------|------------------|------------------|
|  | <b>1990</b>                | <b>1994</b>      | <b>1998</b>      |
| Intercept<br>(Standard error)                | 3.536<br>(0.096)           | 3.357<br>(0.102) | 3.000<br>(0.140) |
| Form Parameter, $\sigma$<br>(Standard error) | 1.899<br>(0.152)           | 2.298<br>(0.220) | 3.848<br>(0.600) |
| Log likelihood                               | -1284.000                  | -1095.193        | -1038.588        |
| No. of right-censored cases                  | 1,136                      | 823              | 638              |
| No. of left-censored cases                   | 879                        | 847              | 932              |
| Median Age (years)                           | 16.95                      | 12.36            | 4.90             |
| 99% conf. int. median                        | [15.3,18.7]                | [11.7,13.0]      | [4.0,6.0]        |

NOTE:  $\lambda = \exp(-\text{intercept})$  and  $\text{Median} = (1/\lambda)(\ln 2)^{\sigma}$

**Table 3-B** Timing of geographical sequence: Event History Analysis (Weibull approximation)

|  | Exporting to the rest of OECD |                  |                  |
|--|-------------------------------|------------------|------------------|
|  | 1990                          | 1994             | 1998             |
| Intercept<br>(Standard error)                | 4.185<br>(0.138)              | 4.097<br>(0.146) | 4.112<br>(0.190) |
| Form Parameter, $\sigma$<br>(Standard error) | 1.589<br>(0.136)              | 1.908<br>(0.185) | 2.497<br>(0.307) |
| Log likelihood                               | -1141.121                     | -1037.841        | -1034.876        |
| No. of right-censored cases                  | 1,408                         | 1,051            | 898              |
| No. of left-censored cases                   | 600                           | 619              | 672              |
| Median Age (years)                           | 36.69                         | 29.91            | 24.46            |
| 99% conf. int. median                        | [29.2,46.0]                   | [24.4,36.6]      | [20.0,29.9]      |

NOTE:  $\lambda = \exp(-\text{intercept})$  and  $\text{Median} = (1/\lambda)(\ln 2)^{\sigma}$

**Table 3-C** Timing of geographical sequence: Event History Analysis (Weibull approximation)

|  | Exporting to the rest of the world |                  |                  |
|--|------------------------------------|------------------|------------------|
|  | 1990                               | 1994             | 1998             |
| Intercept<br>(Standard error)                | 4.384<br>(0.149)                   | 4.415<br>(0.173) | 4.438<br>(0.210) |
| Form Parameter, $\sigma$<br>(Standard error) | 1.340<br>(0.117)                   | 1.727<br>(0.173) | 2.170<br>(0.256) |
| Log likelihood                               | -1000.953                          | -964.873         | -985.248         |
| No. of right-censored cases                  | 1,544                              | 1,162            | 1,004            |
| No. of left-censored cases                   | 464                                | 508              | 566              |
| Median Age (years)                           | 49.02                              | 43.92            | 38.19            |
| 99% conf. int. median                        | [37.3,64.5]                        | [33.1,58.2]      | [28.3,51.5]      |

NOTE:  $\lambda = \exp(-\text{intercept})$  and  $\text{Median} = (1/\lambda)(\ln 2)^{\sigma}$

Tables 4 and 5 show transition ages for the two possible paths that a firm can take if we combine the sequence of stages with the extension of activities to new markets, for the 1998 sample. In path 1 (Table 4), the firm changes destination of activities in the short run, while entry mode changes in the long run. On the contrary, in path 2 (Table 5) destination of activities changes in the long run and entry mode changes in the short run. Note that the first, the second and the last stage in both paths are the same (see Figure 1), so the correspondent transition ages must be equal too. Results show that transition's median ages increase as we move towards more advanced stages, confirming hypothesis 1 and 2 again. Moreover, transition's median ages numbers 3, 4 and 5 for path 1 are always smaller than those for path 2, indicating that it is easier for the firm to extend its activities to new markets that to change the entry mode. This led us to conclude that path 1 is more likely to occur than path 2, accepting hypothesis 3a and rejecting hypothesis 3b.

**Table 4** Timing of internationalization phases in 1998 (path 1): Event History Analysis (Weibull approximation)

|  | Transition 1     | Transition 2     | Transition 3     | Transition 4     | Transition 5     | Transition 6     |
|--|------------------|------------------|------------------|------------------|------------------|------------------|
| Intercept<br>(Standard error)                | 3.429<br>(0.152) | 3.589<br>(0.157) | 3.609<br>(0.154) | 3.929<br>(0.177) | 4.317<br>(0.192) | 4.571<br>(0.215) |
| Form Parameter, $\sigma$<br>(Standard error) | 3.030<br>(0.430) | 2.789<br>(0.376) | 2.689<br>(0.353) | 2.472<br>(0.316) | 1.952<br>(0.230) | 1.770<br>(0.210) |
| Log likelihood                               | -921.211         | -921.358         | -919.710         | -910.652         | -851.201         | -795.116         |
| No. of right-censored cases                  | 638              | 675              | 684              | 755              | 886              | 963              |
| No. of left-censored cases                   | 735              | 698              | 689              | 618              | 487              | 410              |
| Median Age (years)                           | 10.16            | 13.02            | 13.78            | 20.56            | 36.67            | 50.49            |
| 99% conf. int. of median                     | [10.0,10.3]      | [12.4,13.7]      | [12.9,14.7]      | [17.5,24.1]      | [27.8,48.4]      | [35.4,72.1]      |

NOTE:  $\lambda = \exp(-\text{intercept})$  and  $\text{Median} = (1/\lambda)(\ln 2)^{\sigma}$

**Table 5** Timing of internationalization phases in 1998 (path 2): Event History Analysis (Weibull approximation)

|  | Transition 1     | Transition 2     | Transition 3     | Transition 4     | Transition 5     | Transition 6     |
|--|------------------|------------------|------------------|------------------|------------------|------------------|
| Intercept<br>(Standard error)                | 3.429<br>(0.152) | 3.589<br>(0.157) | 4.139<br>(0.196) | 4.132<br>(0.188) | 4.478<br>(0.227) | 4.571<br>(0.215) |
| Form Parameter, $\sigma$<br>(Standard error) | 3.030<br>(0.430) | 2.789<br>(0.376) | 2.330<br>(0.296) | 2.234<br>(0.276) | 2.114<br>(0.267) | 1.770<br>(0.210) |
| Log likelihood                               | -921.211         | -921.358         | -895.981         | -890.433         | -853.416         | -795.116         |
| No. of right-censored cases                  | 638              | 675              | 806              | 815              | 892              | 963              |
| No. of left-censored cases                   | 735              | 698              | 567              | 558              | 481              | 410              |
| Median Age (years)                           | 10.16            | 13.02            | 26.72            | 27.46            | 40.56            | 50.49            |
| 99% conf. int. of median                     | [10.0,10.3]      | [12.4,13.7]      | [21.3,33.5]      | [22.0,34.4]      | [29.1,56.6]      | [35.4,72.1]      |

NOTE:  $\lambda = \exp(-\text{intercept})$  and  $\text{Median} = (1/\lambda)(\ln 2)^{\sigma}$

Finally, concerning of the acceleration postulate, if we compare transition median ages of the three samples in any results table, we can observe that those for 1990 are the largest and those for 1998 are the smallest. For example, in Table II we can see that firms became exporters at a median age of 16.95 years old in 1990, 12.36 in 1994 and 4.90 in 1998. This means that duration of stages have decreased gradually in the period of study, accelerating the process of internationalization. Therefore, we accept hypothesis 4.

## 5. CONCLUSIONS

The goal of the study was to analyze the duration of the different stages of the internationalization process of the Spanish manufacturing firms in the period 1990-1998. We have analyzed timing for both the entry mode sequence and the geographical sequence of marketing abroad separately. Our results confirm that firms' development seems to be in accordance with the incremental internationalization process proposed by the Uppsala School. The establishment chain –no regular export, independent representative (an agent), sales subsidiary, and manufacturing- seems to be a correct description of the order of the development of firms' operations in an individual country. With regard to the psychic distance, our study shows that the firm starts exporting to closing countries and continues its activities to more distant countries in terms of psychic distance. These results are similar to that obtained by Pla-Barber (2001) for the Spanish firms. Additionally, combining the sequence of stages with the extension of activities to new markets, which is a novelty in the internationalization literature, we have concluded that it is more likely that firms will change destination of activities in the short run and mode of entry in the long run. This can be explained because the resource commitments necessary for switching between several markets are smaller than those necessary for changing between entry modes.

The use of three samples from three different years (1990, 1994 and 1998) has allowed us to compare the duration of the internationalization stages. We have seen that such durations have decreased gradually in the period of study. This fact reflects the progressive removal of trade barriers, the economic integration of world markets and the spectacular advance in transports and communications. We have used the event history analysis to estimate the duration of each internationalization stage. We think this is the better tool for studying a phenomenon of a dynamic nature like that treated here.

RECEIVED MARCH, 2012  
REVISED APRIL, 2012

## REFERENCES

- [1] ALLISON, P.D. (2001): **Survival Analysis Using the SAS System. A Practical Guide**. SAS Publishing.
- [2] ASPELUND, A. and MOEN, Ø. (2001): A Generation Perspective on Small Firms' Internationalization: From Traditional Exporters and Flexible Specialist to 'Born Globals'. In AXINN, C.N. AND P. MATTHYSSENS (Eds.) **Reassessing the Internationalization of the Firm, Advances in International Marketing**. 11. Amsterdam: JAI/Elsevier Inc., 197-225.
- [3] AUTIO, E., SAPIENZA, H. and ALMEIDA, J. (2000): Effects of Age at Entry, Knowledge Intensity and Imitability on International Growth. **Academy of Management Journal** 43, 909-924.
- [4] AXINN, C.N. and MATTHYSSENS, P. (2002): Limits of internationalisation theories in an unlimited world, **International Marketing Review**. 19, 436-449.
- [5] BELL, J., MCNAUGHTON, R. and YOUNG, S. (2001): Born again global firms. An extension to the born global phenomenon. **Journal of International Management** 7, 173-189.
- [6] BILKEY, W. and TESAR, G. (1977): The Export Behavior of Smaller Wisconsin Manufacturing Firms, **Journal of International Business Studies** 8, 93-98.
- [7] BUCKLEY, P. J. and CASSON, M. A. (1981): The optimal timing of foreign direct investment. **Economic Journal** 91, 75-87.
- [8] BUCKLEY, P. J. and GHAURI, P. (1993): **The Internationalisation of the Firm: A Reader**. Academic Press Ltd., London.



- [9] CALOF, J. and BEAMISH, P. (1995): Adapting to Foreign Markets: Explaining Internalization. **International Business Review** 4, 115-131.
- [10] CAVUSGIL, S. T. (1982): Some observations on the relevance of critical variables for internationalization stages, in CZINKOTA, M. R. AND TESAR, G. (Eds.): **Export management: An international context**, 276-285, Praeger, New York.
- [11] GABA, V., PAN, Y and UNGSON, G.R. (2002): Timing of Entry in International Market: An Empirical Study of U.S. Fortune 500 Firms in China, **Journal of International Business Studies** 33, 39-55
- [12] JOHANSON, J. and VALHNE, J.-E. (1977): The Internationalisation Process of the Firm – A Model of Knowledge Development and Increasing Market Commitment. **Journal of International Business Studies** 8, 23-32.
- [13] JOHANSON, J. and VAHLNE, J. (1990): The mechanism of internationalisation. **International Marketing Review** 7, 11-34.
- [14] JOHANSON, J. and WIEDERSHEIM-PAUL, F. (1975): The internationalization of the firm: Four Swedish cases. **Journal of Management Studies** 12, 305-322.
- [15] LEONIDOU, L.C. and KATSIKEAS, C.S. (1996): The export development process: An integrative review of empirical models. **Journal of International Business Studies** Third Quarter, 517-551.
- [16] PLA-BARBER, J. (2001): The internationalisation of foreign distribution and production activities. New empirical evidence from Spain. **International Business Review** 10, 455-474.
- [17] SIMPSON, C.L. and KUJAWA, D. (1974): The Export Decision Process: An Empirical Enquiry. **Journal of International Business Studies** 5, 107-118.
- [18] VERNON, R. (1966): International investment and international trade in the product life cycle. **Quarterly Journal of Economics** 80, 190-207.