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A model for the THS industry in the presence of unemployment:  
theoretical and empirical analysis for Spain

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## **ABSTRACT**

**The temporary help services (THS) industry has experienced an impressive growth, representing 16% of temporary hiring in Spain. At the same time it exhibits a remarkable regional disparity. The main purpose of this paper is to develop an appropriate theoretical model for analysing the THS phenomenon in the presence of unemployment. In addition, this study examines the Spanish case, using proxy variables and panel data methodology. The paper concludes that the fixed cost of hiring is an essential factor to explain the growth of this business and regional discrepancies. In particular, it is stated that the sectorial composition for provinces (proxy variable for the hiring costs) constitutes a major factor in determining the proportion of temporary contracts formalised through THS firms.**

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# 1. Introduction

The Temporary help services (THS) industry has experienced an astonishing growth throughout the 1990s, which has proved to be particularly remarkable in countries like the UK, the US and especially Spain.<sup>1</sup> The increasing success of THS firms has caught attention of labour economists.

This paper provides a plausible theoretical model, which accounts for the presence of unemployment. It illustrates the manner in which such firms perform their tasks and studies the probability of hiring temporary workers through THS firms instead of doing it directly. In constructing the model the principal role is given to the fixed cost of direct hiring, as suggested by some previous studies.<sup>2</sup>

The theoretical study permits to conclude that the fixed cost of hiring is the essential feature to explain the THS industry's success and the regional discrepancies. This hypothesis is tested, through the introduction of 'proxy' variables, based on the empirical study for the period: January-1996 to December-1999 and for 50 provinces in Spain. From the analysis of the evidence, the following conclusion emerges: the THS firms experience greater success in places where there is a higher proportion of allocations in the industry and services sectors.

Once the institutional barriers were removed in 1994, the THS industry has exhibited a tremendous growth rate in Spain.<sup>3</sup> The following table summarises some information about this industry.

**Table 1.1.** Temporary and permanent contracts in Spain.

	Proportion of contracts		Total number of contracts		
	Temporary (2) / (1+2)	By THS (3) / (2)	Permanent (1)	Temporary (2)	THS * (3)
1995	94.99	5.43	367,047	6,963,000	378,739
1996	95.89	9.78	354,372	8,273,175	809,139
1997	92.99	13.94	707,481	9,386,084	1,309,021
1998	91.67	16.87	970,964	10,692,315	1,803,547
1999	90.87	16.65	1,208,416	12,026,911	2,002,039
2000	91.37	15.87	1,192,962	12,635,957	2,005,132

\* Those are contracts between the THS firm and the client firm (*contratos de puesta a disposición*).

SOURCE: INEM, *Instituto Nacional de Empleo*. Spain.

<sup>1</sup> In spite of its novelty, the THS business in Spain accounted for about 16% of temporary hiring in the last years (in some provinces the percentage reaches above 30%). This fact, as well as data availability, suggests carrying out the empirical study using data from the Spanish THS industry.

<sup>2</sup> For a survey of the literature, Cf. Garcia-del-Barrio and Cardenal Carro (2000); or Muñoz Bullón (1999).

<sup>3</sup> Before 1994, THS firms were prohibited by Article 3 of the *Estatuto de los Trabajadores*, as they were thought to neglect the interests of workers. THS business found support in law when the *Ley 14/1994, de 1 de junio* was promulgated.

Note that the proportion of contracts formalised by THS firms has experienced a continuous increase up to 1998. From that year onwards, the proportion is stabilised around 16% of the temporary hiring as a whole.

On the other hand, *Table 1.2* shows the distribution of THS contracts by sectors. Almost 95% of the THS contracts, have been established in the industry or services sectors. Since 1998, this proportion becomes smaller, due to the remarkable increase in the THS contracts in agriculture.

**Table 1.2.** Number and proportion of THS contracts by sectors, in Spain.

Absolute Values	Total	Agriculture	Industry	Construction	Services	Other
1995*	129,118	619	45,884	5,286	72,444	4,885
1996	809,139	5,021	296,472	37,869	429,757	40,020
1997	1,309,021	12,095	497,729	74,355	710,917	13,925
1998	1,803,547	94,306	613,441	104,911	948,957	41,932
1999	2,002,039	55,193	708,372	95,130	1,129,807	13,537
2000	2,005,132	79,350	723,412	68,391	1,118,727	15,252

Percentages	Total	Agriculture	Industry	Construction	Services	Other
1995*	100	0.48	35.54	4.09	56.11	3.78
1996	100	0.62	36.64	4.68	53.11	4.95
1997	100	0.92	38.02	5.68	54.31	1.06
1998	100	5.23	34.01	5.82	52.62	2.32
1999	100	2.76	35.38	4.75	56.43	0.68
2000	100	3.96	36.08	3.41	55.79	0.76

\* The records for 1995 correspond to the last quarter of 1995.

SOURCE: INEM, *Instituto Nacional de Empleo*. Spain.

It has already been said that the relevant literature points toward the transaction costs (or, more specifically, towards the hiring costs) as the main cause to explain the growth of the THS business. The theoretical framework in this paper will be constructed to account for this fact, and the empirical study will try to test this hypothesis.

## 2. A Basic Model with Unemployment

The role of intermediation, which THS firms develop, has peculiar characteristics: these companies match job-buyers (the client firms) with job-sellers (the workers). While doing their job, THS firms incur some matching costs ( $\vartheta$ ) and generate revenues by charging fees –in the form of a mark-up on wages–. As far as both the client firm and the worker take advantage from the THS firm services, they also both have to reward such a service: part of the fee is paid by the client firm ( $\alpha$ ) and other part is paid by the workers ( $\beta$ ).<sup>4</sup>

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<sup>4</sup> Commission  $\beta$  can be thought of as a mark-up subtracted from the wage bill that workers receive.

The prevailing wage, for each particular type of contract, is assumed to be determined exogenously. The model relies on a number of **basic assumptions** that are consistent with a theoretical framework, accommodated for a labour market in which there is unemployment:

- (1) There is uncertainty about the worker's success in the job-searching process. By resorting to a THS firm, the individual find the job with a probability  $p'$ . On the other hand, if the worker chooses to search directly, the probability of success is  $p$ .<sup>5</sup> Obviously, it must always be the case that:  $0 < p, p' < 1$ .
- (2) The prevailing wage ( $w^N$ ) is established through collective bargaining.
- (3) From assumptions (1) and (2), it follows that workers may experience unemployment spells, in which they receive the unemployment benefit  $s$ .
- (4) There are: 'i' regional labour markets.  
'm' types of client companies.
- (5) Workers are homogeneous and THS firms do not know what amount each worker would be willing to pay each worker as a fee; and hence:  $\beta_i = \beta, \forall i$ .<sup>6</sup>
- (6) The cost incur by the worker when directly searching for a job is the same across all the regional labour markets.<sup>7</sup> Equivalently, it holds that:  $c_i = c, \forall i$ .
- (7) THS firms are specialist in matching and operate all over the country. Therefore:
  - (7.a) They experience similar matching costs:  $\vartheta_i = \vartheta, \forall i$ .
  - (7.b) They charge the same fee to the client firm, regardless the market:  $\alpha_i = \alpha, \forall i$ .
- (8) Client firms are not specialised in matching. The fixed cost of direct hiring differs for each contract; however, in order to make the problem more tractable, the cost is going to be characterised according to the type of client firm 'm' and is going to depend on the analysed local labour market 'i'. Consequently,  $K_{im}$  presents only these two subindexes.

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<sup>5</sup> It could also be assumed, with no loses of generality, that THS firm increases the probability of success in the job-searching process; so that:  $0 < p < p' < 1$ .

<sup>6</sup> The analysis implicitly assumes that we refer to an particular kind of contract, which presents very specific characteristics, such as duration, qualification requirements, etc. It could be interpreted that there are 'j' types of contracts to which identical arguments are applied.

<sup>7</sup> This hypothesis may be considered excessively strong in local markets, which present different unemployment rates, etc. However, it might be defended, at least theoretically, on the basis of perfect labour force mobility and no migration costs).

## 2.1. The decision problem of the client firm

Consider the case in which the client firm has already decided to establish a temporary contract, so that she simply faces a twofold decision: either to contact with a THS firm or to hire the temporary worker directly.<sup>8</sup> If hiring through a THS firm is chosen, the THS firm will have to pay the THS firm a fee that usually take the form of a mark-up upon the worker wage bill; and the total cost is then equal to:  $w + \alpha \cdot w$ .<sup>9</sup> If the opposite possibility takes place, and direct hiring prevails, the client firm will have to afford the wage plus the fixed costs of hiring.<sup>10</sup> Denoting the fixed cost of hiring by  $K_{im}$ , the second alternative accounts for the following total cost:  $w + K_{im}$ .

As a result, the decision problem of the client firm consists of choosing the most profitable alternative. First, consider the **cost of direct hiring** a temporary worker:

$$[2.1] \quad C^D = w + K_{im}$$

On the other hand, expression [2.2] accounts for the **cost of hiring through THS firm**:

$$[2.2] \quad C^{THS} = w + \alpha \cdot w, \quad \text{for } \alpha \geq 0$$

Hence, the condition allowing the client firm to use a THS firm is simply that the fee charged by the THS firm is lower than the cost of direct hiring (in terms of the wage).

$$[2.3] \quad \alpha \cdot w \leq K_{im} \quad \text{or: } \alpha \leq \frac{K_{im}}{w} = k_{im}$$

Expression [2.3] must hold in each and every contract formalised by THS firms. Assuming perfect competitive markets, it should happen that the wage does not change all around the country —at least, with regards to a particular type of contract with its specific characteristics. Similarly, it can be assumed that the fee  $\alpha$ , charged by the THS from the client firm, does not differ across regions.<sup>11</sup>

In summary, when choosing whether to use a THS firm or not, the client firm compares the fee  $\alpha$  with the fixed cost of hiring divided by the wage. As far as condition [2.3] is verified, the client firm resorts to the THS firm.

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<sup>8</sup> Other possibilities (like a client firm running its own temporary agency) has not been considered, since the framework especially parallels the Spanish experience. In Spain, a highly tight legal system results in no other enterprises, than THS firms, being allowed to provide labour force to other companies.

<sup>9</sup> For simplicity, this is going to be designed by  $w$ .

<sup>10</sup> Hiring costs include, among others, recruiting, training and screening costs.

<sup>11</sup> This hypothesis may rely on the fact that many THS firms operate all over the country and usually apply the same fees, for each category 'j' of contract. The analysis should therefore be thought of as applied to a particular type of job 'j', with specific duration, qualification requirement, etc. Provided that the reader notices this feature, the subindex 'j' can be omitted as a label of contract categories.

## 2.2. Decision problem of the worker

In the presence of unemployment, the individual has no guaranty of the success in the job-search process. The work-seeker faces two alternatives with different probabilities of success: either to hire through a THS firm or to do it directly with the client firm. Notice that these two possibilities should not be consider as incompatible alternatives; in fact, they both often take place together. Moreover, the worker who signs with THS firm, usually looks for a job also directly.

The basic assumptions of the model were previously described. There is some probability ( $p$ ) of finding a job if the worker searches directly; and there is a different one ( $p'$ ) whenever the worker resorts to a THS firm. In addition, it is assumed that the individual, who does not get a job, receives certain amount as unemployment benefit:  $s$ . As a result, the expected revenue of a worker who does not register whit a THS firm, is:

$$[2.4] \quad G^D = p \cdot (w - c) + (1 - p) \cdot (s - c), \quad \text{for } 0 < p < 1$$

Expression [2.4] states that the worker will suffer the cost  $c$ , no matter the result of the job-searching process. Also, the analysis implicitly presumes that  $w$  must be greater than  $s$ .<sup>12</sup> Similarly, the expected revenue of searching a job directly could be expressed:

$$[2.4'] \quad G^D = s - c + p \cdot (w - s), \quad \text{for } 0 < p < 1$$

The last equation support the following interpretation: the individual receives, at least, the unemployment benefit  $s$  and, regardless the outcome of the job-search process, spends looking for a job the amount  $c$ . Above that, the individual gets a job with probability  $p$ , which brings about an additional amount given by the difference between the wage and the unemployment benefit.

The other case considered is that of registering with the THS firm and, at the same time, looking directly for a temporary position. Such a behaviour is judicious in markets with unemployment, where the uncertainty about the result of the searching process recommends using all the available means. In this context, to sign a contract with the THS firm is conceived as one, among others, procedure of job-search. The expected revenue of this mixed procedure or search( $G^M$ ), is given by:

$$[2.5] \quad G^M = p'(1 - p) \cdot (w - \beta \cdot w - c) + (1 - p') \cdot p \cdot (w - c) + (1 - p') \cdot (1 - p) \cdot (s - c) + p' \cdot p \cdot (w - c)$$

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<sup>12</sup> It cannot be considered in a different manner, unless the government wishes to foster and perpetuate the situation of unemployment among the population.

According to [2.5] the expected revenue in this case involves four terms, corresponding to the four possible outcomes. The *first term* reflects the situation of a worker who finds the job through the THS firm, but who does not succeed when searching directly. The probability for both events to happen together is  $p'$  multiplied by  $(1-p)$ . In such a situation, the individual must subtract from her wage both the fee charged by the THS firm and the cost provoked by the direct searching process. The *second term* describes the opposite situation: a worker finds a job directly, and does not find it through the THS firm. Then, from the expected wage, only the amount  $c$  has to be subtracted. The *third element* considers the probability that no job is found by the individual through all available means, so that the revenue is the unemployment benefit, after having deduced  $c$ . *Finally*, it may occur that a worker finds two jobs. If this is the case, we expect that the worker will accept the one directly found, since otherwise the THS firm would charge the worker an extra fee.<sup>13</sup> The expected revenue reported in [2.5] permits a reduced form:

$$[2.5'] \quad G^M = s - c + p \cdot (w - s) + (p' - p' \cdot p) \cdot (w - s - \beta \cdot w)$$

This alternative expression is appealing as far as it disclose a more intuitive interpretation: the individual earns, at least, the unemployment benefit, and incur necessarily the cost  $c$ . In addition, the expected revenue includes the additional amount that the worker would achieve in the case of getting a job directly (third term) and the additional amount generated if signing through a THS firm, but not directly (forth term).

In equilibrium, there are strong reasons to believe that the **expected revenue** of [2.4'] equals that of [2.5']. The main argument to justify such idea comes from the evidence. It happens that, in the same labour market —and among homogeneous workers—, some individuals decide to sign with the THS firm while seeking directly for a job, whereas other individuals search exclusively on their own account, without asking for THS firm cooperation.<sup>14</sup> This evidence allows to infer that the expected revenue generated by the two strategies must be the same. In other case, one of the groups mentioned would abandon its position to move towards the solution which yields greater earnings. In other words, all the equilibrium situation in which certain workers prefer the direct searching procedure and, at the same time, other choose the mixed strategy, the following condition must be true:

$$[2.6] \quad G^D \equiv G^M$$

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<sup>13</sup> Naturally, the summation of all the probabilities must be equal to 1. This assertion must be proved by developing the following expression:  $p' \cdot (1-p) + (1-p') \cdot p + (1-p') \cdot (1-p) + p' \cdot p$ .

<sup>14</sup> It does not seem feasible —therefore, it is not going to be studied— that individuals, who really wish to find a job, limit their search efforts to sign with a THS firm, and neglect absolutely the direct procedure.



From this equality, the equilibrium value of  $\beta$  is immediately obtained:<sup>15</sup>

$$[2.7] \quad \hat{\beta} = \frac{w-s}{w}$$

A couple of comments may be clarifying here. On one hand, the expected revenue of any worker who adopts the mixed searching procedure, when the fee  $\beta$  takes its equilibrium value, is exactly the same as the expected revenue of direct searching:

$$[2.8] \quad E \left( G^M \mid \hat{\beta} = \frac{w-s}{w} \right) = s - c + p \cdot (w - s)$$

On the other hand, if we face an equilibrium, the option of looking for a job must be at least as appealing as that of not doing it at all (so that the individual would only receive the unemployment benefit). Hence, the following participation constraint can be defined:

$$[2.9] \quad s - c + p \cdot (w - s) \geq s$$

$$\text{or either:} \quad p \cdot (w - s) \geq c \quad \text{or: } w \geq s + \frac{c}{p}$$

The last expressions indicate that, for any value of  $\beta$  minor than the one show in [2.7], the workers will certainly prefer the mixed strategy, so that they will resort to the THS firm. On the other hand, the direct search will be chosen, rejecting the possibility of contacting the THS firm, if the value of  $\beta$  is greater than expression [2.7].

Another issue here is the situation in which there is no unemployment benefit ( $s = 0$ ).<sup>16</sup> In this case, the individuals will always prefer the mixed strategy; or, to be more precise, they will chose the THS contract as far as the fee  $\beta$  is less than one.<sup>17</sup> The intuition behind this assertion is the following. In labour markets with unemployment, in which the public sector guarantees no unemployment benefit, the individuals find themselves unprotected. It implies that the potential workers will use all the alternatives they face, and will not reject that of hiring through a THS firm. They will not be satisfied by simply resorting to the direct searching procedures, since their priority is to get the job at any rate.

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<sup>15</sup> The expression “equilibrium value”, in this context, means that there are no unhappy workers when  $\beta$  takes that specific value.

<sup>16</sup> Another estrange case would take place if  $w = s$ . However, this case does not correspond to an equilibrium situation, since workers will certainly not search for a job. The participation constraint does not hold any more.

<sup>17</sup> When  $\beta = 1$ , the worker receives an effective wage of zero. Obviously, it is not endurable situation for the workers, so that we will not consider it in the analysis.

### 2.3. Profits of THS firms

In order for a THS business to survive in the market, it must obtain extraordinary profits or, at least, non negative profits.<sup>18</sup> The revenues for the THS firm come from two sources: the fee that the client firm pays ( $\alpha \cdot w$ ) and the proportion of wage to which the worker renounces ( $\beta \cdot w$ ).<sup>19</sup> On the other hand, the costs of the THS firm depend basically on the matching cost of establishing a new temporary contract:  $\theta$ ; or also (as a proportion of the wage):  $\mathcal{G} \cdot w$ .

The matching cost is supposed to be the same all over the country. In fact, the THS firms are characterised for being specialist intermediaries that perform their task in a efficient manner. In addition to that, as far as the THS firm operates simultaneously in several regional markets, it might be assumed that they share the matching costs, so that, *de facto*, the  $\mathcal{G}$  value might be considered the same across provinces. Accordingly, the profit of a THS firm can be defined by the following expression:<sup>20</sup>

$$[2.10] \quad \pi = (\alpha + \beta) \cdot w - \theta$$

or also: 
$$\pi = (\alpha + \beta) \cdot w - \mathcal{G} \cdot w$$

The previous expression means that a THS firm will be interested in establishing a new contract as far as the expected profit from it were greater or equal to zero. This might be interpreted as a participation constraint for the THS firms:

$$[2.11] \quad (\alpha + \beta - \mathcal{G}) \cdot w \geq 0$$

Since  $w > 0$ , expression [2.11] implies that the following must also be true:

$$[2.12] \quad \alpha + \beta \geq \mathcal{G}$$

The last inequality simply says that the THS business will be profitable—and, hence, lasting—as far as the matching cost for the THS firm ( $\mathcal{G}$ ) is smaller than the worker's hiring cost plus the hiring cost of the client firm.<sup>21</sup>

The hypothesis of perfect competition permits to impose some more precise restrictions. Actually, in competitive markets, the free entrance of enterprises in the

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<sup>18</sup> More specifically, this hypothesis relies on the fact that many THS firms usually apply the same fees everywhere, for each category 'j' of contract. The analysis should therefore be thought of as applied to a particular type of job 'j', with specific duration, qualification requirement, etc.

<sup>19</sup> Notice that the client firm—in addition to pay the fee ( $\alpha \cdot w$ ) to the THS firm— assigns the amount  $w$  to reward the workers. However from that amount  $w$ , given to the THS firm, the THS firm will retain  $\beta \cdot w$ , which will also enhance its profits.

<sup>20</sup> Obviously, the larger the number of contracts, the greater the total profits for the THS firms.

<sup>21</sup> Otherwise, the THS firm would achieve no savings of transaction costs in temporary hiring, so that the market mechanism would certainly exclude them.

sector guaranties that no extraordinary profits persist. Therefore, at least in the long run, expression [2.12] must hold in the form of a exact equality:

$$[2.13] \quad \alpha + \beta = \mathcal{G}$$

In summary, a situation of competitive equilibrium requires that the sum of the fees charged by the THS firm ( $\alpha$  and  $\beta$ ) will be equal to the matching cost.

## 2.4. Characterisation of the equilibrium

According to the previous theoretical framework, three are the conditions that define a situation of equilibrium:

1. Client firms decide to resort to a THS firm as far as condition [2.3] holds.
2. The commission that the THS charges to the worker, in equilibrium, takes the value shown in expression [2.7].
3. In the long run, the THS firms obtain no extraordinary profits. In other words, the equality expressed by condition [2.13] must be satisfied, at least in the long run.

These three assumptions allow us to determine the equilibrium value of the fees charged by the THS firms. The equilibrium value of  $\beta$  was already defined in [2.7]. By introducing that value in [2.13], one can obtain the equilibrium value of  $\alpha$ :

$$[2.14] \quad \hat{\alpha} = \frac{\theta - (w - s)}{w} = \mathcal{G} - \frac{w - s}{w}$$

Therefore, these are the equilibrium values for the two commissions:

$$[2.15] \quad \left( \hat{\alpha}, \hat{\beta} \right) = \left( \mathcal{G} - \frac{w - s}{w}, \frac{w - s}{w} \right)$$

In summary, the *walrasian* metaphor of the auctioneer fits well with the procedure in which the fees are determined.<sup>22</sup> In any equilibrium, the price must clear the market. The THS firms sell their services and, as far as there exist individuals willing to pay, they increase the price up to the point in which the fee takes the highest level. At the end of this process, there in no unsatisfied agent in the market (neither the worker, nor the THS firm, nor the client firm).

Once the equilibrium has been described, and given the equilibrium value of commission  $\hat{\alpha}$ , the decision problem faced by the client firm can be more precisely defined. The problem is simply that of verifying whether condition [2.3] holds or not, for that particular value of the fee  $\hat{\alpha}$ . Following the result contained in expression [2.3], the

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<sup>22</sup> The picture is adequate – the ETT market is supposed to be competitive.

client firm will resort to the THS firms as far as the cost of directly hiring is greater than the value of  $\hat{\alpha}$ , whereas the opposite will occur otherwise.

## 2.5. Graphical representation of the problem

The problem faced by the client company has a probabilistic nature, which presumably makes it advisable to realise the empirical study with the basic Probit or Logit model.

However, although the disjunction described would in principle demand a qualitative dependent variable – given that the client company struggles between two exclusive and unique alternatives –, it is also possible to contrast empirically this result using aggregated data (which are available here). Specifically, if we use the data aggregated by provinces, the condition expressed in [2.3] can be interpreted in different manner. In this case, the dependent variable (instead of taking the values of 0 and 1) would be the proportion of the temporal contracts executed by THS firms in each period and province; this is to say, the relative frequency that a client firm decide to resort to THS firms.

In any case, the dependent variable is now conceived as the estimated probability that a temporary contract being materialised itself throughout THS firms. Therefore, it could be conjectured that the proportion of THS contracts in one particular market responds to the probability of expression [2.3] being fulfilled. In other words, we postulate that the empirical study can be elaborated on the base of the following relationship:

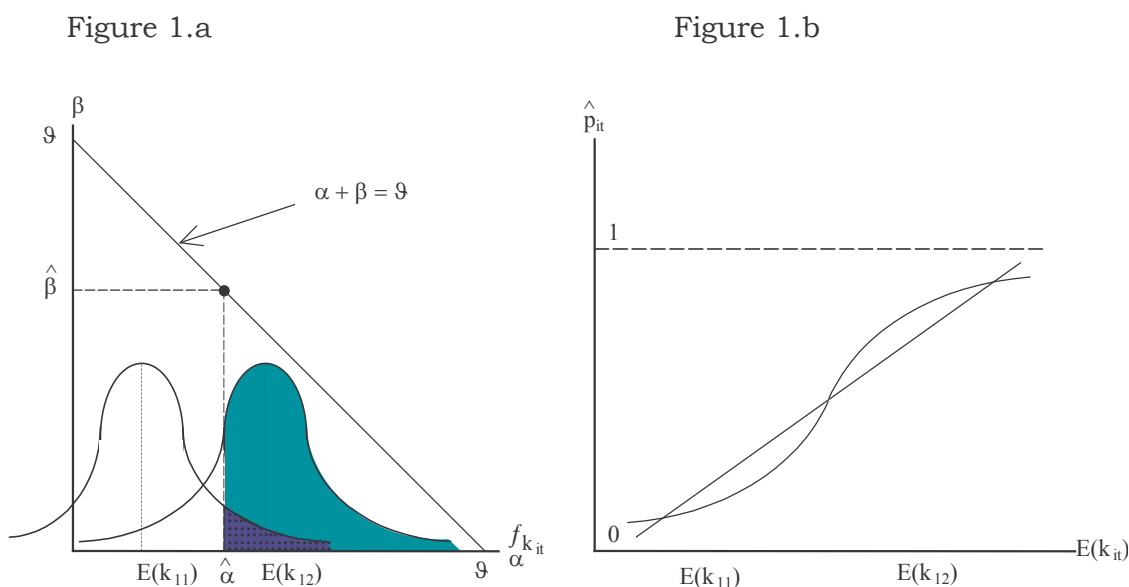
$$[2.16] \quad \frac{H_i^{ett}}{H_i^{ett} + H_i^D} = \hat{p}_i = \text{prob}\left(\hat{\alpha} \leq \frac{K_{im}}{w}\right) = \text{prob}\left(\hat{\alpha} \leq k_{im}\right)$$

Where  $H_i^{ett}$  is the number of the temporal contracts formalised by THS firms, and  $H_i^D$  are the temporal contracts realised directly.

This problem of election is susceptible to probabilistic formulation by means of incorporating density functions. Concretely, it is supposed that in each labour market, the distribution of the direct hiring costs could be described with the same conventional density function (normal, logistic, etc.) but with different mean in each province. In some labour markets, taking into account the specific characteristics and types of clients' firms to be encountered in them, such density function would situate itself more to the right; in other places, under lower hiring costs, the corresponding density function would be closer to the origin.

The graphical interpretation of this problem is illustrated in the *Figure 1*.<sup>23</sup> In the space of  $(\alpha, \beta)$  the condition [2.13] is presented, equation in which should be met the two equilibrium values for the commissions of  $\alpha$  y  $\beta$ , as defined in [2.15]. In the same diagram, using density function, each regional workforce market is characterised in relation to the fixed costs of direct hiring. According to the distribution of these costs (associated to the client firms' types), in each place and time period, bigger or smaller probability of appealing to THS firm should be expected.

**Figure 1**



The bigger is the mean of the fixed cost of direct hiring in one province and period,  $E(k_{it})$ , the greater is the area left to the right of  $\hat{\alpha}$ , and therefore, the higher is the probability of appealing to THS firms in this market ( $\hat{p}_{it}$ ).<sup>24</sup> In addition, given that  $\hat{\alpha}$  is unique for all the territory and because the same probability distribution function is supposed for all the markets, the previous discussion permits to establish a functional dependence between the proportion of temporal contracts formalised by THS firms and the distributional mean of the fixed direct hiring costs in each province.

It is to say, the empirical analysis could be applied upon expression [2.17], in which disappears the subscript 'm' — as the consequence of finding the mean of the

<sup>23</sup> A detailed description of it can be found in: Garcia-del-Barrio (2002), which also explains why  $\alpha$  is presumed to be equal in all parts of the country — for the contracts of the same type — and why the salary is also constant.

<sup>24</sup> The relative frequency of the temporal hiring affected by THS firms (in respect to the total temporal hiring), could be interpreted as the estimated probability that the commission  $\alpha$  would be less than the cost of direct hiring.

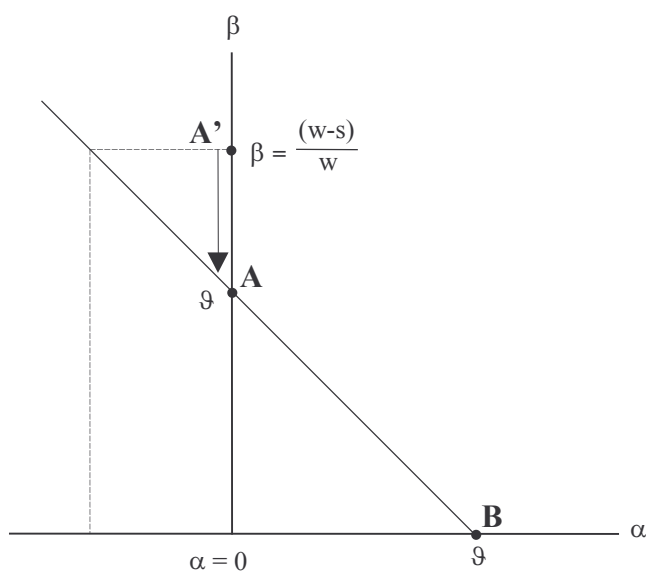
costs —; and to which the subscript ‘t’ is added to take care, in its case, to the temporal dimension of the data):

$$[2.17] \quad \hat{p}_{it} = f\left(E\left(\frac{K_{it}}{w}\right)\right) = f(E(k_{it}))$$

The relation postulated in the last expression presumes that the existing disparity between the density functions (of the fixed hiring costs for each province and time period) can be summarised in the relative position of the distribution mean with respect to the origin.<sup>25</sup> Nevertheless the specification of the functional relation contained in [2.17] and represented in *Figure 1.b* has not become explicit yet.

In this point, it is necessary to approach one point which still remains unclear. In accordance to [2.7], it could happen that the value of  $\beta$  would reach a point such as **point A'** in the *Figure 2*. If  $\beta$  obtains such a value,  $\alpha$  will have to be equal to zero (since it cannot take negative value) and this means that the equation [2.13] is not fulfilled. Such a situation can be conceived as the situation of **short term equilibrium**: the workers pay the commission ( $\beta$ ) which not only covers the costs of THS firm ( $\vartheta$ ) but also leaves some remainder; the THS firms have extraordinary profits and the client companies do not pay any commission ( $\alpha = 0$ ).

**Figure 2**



It is evident that such a situation cannot last. As the THS firms have extraordinary profits, some new firms will enter the sector. The competition between the THS firms will yield the commissions of the workers to fall and the process will continue up to the

<sup>25</sup> This value would be obtained from the costs associated to each type of client company type ‘m’ and from the costs associated to the number of firms of each type present in the respective market.

moment when  $\hat{\beta} = \vartheta$  (**point A** in *Figure 2.3*). Note that, in this new situation where  $\beta < \frac{w-s}{w}$ , it is the same to say that  $G^M > G^D$ . In other words the option of the mixed search is preferred to the option of direct search and all the workers enroll THS firms.

Another extreme case would be the one where  $\hat{\alpha} = \vartheta$  and  $\hat{\beta} = 0$  (**point B**, in *Figure 2*). In this situation, as in the previous one, all the workers enrol to THS firm. Let's notice, however, that if  $\hat{\beta} = 0$ , together with  $G^M = G^D$ , implies that  $w = s$ , and this violates the condition of the participation expressed in [2.9]. Therefore, the only possibility for equilibrium to happen with  $\hat{\beta} = 0$  would be if  $G^M > G^D$ .

We can conclude from this discussion above that there can exist corner solutions where all the costs of THS firm will be assigned to the workers ( $\hat{\alpha} = 0$ ,  $\hat{\beta} = \vartheta$ ) or to the client firms ( $\hat{\alpha} = \vartheta$ ,  $\hat{\beta} = 0$ ). In both cases expression [2.6] would not be fulfilled anymore, and this implies that all the workers would enrol a THS firm: in first case, it would happen because the workers are ready and willing to pay high commissions (possibly because of high salaries) and this would cover all the costs of the THS firm  $s$ ; in second case, it would happen because the client companies are ready to take on the total cost. In such a situation, workers do not need to pay any commission, and all of them resort to the service provided for free.

In summary, to tackle the empirical study, the hypothesis about the functional dependence between the mean of the direct hiring costs, in all provinces and periods, and the frequency at which the client firms appeal at the THS firms is being proposed. The identification of the most adequate functional form, will begin with the results coming from different specifications adopted in the empirical study. The expected sign of the relation between hiring costs and the proportion of temporal contracts realised by THS firms, is, of course, positive. In addition, since it is not possible to measure exactly the mean of the direct hiring cost — in each province and period — it will have to be approximated with the recourse to some proxy variables.

### 3. Empirical study of the THS firm sector in Spain

It has been already stated that a functional dependence between the probability of appealing to THS firm and the mean of the direct hiring costs is presumed. Before an empirical study can be carried out, we must however add some other considerations.

### 3.1. Other methodological issues

To check empirically the relation contained in [2.17], the underlying functional form must be specified. If we suppose that the relation which links the dependent variable with the mean of the direct hiring cost is linear, it is accurate to apply a linear regression model:

$$[3.1] \quad \hat{p}_{it} = \beta_0 + \beta_1 \cdot E(k_{it}) + \varepsilon_{it}$$

Alternatively, a non-linear relation between the dependent variable and the explaining variables can be postulated. In particular, if we assume that the implicit function in [2.17] is a normal cumulative probability function, the problem would remit us to the Probit model, which would be consistent with microeconomic fundamentals of the described election problem.

It could also be adopted the Logit model — associated to the logistic cumulative probability function — to tackle accurately the problem within a proper probabilistic concept. Between the Probit and the Logit model, the latter has been preferred since it can be estimated by OLS. The **Logit model** has in this context the following form:

$$[3.2] \quad \hat{p}_{it} = F(Z_{it}) = F(\beta_0 + \beta_1 \cdot E(k_{it})) = \frac{1}{1 + e^{-Z_{it}}}$$

where  $Z_{it}$  is some index underlying continuity determined by explicative variables. This function is not linear and therefore OLS cannot be applied directly. However, the relevant transformations lead us to:

$$[3.3] \quad Z_{it} = \log\left(\frac{\hat{p}_{it}}{1 - \hat{p}_{it}}\right) = \beta_0 + \beta_1 \cdot E(k_{it})$$

In expression [3.3], the dependent variable is the logarithm of the ‘odds’. This functional form is particularly interesting, as, in the first place, it avoids the limitations and troubles associated commonly to the linear probability model. From the other side, this specification fits especially well the present study, as it allows to apply OLS without further complications. Recall that this possibility previously requires to perform a grouping procedure of the individual data – in order to estimate the probability  $p_{it}$  —; procedure that is not always feasible or rigorous. In our case, such a problem is completely absent given that we know exactly the value of this estimated probability ( $\hat{p}_{it}$ ), for each province and time period.

To estimate the successive models, we employ ( $\hat{p}_{it}$ ) as a dependent variable, which is the ratio between the number of THS contracts and the total number of temporary contracts. Even if, hypothetically, we could assume the linear model and apply OLS to



equation [3.1], the theoretical nature of the problem and the bad results in the diagnosis of the residuals, suggest to discard this alternative in favour of the Logit specification of the model.<sup>26</sup>

As to explicative variables, we do not have a direct measurement of the mean hiring cost. Therefore, in order to evaluate the magnitude of such a cost, for each province and time period, a proxy variable is employed.

### 3.2. Identification of proxy variables

Before beginning of the empirical study, it is essential to identify an adequate proxy variable to evaluate the mean of direct hiring cost in each province and period. The theory predicts a large quota of THS transactions in any local market in which hiring costs are higher. There are reasons to advocate that these costs are biggest in size when the activities of industrial and services sectors are concentrated the most. In agreement with this intuition, the regional composition of the sectorial structure can be related with the market quota of THS firms. From there, to evaluate the mean of the direct hiring costs, we are going to employ the concentration index for industry and services sectors in each province and period. Specifically, we propose the proportion of job allocations in industry and services with respect to the total volume of job allocations as a proxy variable. We name this variable *INDSER*.<sup>27</sup>

To justify this with plausible arguments, we can say that the THS firms will have superior role in those markets in which a large concentration of activities with expensive hiring processes exist. In opposition, in markets where predominate economic activities in which the client firms can easily cover vacant posts, the collaboration of THS firms will be less necessary. One classification of activities should be feasible — in rigorous manner — meeting the lines of economical activity. However, because we do not dispose of so detailed data, we opted for constructing the study using information on the four sectors of activity. For more particular description of this point, the arguments presented in *Annex 1* can be confronted.

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<sup>26</sup> For logit model the dependent variable is the logarithm of the *odds*, which is equivalent to suppose a non-linear relation between  $p_{it}$  and the explicative variables.

<sup>27</sup> It is logical to suppose that the level of the THS firms presence, in one period and local market, responds to the type of client companies which are concentrated in this market. Some client companies because of their specific characteristics or because of the activity type they realise, fall systematically into bigger recruitment costs than others. In such local markets where this type of companies predominates, the THS firms will have bigger presence and will get more participation quota (within the conjunction of temporary hiring), inasmuch as the costs savings provided by the THS firms result more attractive.

### 3.3. Description of Data and Sources employed

The variable ( $\hat{p}_{it}$ ) was defined as a ratio between the contracts formalised by the THS firms and the temporary contracts as a whole. The number of contracts executed by the THS firms, as well as the total number of temporary contracts, was obtained from the same source: the INEM.<sup>28</sup>

As for the explicative variables, INDSER — proportion of job allocations in the industries and services — was obtained from the INEM. The information on this variable is available for every province with monthly periodicity, which permits to develop an extended data base, suitable for the methodology of panel data. The rest of the regressors are dummy variables, to control for the time periods.

### 3.4. Results interpretation

The empirical analysis is realised with **panel data** methodology. Using monthly data, a panel of 2.800 observations (56 periods and 50 provinces) was developed.<sup>29</sup> The data base is a big one and permits to benefit from statistical properties commonly associated to large samples. From another point of view, by using panel data, it will be possible to consider the influence of the individual heterogeneity component that could be present.

The presented estimations will be those obtained from the estimated Logit model, inasmuch as, given the probabilistic character of election problem, it is more accordant than the linear specification with the theoretical foundations of the model.<sup>30</sup>

#### 3.4.1. ESTIMATION OF THE POOLED MODEL

First, the regression results, estimated by OLS, and coming from 2.800 available observations (50 provinces by 56 monthly periods), are presented.<sup>31</sup> Naturally, to work with a panel demands to control for temporal periods, incorporating ‘dummy’ variables. Specifically, even if the data comprehend 56 periods (from January-1996 to August-2000), it is sufficient to introduce 4 ‘dummy’ variables for years and 11 corresponding to months. (January-1996 is the reference period.) *Table 3.1* collects the results.

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<sup>28</sup> INEM: ‘National Institute of Employment’, Ministry of Labour and Social Affairs. The reliability of this data is unquestionable inasmuch as the Spanish authorities established that all the contracts must be registered.

<sup>29</sup> 56 monthly periods include data from January-1996 to August-2000.

<sup>30</sup> In addition, the estimated regressions for the linear version showed lack of normality in the residuals. This diagnosis problems yielded in that the results of linear model were finally discarded.

<sup>31</sup> All the estimations were calculated with STATA.

**Table 3.1.**  $\log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \beta_1 \cdot indser_{it} + \sum_{t=97}^{00} \sigma_t \cdot D_t + \sum_{m=2}^{12} \sigma_m \cdot M_m + \varepsilon_{it}$

Source	SS	df	MS	Number of obs =	2800
Model	1545.3684	16	96.5855253	F( 16, 2783) =	310.47
Residual	865.766724	2783	.311091169	Prob > F =	0.0000
				R-squared =	0.6409
				Adj R-squared =	0.6389
Total	2411.13513	2799	.861427341	Root MSE =	.55776

Variable	Coefficiente	Error Est.	t	P> t
indser	4.229112	.068228	61.98	0.000
d97	.5733168	.032205	17.80	0.000
d98	.7925322	.0322158	24.60	0.000
d99	.6905902	.0322496	21.41	0.000
d00	.6236137	.0369525	16.88	0.000
m2	.084796	.0499091	1.70	0.089
m3	.202438	.0498915	4.06	0.000
m4	.1853449	.0498972	3.71	0.000
m5	.2409067	.0499118	4.83	0.000
m6	.2677947	.0499346	5.36	0.000
m7	.0621607	.0500287	1.24	0.214
m8	.2702455	.0499809	5.41	0.000
m9	.2418731	.0533208	4.54	0.000
m10	.1327808	.0532878	2.49	0.013
m11	.2586869	.0532974	4.85	0.000
m12	.2900491	.0533634	5.44	0.000
_cons	-5.95228	.0625156	-95.21	0.000

The coefficient estimated for INDSEER is positive and very significant, indicating that the THS firms establish a higher proportion of contracts in the provinces and periods with larger concentration of activities in industry and services. This evidence is based on the occurrence that these sectors concentrate the entrepreneurial activities associated with the biggest hiring costs. Moreover, the Adjusted- $R^2$  (with value: 0,6389) is very elevated for a study of this type, especially if one takes into account the fact that, excluding the constant and the ‘dummy’ variables, only one explicative variable has been introduced.

Nevertheless, before other comments or before extracting conclusions from these results, the behaviour of the residuals (in case if heteroscedasticity or serial correlation existed) should be examined. First, to check for **heteroscedasticity** the test by ‘Cook-Weisberg’ is computed.<sup>32</sup> The value of the statistic, which follows ‘chi-square’ ( $\chi^2$ ) distribution with one degree of freedom, is equal to 184,38. Given that this statistic is superior to the correspondent critical value (3,8 for 95% confidence level; and 6,6 for 99% confidence level), the null hypothesis of homocedasticity is rejected.

<sup>32</sup> This test we owe to COOK y WEISBERG (1983). In particular, this test contrasts the null hypothesis of homocedasticity, verifying when  $t=0$  in the expression:  $Var(e)=\sigma^2 \cdot \exp(z \cdot t)$  is fulfilled; where  $z$  represents the ‘fitted values’. For  $t=0 \exp(0) = 1$  is fulfilled, in the way that the variance would be constant.

Before exploring the different solutions to the heteroscedasticity, it is advisable to check for the existence of **serial correlation**.<sup>33</sup> Accordingly, the ‘Breusch-Godfrey’ test was carried out. This test, among other things, allows to check for correlation of higher than one orders and possesses properties that do not change with addition of retarded variables in the role of the regressors.<sup>34</sup> The Breusch-Godfrey test is obtained by estimating a regression of the model residuals versus the successive retarded residuals, as well as versus the explicative variables from the original model. If the determination coefficient ( $R^2$ ) of this regression is very high, it means that the actual residuals depend strongly on the past, indicating the presence of the autocorrelation. Specifically, this test contrasts  $N \cdot T \cdot R^2$  with the tables of  $\chi^2$  distribution with so many degrees of freedom as many retarded residuals were introduced in the regression.<sup>35</sup> In agreement with this checking, the null hypothesis of no autocorrelation is not rejected if the product of number of observations times determination coefficient ( $N \cdot T \cdot R^2$ ) is less than the corresponding critical value.<sup>36</sup>

In *Table 3.1* the first order autocorrelation in the residuals of the presented model is unquestionable.<sup>37</sup> The goodness of fit of the correspondent regression is 0,6252 and therefore, it is evident that the product of number of observations<sup>38</sup> times the *Adjusted-R<sup>2</sup>* exceeds the critical value with one degree of freedom, which —at 95% confidence level— is equal to 3,84. Then, it seems undeniable the existence of the first order correlation, which disqualifies the validity of the hypothesis about the significance of the estimated coefficients.

Therefore, before drawing any conclusions, we have to account for serial autocorrelation. There are two possible ways to do it. The first one is to incorporate in the estimation the autoregressive structure which is professedly presented by residuals. The second possibility would be to add a dynamic component in the model (that is to say, to

<sup>33</sup> The heteroscedasticity have problems of inefficiency in OLS estimators. More alarming is the autocorrelation, since above inefficiency, can provoke that estimators will not be unbiased.

<sup>34</sup> Notice that traditional autocorrelation test of Durbin-Watson is neither valid if the alternative hypothesis includes more general specifications from the autoregressive model of the first order; nor when the model includes any of the variable retarded.

<sup>35</sup> The properties of this test, in the version proposed for the analysis of temporal time series, can be found in NOVALES CINCA (1997). Moreover, it has enormous parallel with any of the tests — for serial correlation in panel data— described in BALTAGI (2001), p. 90. In any case, given that the Breusch-Godfrey test is not precisely defined in the literature for panel data, the results obtained would be indicative, without strict linkage to the criterion shown.

<sup>36</sup> At 95% confidence level, this critical value is 3,84 with one delay in the residuals; 5,99 when second delay is introduced; 7,81 with three and 9,48 for checking AR (4) process.

<sup>37</sup> According to Breusch-Godfrey test, the null hypothesis of no autocorrelation is rejected always when the product of observations number times determination coefficient ( $N \cdot T \cdot R^2$ ) is bigger than critical value of the ‘chi-square’ distribution, with as many degrees of freedom as there are number of lags in the residuals included as regressors. Given that there is a serial correlation of order 1, it we omit the results presentation of higher order autocorrelation testing.

<sup>38</sup> As we introduce one delay in the residuals employed as a regressor, the number of observations is not

introduce as a regressor the dependent variable retarded once). This last alternative has been the chosen one, while the results of the first one are relegated to *Annex 2*, as they are less satisfactory from all points of view.<sup>39</sup>

In other words, theoretic nature of the problem suggests that the model, in order to be correctly specified, demands a dynamic form. The next section analyse whether or not this statement is backed by the results of the corresponding estimations.

### 3.4.2. DYNAMIC SPECIFICATION

As it was stated, the autocorrelation might come from the incorrect functional specification of the model. If it was the case, this problem would disappear after appealing to dynamic specification of the model,<sup>40</sup> adding as a regressor any retarded dependent variable. (This retarded dependent variable will be named ‘odds<sub>lag</sub>’.) In addition to that, we have to face the heteroscedasticity problem.

To tackle both the serial correlation and heteroscedasticity simultaneously — it could be experimented with some dynamic specification of the model and, furthermore, estimate the regressions with GLS. The first would address and account for the serial correlation problem, while the GLS estimation proves appropriate in the presence of heteroscedasticity.<sup>41</sup> *Table 3.2* presents the results of this new estimation, which is carried out with 2.750 observations.<sup>42</sup>

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2.800 anymore, but 2.750 ( 50 provinces times 55 periods).

<sup>39</sup> They are fundamentally less satisfactory because the problem’s nature seems to points out another cause as the origin of this autocorrelation. The theoretic base on which rests the incorporation of some autoregressive process responds to idea that there exists a series of *shocks*, of which influence is perpetuated into a long run. On the contrary, the interpretation and theoretical implications which underlie dynamic specification of the model are very different. In this case, it is supposed that the value of the dependent variable, in some determined moment, is conditioned by the value from the instantly preceding period. From the other side, the practice of introducing a AR(1) structure into the residuals has a drawback that it can only alleviate the first order correlation. It is does not, however, guarantee to resolve other correlation of higher orders. STATA can realise this type of estimations with GLS (*Generalised Least Squares*), adding each time in the residuals one AR(1) structure; that is to say, assuming that:  $u_{it} = \rho \cdot u_{it-1} + \varepsilon_{it}$ ; for  $\varepsilon_{it}$  being a white noise. The program command for this estimation, assuming that the correlation coefficient is common for all the panels is: `xtgls [vardep] [varlist], i() t() p(a) c(a)`.

<sup>40</sup> This that one or more retarded dependent variable are introduced or that the observation from the preceding month or the three months or a year before is used, responds to the nature of the data (monthly, yearly, etc.) In this case, after examining results from different specifications, only one delay in dependent variable was chosen: the value from the previous month. The results showed that the coefficients of the corresponding ‘dummy’ variables are significant, which indicates that this may be the most adequate specification.

<sup>41</sup> The GLS estimations also take into account the possibility of panels that are correlated between themselves.

<sup>42</sup> Introducing the retarded dependent variable as the regressor yielded in losing 50 of initial 2.800 observations.

**Table 3.2.**  $\log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \beta_1 \cdot \text{odds}lag_{it-1} + \beta_2 \cdot \text{ind}ser_{it} + \sum_{t=97}^{00} \sigma_t \cdot D_t + \sum_{m=2}^{12} \sigma_m \cdot M_m + \varepsilon_{it}$

Cross-sectional time-series FGLS regression			
Coefficients:	generalized least squares		
Panels:	heteroskedastic with cross-sectional correlation		
Correlation:	no autocorrelation		
Estimated covariances	=	1275	Number of obs = 2750
Estimated autocorrelations	=	0	Number of groups = 50
Estimated coefficients	=	18	No.of time periods = 55
			Wald chi2(17) = 226782.41
Log likelihood	=	1286.162	Prob > chi2 = 0.0000

Variables	Coefficiente	Error Est.	z	P> z
odds	.7888423	.005624	140.26	0.000
indser	.9198878	.0255436	36.01	0.000
d97	.083127	.009954	8.35	0.000
d98	.1146486	.0104274	10.99	0.000
d99	.0653256	.0102495	6.37	0.000
d00	.0546153	.0115078	4.75	0.000
m2	.1544332	.0154716	9.98	0.000
m3	.3115414	.0155541	20.03	0.000
m4	.251164	.0155488	16.15	0.000
m5	.2668116	.0155255	17.19	0.000
m6	.2496423	.0155502	16.05	0.000
m7	.0750574	.0156454	4.80	0.000
m8	.3362279	.0155975	21.56	0.000
m9	.0833835	.0164135	5.08	0.000
m10	.0264836	.0164013	1.61	0.106
m11	.3101166	.0165161	18.78	0.000
m12	.2966946	.0164731	18.01	0.000
_cons	-1.371356	.0342226	-40.07	0.000

With the GLS estimation we do not need to worry anymore about the heteroscedasticity problem. As for serial correlation, Breusch-Godfrey test shows that it is no longer present, when applying a dynamic structure.<sup>43</sup>

The **indser** coefficient is positive and very significant, which indicates that the level of the THS firms presence is remarkably bigger in the labour markets where the typical activities of the industry and services are concentrated. It concerns these labour markets where, presumably, the biggest hiring costs for the clients are encountered. This would confirm the thesis suggested by theory. The coefficients of the rest explicative variables, with exception to October dummy (m11), are also significant. The estimated

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<sup>43</sup> Or, at least, that serial correlation has been drastically reduced. The regression of the residuals from the dynamic model (in respect to one delay of the residuals and the rest regressors from the original model) presents  $R^2$  of 0,0752 in comparison to  $R^2 = 0,7041$  from the regression applied to the residuals from the not dynamic model.



coefficient of the retarded variable ('odds<sub>lag</sub>') is very significant, which speaks in favour of the dynamic specification.<sup>44</sup>

For now, the panel data analysis enabled us to state that the THS firms industry underwent in a long term a general expansion — at least until 1998 — and that the model has a dynamic character, in the sense that there exists a strong inertia of the dependent variable to maintain the state from preceding period.<sup>45</sup>

Nevertheless, the whole information contained in the data was yet not exploited conveniently. This information can be extracted applying the fixed effects and random effects models. These models, which are usually estimated in panel data analysis, allow to isolate the possible influence on the dependent variable of peculiarities characteristic associated to each province.

That is to say, these models allow to isolate a hypothetical 'individual heterogeneity component', which could be encountered in the great regional disparities that exist in Spain in the moment of appealing to the THS firms.

### 3.4.3. DYNAMIC ESTIMATION WITH INDIVIDUAL COMPONENTS

The presence of some unobservable 'individual heterogeneity component' — different for every province — can be introduced in the analysis, considering as if it was about fixed effect ('fixed effects' model), or supposing that it has some random effect ('random effects' model).<sup>46</sup> These models success in avoiding that the estimations will be distorted by any peculiar characteristic of a determined province or region which were not captured by none of other explicative variables. As a counterpart, the introduction of individual heterogeneity component has a risk that this component will monopolise large part of the model explicative capacity, diminishing at the same time relevance of other employed variables.<sup>47</sup>

Obviously, because of the presumed autocorrelation, the estimations with individual components will have to be done for the dynamic version of the model, since the non-dynamic specification will have undoubtedly problems with diagnosis.<sup>48</sup>

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<sup>44</sup> Among distinct possibilities of introducing the dynamic into the model, the most adequate is the one that includes only one retardation of the dependent variable. Other attempts produced less satisfactory results with respect to the significance of the variables and, especially, with the residuals diagnosis.

<sup>45</sup> In the same way it is indicated by positive signs of the 'dummy' variables attached to months and years.

<sup>46</sup> To fathom the themes of the nature and characteristics of these models any of the following basic references for the panel data can be consulted: Cf. HSIAO (1986); or: BALTAGI (2001).

<sup>47</sup> This possibility is relevant here, once the disparity of the data between distinct regions is very large and, on the contrary, the variability of the observations in time is very small.

<sup>48</sup> Breusch-Godfrey test warns newly of autocorrelation.  $R^2$  from the residuals regression is very high in both models. The successive regressions of the residuals with respect to the regressors of original model and successive groups of the delayed residuals were estimated. With only one retardation,  $R^2$  was 0,7288 for the fixed effects model; and 0,7125 for the 're' model. The existence of the autocorrelation implicates the

Nevertheless, for the simply illustrative purpose, *Annex 3* collects the estimations of both models, together with the corresponding test of Hausman.<sup>49</sup>

Before moving to the examination of the dynamic specification of the model, we need to clarify also that we tried to account for autocorrelation — in the presence of the fixed and random effects — by incorporating an AR(1) process.<sup>50</sup> The results of this method will not be presented, because there were not considered relevant from theoretical point of view.

On the other hand, we must keep in mind that, for the case of random and fixed effects models, a dynamic specification cannot be applied directly, given that correlation between regressors would certainly appear. Specifically, having that the individual heterogeneity part does not change throughout the distinct periods, introducing retarded dependent variable would provoke inevitably multicollinearity. In practice, to experiment with various dynamic specifications of the model —and avoid multicollinearity in the same time—, we resort to instrumental variables methodology to be applied upon the retarded variable: ‘odds1ag’.

In other words, when analysis of unobservable individual heterogeneity component is incorporated, the correct functional form of the model demands a dynamic specification. Nevertheless, in the presence of the individual heterogeneity elements, all attempts of dynamic specification should, necessarily, instrument the retarded dependent variable.

Having said that, it is accurate to look for instrumental variables that are very correlated with the retarded dependent variable, but which are not correlated with the individual heterogeneity part. For the sake of simplicity, the retarded dependent variable was tried to be instrumented with the value of the change rate with respect to the previous period. This instrumental variable (named as ‘odds1lag’)<sup>51</sup> will be used in the successive estimations.

On one hand, in *Table 3.3.a* are gathered the results of estimating the **‘fixed effects’** model:

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possibility of bias and inefficiency in the estimators.

<sup>49</sup> Test based on the conventional method proposed by HAUSMAN (1978). For exhaustive explication of the theoretical fundamentals of this test, see: Cf. BALTAGI (2001), pp. 65 and Ss. To nail the scope of this test as a selection method between the fixed and random effects models, see: Cf. BALTAGI (2001), pp. 20.

<sup>50</sup> STATA allows to do these types of estimations (supposing  $u_{it} = \rho \cdot u_{it-1} + \varepsilon_{it}$ ;  $\varepsilon_{it}$  being white noise), with the command: `xtregar [vardep] [varlist], fe/re lbi`.

<sup>51</sup> STATA allows to estimate these types of models with instrumental variables. This is done by the command: `xtivreg [vardep] [varlist] (odds1ag = ths1lag), fe/re i()`. The number of the observations is now 2.700, once we lost 50 observations to obtain the period-to-period increase in the dependent variable, and other 50 to employ the retardation of this variable as a regressor.



**Table 3.3.a**  $\log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \gamma_i +$

$$\beta_1 \cdot (\text{odds}lag_{it-1} = \text{odds}llag_{it-1}) + \beta_2 \cdot \text{indser}_{it} + \sum_{t=97}^{00} \sigma_t \cdot D_t + \sum_{m=2}^{12} \sigma_m \cdot M_m + \varepsilon_{it}$$

<b>Fixed-effects(within) IV regression</b>	Number of obs	=	2700
Group variable: prov	Number of groups	=	50
R-sq: within = 0.5603	Obs per group: min =		54
between = 0.8585	avg =		54.0
overall = 0.7604	max =		54
	Wald chi2(17)	=	127157.21
corr(u_i, Xb) = 0.5303	Prob > chi2	=	0.0000

Variable	Coefficiente	Error Est.	z	P> z
odds	.1960865	.0380317	5.16	0.000
indser	2.214642	.1357619	16.31	0.000
d97	.3885932	.0288245	13.48	0.000
d98	.5703846	.0367139	15.54	0.000
d99	.4952143	.0357897	13.84	0.000
d00	.4412646	.0351827	12.54	0.000
m2	.0934795	.0321163	2.91	0.004
m3	.1449054	.0317061	4.57	0.000
m4	.1436409	.0304429	4.72	0.000
m5	.1991725	.0301354	6.61	0.000
m6	.226229	.0301277	7.51	0.000
m7	.0547419	.0307016	1.78	0.075
m8	.2631902	.0305032	8.63	0.000
m9	.1588761	.0326257	4.87	0.000
m10	.0413303	.0318668	1.30	0.195
m11	.2157969	.0322296	6.70	0.000
m12	.2646519	.0322622	8.20	0.000
_cons	-3.85416	.1686092	-22.86	0.000

sigma_u		.37569451		
sigma_e		.31226514		
rho		.5914221	(fraction of variance due to u_i)	
F test that all u_i=0:	F(49,2633) =	8.47	Prob > F =	0.0000
Instrumented:	thslag			
Instruments:	indser d97 d98 d99 d00 m2 - m12 thsllag			

On the other hand, *Table 3.3.b* shows the ‘**random effects**’ model estimations.

**Table 3.3.b.**  $\log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \beta_1 \cdot (\text{odds}lag_{it-1} = \text{odds}llag_{it-1}) +$

$$+ \beta_2 \cdot \text{indser}_{it} + \sum_{t=97}^{00} \sigma_t \cdot D_t + \sum_{m=2}^{12} \sigma_m \cdot M_m + \gamma_i + \varepsilon_{it}$$

<b>EC2SLS Random-effects regression</b>	Number of obs	=	2700
Group variable: prov	Number of groups	=	50
R-sq: within = 0.6340	Obs per group: min =		54
between = 0.9428	avg =		54.0
overall = 0.8562	max =		54
	Wald chi2(17)	=	11897.65
corr(u_i, X) = 0 (assumed)	Prob > chi2	=	0.0000

Variable	Coeficiente	Error Est.	z	P> z
odds1lag	.5185078	.0273905	18.93	0.000
indser	2.047857	.1205586	16.99	0.000
d97	.2030127	.0256328	7.92	0.000
d98	.2999103	.0298554	10.05	0.000
d99	.2313954	.0286602	8.07	0.000
d00	.1994784	.0294481	6.77	0.000
m2	.1598808	.0343427	4.66	0.000
m3	.2383229	.0334127	7.13	0.000
m4	.1867269	.0330549	5.65	0.000
m5	.2160562	.0328592	6.58	0.000
m6	.2153484	.0327219	6.58	0.000
m7	.0269123	.0328635	0.82	0.413
m8	.2682624	.0330703	8.11	0.000
m9	.0937685	.0347558	2.70	0.007
m10	.0158561	.0346737	0.46	0.647
m11	.2497833	.0350876	7.12	0.000
m12	.2531435	.0349319	7.25	0.000
_cons	-2.856136	.1580274	-18.07	0.000
sigma_u	0			
sigma_e	.31226514			
rho	0	(fraction of variance due to u_i)		
Instrumented: thslag				
Instruments: indser d97 d98 d99 d00 m2 - m12 ths1lag				

The previous results are highly satisfactory. The estimated coefficients for fixed effects, as well as those estimated for random effects,<sup>52</sup> are significant — with the exception of (m11) and, to less extent, of (m7) —. Furthermore, the recourse to instrumental variables —as a way to introduce dynamics without producing correlation between the regressors and the disturbance — seems satisfactory, as far as the correspondent estimated coefficient is also significant.

Before interpreting these results, it is advisable to examine the diagnosis of the residuals. For the case of the **fixed effects** model, the regression of its residuals present a tremendously high Adjusted- $R^2$ ,<sup>53</sup> which acknowledges that the problem of the serial correlation was not resolved. Probably, this was the case because the employed instrument was not adequate to estimate the fixed effects model.<sup>54</sup>

On the contrary, the results from the **random effects** model can be considered as conclusive ones, in the sense in which the serial correlation was drastically reduced.<sup>55</sup> The instrument applied (odds1lag) is exactly the same as before, but here it works well.

<sup>52</sup> In the estimation of the random effects model GLS estimator was chosen proposed by Baltagi (ec2sls) in the place of the one derived by Balestra and Varadharajan-Krishnakumar (g2sls). For technical details about the differences between both estimators, Cf. STATA version 7.0 (2001), pp. 367-8 y 375-6.

<sup>53</sup> In particular, the determination coefficient is equal to 0.55 if one delay in the residuals was introduced; and a little bigger than 0.62 if 2, 3 or 4 lags were introduced.

<sup>54</sup> The same conclusion seems to be inferred when we observe that the 'odds1lag' coefficient is a lot less significant when the estimations are computed with this model.

<sup>55</sup> The correspondent determination coefficient is equal to 0.074 with one retardation in residuals, and not surpasses 0.25 when up to four lags are included.

(In fact, it is one of the instruments which habitually are recommended for the random effect model). In conclusion, the introduction of the dynamics into the model, through the use of instrumental variables, is successful in the case of the random effects model.

The last estimations permit to extract very analogous conclusions to the ones advocated until now.<sup>56</sup> The positive sign of the **indser** coefficient indicates that the proportion of the temporal contracts realised by THS firms is bigger where the activities of the industry and services sectors predominate. However, the last analysis contain one additional overtone, since, by incorporating the individual heterogeneity element, the previous affirmation can be formulated itself more roundly. In fact, this thesis could be defended even when the unobservable characteristics of the provinces were incorporated in the estimation. Therefore, these results reinforce the ones obtained previously.

In the analysis, we have avoided to interpret the magnitudes of the estimated coefficients, as we employed ‘proxy’ variables. Then, the effort has been placed in studying the sign and significance of the coefficients. In this sense, the conclusion is unanswerable. The estimated coefficients for **indser** — positive and very significant in all the cases — confirm that: *the THS firms formalise major proportion of the temporal contracts in the markets where the presence of the industrial and service sectors is greater.*

## 4. Conclusions

The temporal employment characterises —each time in bigger extent— the reality of the Spanish labour market. The THS firms’ industry, in spite of its novelty, have represented in the last years about 16% of the temporary hiring. Besides that, there are enormous discrepancies between the distinct Spanish provinces, which deserves some explication.

The main contribution of this paper is the description of an equilibrium model for the THS industry, in the presence of unemployment. Furthermore, a careful empirical examination of the theoretical hypothesis was carried out. In summary, it can be concluded that the fixed hiring costs is the determinative factor which explains the growing success of the THS firms, as well as the discrepancies between provinces. This result is established by the fact that the biggest hiring costs are presumed in the places where the biggest concentration of industrial and service activities exists. The theoretical hypothesis were checked with the use of the ‘proxy’ variables and with the application of the proper methodology for panel data.

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<sup>56</sup> Having said all that, it seems legitimate to concede importance to the estimations of the random effects model model, which will be consistent and efficient. (Specifically, the coefficient estimated for **indser** takes value 2.04 when the model random effects model is applied). However the Hausman test was not applied here (dynamic version of the model and recourse to instrumental variables), as the estimations of the fixed effects model are tainted by serial correlation.

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## ANNEX 1

First, suppose that the hiring cost differs according to activity branch. In this case, the medium cost of the direct hiring—in each province—should be obtainable calculating the weighted mean of the hiring costs in each of these branches,  $k^r$ , accordingly to the percentage of the contracts that are materialised in each activity branch,  $\eta_i^r$ . That is to say:

$$[A.1.1] \quad E(k_i) = \sum_{r=1}^R \eta_i^r \cdot k^r$$

Assuming that the salary would not vary—within each activity branch and between homogeneous workers—in all territory ( $w_i^r = w^r$ ), the preceding expression changes to the following relation:

$$[A.1.2] \quad \frac{E(k_i)}{w} = \sum_{r=1}^R \eta_i^r \cdot \frac{k^r}{w^r}$$

The cautious investigation of the last expression, manifests one implicit assumption in the present analysis: the costs of direct hiring of a professional equally qualified (in the context of the specific activity branch) in all provinces are supposed to be equal. Whereof, the unique factor that enables to differ the costs by provinces is the proportion which each of these branches represents in the conjunction of the hiring. That is to say, it can be expected that THS firms will be more present in those local markets, in which the firms from activity branches with high hiring costs are concentrated.

For simplicity, we are going to assume that the activity branches can be grouped, for the finality just described, by sectors of activity. Specifically, it seems that—in general—a good criterion would be to classify the activity branches into two large blocks: industry and service activities from one side and, from the other side, the ones corresponding to agriculture, fishing and construction. From here the weighted mean in the expression [2.31] could be rewritten (incorporating temporal dimension and for the Spanish case) as:

$$[A.1.3] \quad \frac{E(k_{it})}{w} = \eta_{it}^{indser} \cdot \frac{k^{indser}}{w^{indser}} + \eta_{it}^{agrcon} \frac{k^{agrcon}}{w^{agrcon}}$$

The activities were grouped in two blocks and the weighing factors should sum to one. Assigning ‘a’ and ‘b’ respectively to the cost of hiring in industry-services sector and to the cost of hiring in agriculture-construction sector, we have that the expression [2.32] can be expressed alternatively as:

$$[A.1.4] \quad \frac{E(k_{it})}{w} = \eta_{it}^{indser} \cdot a + (1 - \eta_{it}^{indser}) \cdot b = b + (a - b) \cdot \eta_{it}^{indser}$$

This suggests that for the ‘proxy’ variable, to evaluate medium hiring costs, one index of the concentration in the industry and services should be used. In particular, we are going to propose as the ‘proxy’ variable **the proportion of collocations which have place in the industry and services in relation to the total volume of collocations in each province**. This variable from now on will be denominated INDSEER.

## ANNEX 2

**Table A.2.1.** GLS ESTIMATION WITH AR (1) PROCESS

$$\log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \beta_1 \cdot indser_{it} + \sum_{t=97}^{00} \sigma_t \cdot D_t + \sum_{m=2}^{12} \sigma_m \cdot M_m + u_{it}$$

being  $u_{it}$  some AR(1) process; that is to say:  $u_{it} = \rho \cdot u_{it-1} + \varepsilon_{it}$

<b>Cross-sectional time-series FGLS regression</b>			
Coefficients: generalized least squares			
Panels: heteroskedastic with cross-sectional correlation			
Correlation: common AR(1) coefficient for all panels (0.7060)			
Estimated covariances	=	1275	Number of obs = 2800
Estimated autocorrelations	=	1	Number of groups = 50
Estimated coefficients	=	17	No. of time periods = 56
			Wald chi2(16) = 26591.83
Log likelihood	=	1231.111	Prob > chi2 = 0.0000

Variable	Coefficiente	Error Est.	z	P> z
indser	3.13512	.0202221	155.03	0.000
d97	.3052266	.0188957	16.15	0.000
d98	.5891647	.0220905	26.67	0.000
d99	.5775894	.0236556	24.42	0.000
d00	.674729	.0278281	24.25	0.000
m2	.0596049	.0105875	5.63	0.000
m3	.1739717	.0137692	12.63	0.000
m4	.179172	.0155662	11.51	0.000
m5	.2479342	.0166318	14.91	0.000
m6	.2922357	.017234	16.96	0.000
m7	.1140212	.0174955	6.52	0.000
m8	.3079788	.0174157	17.68	0.000
m9	.2344538	.0176015	13.32	0.000
m10	.1263818	.0170263	7.42	0.000
m11	.2590796	.0156705	16.53	0.000
m12	.2905927	.0129478	22.44	0.000
_cons	-5.070358	.0271837	-186.52	0.000

## ANNEX 3

**Table A.3.1.** 'FIXXED EFFECTS' MODEL.

$$\log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \gamma_i + \beta_1 \cdot indser_{it} + \sum_{t=97}^{00} \sigma_t \cdot D_t + \sum_{m=2}^{12} \sigma_m \cdot M_m + \varepsilon_{it}$$

<b>Fixed-effects (within) regression</b>		Number of obs	=	2800
Group variable (i) : prov		Number of groups	=	50
R-sq: within	= 0.5034	Obs per group: min	=	56
between	= 0.7204	avg	=	56.0
overall	= 0.5985	max	=	56
		F(16,2734)	=	173.20
corr(u_i, Xb)	= 0.4055	Prob > F	=	0.0000

Variable	Coeficiente	Error Est.	t	P> t
indser	2.42597	.1456443	16.66	0.000
d97	.5847887	.0216529	27.01	0.000
d98	.8173939	.0217261	37.62	0.000
d99	.7368705	.0219537	33.56	0.000
d00	.679443	.0251907	26.97	0.000
m2	.0457011	.0336623	1.36	0.175
m3	.1850963	.0335431	5.52	0.000
m4	.2117743	.0335818	6.31	0.000
m5	.2823276	.0336804	8.38	0.000
m6	.3252898	.0338341	9.61	0.000
m7	.1615569	.0344621	4.69	0.000
m8	.3511238	.0341446	10.28	0.000
m9	.2973419	.0360721	8.24	0.000
m10	.1575625	.0358487	4.40	0.000
m11	.2951548	.0359138	8.22	0.000
m12	.369084	.0363577	10.15	0.000
_cons	-4.702565	.1046138	-44.95	0.000
sigma_u	.50478809			
sigma_e	.37469637			
rho	.64475103 (fraction of variance due to u_i)			
F test that all u_i=0:	F(49, 2734) = 70.05 Prob > F = 0.0000			

**Table A.3.2.** ‘RANDOM EFFECTS’ MODEL

$$\log\left(\frac{p_{it}}{1-p_{it}}\right) = \beta_0 + \beta_1 \cdot indser_{it} + \sum_{t=97}^{00} \sigma_t \cdot D_t + \sum_{m=2}^{12} \sigma_m \cdot M_m + \gamma_i + \varepsilon_{it}$$

<b>Random-effects GLS regression</b>	Number of obs	=	2800
Group variable (i) : prov	Number of groups	=	50
R-sq: within = 0.5030	Obs per group: min	=	56
between = 0.7204	avg	=	56.0
overall = 0.6120	max	=	56
Random effects u_i ~ Gaussian	Wald chi2(16)	=	2850.76
corr(u_i, X) = 0 (assumed)	Prob > chi2	=	0.0000
theta = .87870283			

Variable	Coeficiente	Error Est.	z	P> z
indser	2.662218	.1373004	19.39	0.000
d97	.5832856	.0217333	26.84	0.000
d98	.8141365	.0217981	37.35	0.000
d99	.7308069	.0219998	33.22	0.000
d00	.6721282	.025239	26.63	0.000
m2	.0508234	.0337733	1.50	0.132
m3	.1873684	.0336677	5.57	0.000
m4	.2083115	.0337019	6.18	0.000
m5	.2769006	.0337893	8.19	0.000
m6	.3177567	.0339255	9.37	0.000
m7	.148534	.0344827	4.31	0.000
m8	.3405271	.0342009	9.96	0.000
m9	.2900743	.0361769	8.02	0.000
m10	.1543156	.035979	4.29	0.000
m11	.2903768	.0360366	8.06	0.000
m12	.3587288	.03643	9.85	0.000
_cons	-4.866303	.1148883	-42.36	0.000
sigma_u	.40974739			
sigma_e	.37469637			
rho	.54459361 (fraction of variance due to u_i)			

**Table A.3.3.** HAUSMAN'S TEST

The **'Hausman's test'** permits elucidate which of the two models —the one of fixed effects or of random effects— is preferable. This is done by beginning with the following premise: the estimations of the fixed effects model are necessarily unbiased and consistent, thing that does not happen with the estimations of the random effects model; still, these last estimations are more efficient. The model of the random effects rests in the critical way on the presupposition that the correlation between the regressors and random perturbations does not exist. This is crucial, given that now the perturbations contain some individual, unobservable heterogeneity part, which could be correlated with other regressors. On the contrary, this problem is absent in the model of the fixed effects, as the transformation 'within' eliminates invariant parts before the estimation. That is to say, under the null hypothesis of no correlation, so much the fixed effects estimations as well as those of random effects model would be consistent; but the ones from the second model would be preferred as being more efficient. On the contrary, if the null hypothesis is not fulfilled we would have to adopt the estimations of the fixed effects model, which are always consistent.

### Hausman's test

Variable	Coeficientes		Diferencia
	Ef.Fijos	Ef.Aleatorios	
indser	2.42597	2.662218	-.2362481
d97	.5847887	.5832856	.001503
d98	.8173939	.8141365	.0032574
d99	.7368705	.7308069	.0060637
d00	.679443	.6721282	.0073148
m2	.0457011	.0508234	-.0051222
m3	.1850963	.1873684	-.0022721
m4	.2117743	.2083115	.0034628
m5	.2823276	.2769006	.005427
m6	.3252898	.3177567	.007533
m7	.1615569	.148534	.0130229
m8	.3511238	.3405271	.0105967
m9	.2973419	.2900743	.0072675
m10	.1575625	.1543156	.0032469
m11	.2951548	.2903768	.004778
m12	.369084	.3587288	.0103552

Hausman specification test	
Test:	Ho: difference in coefficients not systematic
	$\chi^2(16) = (b-B)'[S^{(-1)}](b-B), S = (S_{fe} - S_{re})$
	= 23.64
	Prob>chi2 = 0.0976

To check the existence of the correlation between the regressors and the perturbations, Hausman proposes the following procedure. If the model is correctly specified and the null hypothesis of no correlation is fulfilled, then the coefficient estimates for the fixed effects model and the corresponding estimators of random effects model should not differ much statistically. From there comes the interest in checking the null hypothesis that there are no significant differences between the estimated coefficients in these two models. In the present case the *P-value* is equal to 0.0976; which means that the probability of being wrong while rejecting the null hypothesis is sufficiently high to choose not to reject it. (The corresponding statistic follows 'chi-square' distribution with number of degrees of freedom equal to the number of estimated coefficients). Therefore, the random effects model estimations would be preferable now, because they can be considered consistent and furthermore, because they are asymptotically efficient.