LABORatorio R. Revelli
Centre for Employment Studies

FIRMS' DEMAND FOR OCCUPATIONAL PROFILES:
a theoretical and empirical study

by

Marco Novarese

Working Papers Series
No. 9

Collegio "Carlo Alberto" via Real Collegio, 30 - 10024 Moncalieri (TO)
Tel. +39 011.640.26.59/26.60 - Fax +39.011.647.96.43 – www.labor-torino.it - labor@labor-torino.it
LABOR is an independent research centre within Coripe Piemonte

LABORatorio R. Revelli
Centre for Employment Studies

FIRMS' DEMAND FOR OCCUPATIONAL PROFILES: a theoretical and empirical study

by

Marco Novarese*

February 2002

Abstract

This paper aims at analysing, both theoretically and empirically, possible determinants of firm's demand of occupations. Even if traditionally neglected within economics literature, this issue can, in fact, be very useful for Economics, as this paper tries to shows. The theoretical analysis devotes a particular attention to find a preliminary link between the need for occupations and the theory of the firm. The empirical analysis is based on a dataset built using data from the 1996 "Analisi Excelsior", a survey on Italian firms occupational needs. This information have been merged with the balance sheet individual data of the same sample of firms. The dataset so built allow then to look for eventual relations between demand of occupations and some firms characteristics (like vertical integration, tangible and intangible assets equipment, productivity)

*

Acknowledgments. This work continues a study on the demand of professions started with Bruno Contini and Giovanna Garrone. A preliminary analysis based on the same data (whose source is the "Analisi Excelsior") has been published in Contini, Garrone and Novarese (2000). A previous version of the present paper was presented at the Conference "Understanding Skills Obsolescence, Theoretical Innovations and Empirical Applications", ROA/SKOPE, Maastricht, May, 11-12, 2001.

* Centre for Cognitive Economics - Università del Piemonte Orientale, Alessandria - Italy
e-mail: marco@novarese.org - http://www.novarese.org

Contents

1. Introduction

This paper aims at analysing the possible determinants of firm's demand of occupations. Even if traditionally neglected within economics literature, this issue can, in fact, be very useful for Economics, as this paper shows.
Firm's demand of occupational profiles is studied here at both theoretical and empirical level.
Theoretical analysis is directed to present general determinants of firms' demand of jobs with a particular attention to find a link with the different theories of the firm. A detailed analysis would be necessary for any of the proposed approaches, but some elements of interest already emerge, even with this preliminary study.
The traditional neoclassical theory presents firm as a black box. Different occupations can be, at more, seen as different inputs of the production function. Other models - like Stigler's, or the new institutional's, or Pavitt's ones - put, on the contrary, into evidence different aspects of firms behavior and organization, and so, indirectly, suggest also something about their occupational needs.
Firms demand different occupations because they should accomplish different productive tasks, but also because of the need of organising and monitoring internal workers and market transaction. From another perspective the need of different occupations is related also to the necessity of different skills and capabilities.
Then the demand of occupations depend on to what a firm does and how it does it, and so is linked to aspects like level of vertical integrations, hierarchical structure, industrial relations, strategies and organization …

The empirical analysis is based on a dataset built using data from the 1996 "Analisi Excelsior", a survey on Italian firms occupational needs. This information have been merged with the balance sheet individual data of the same sample of firms. The dataset so built allow then looking for eventual relations between demand of occupations and some firms' characteristics (pictured by balance ratio).
As suggested by some preliminary findings, a cluster analysis as been performed on the data, aiming at discovering the existence of eventual typologies of firms in relation to their occupational needs.
This study doesn't aims then at testing a model, but propose a descriptive analysis. Its interest depend on the almost totally lack of similar works. It's seems then useful to discover if there is an empirical link between occupations demand (expressed by firms in a survey aimed at helping to plan educational activities) and firms characteristic. As similar survey are performed in other countries and more statistical information on occupation have been recently made available, this preliminary investigation can have a more general usefulness.

The *demand of occupations* is used here as an analytical concept, independently from the fact that firms use or not it in their practices of workers recruiting. Their planning and search could, in fact, be based on other categories, like skills or educational attainment, as discussed in another paper, where the concept of occupations is also analysed in detail, in relation to its usefulness for Economics (Novarese 2002).

The relation between occupations and firms' strategies can be seen in both directions. Here the attention is focused on the influence of firm's characteristics on demand of occupations (empirical data doesn't allow us to know the stock of occupations but their expected flow).

The paper is organized in this way. After some general reflections on the demand of occupations, the attention is pointed on the link between firms' need of jobs and their level of vertical integration. Stigler's model, Coase/Williamson approach and concepts like firm's functions, transaction costs, and monitoring cost are recalled here. A different vision of the firms is then proposed describing Pavitt's analysis of corporate's knowledge. The section ends with a brief review of the literature on innovation and skills demands and with some related indications for the issue under exam. The second part of the paper starts with a description of the data. Then the results of the cluster analysis are proposed, showing the link between firm's occupational needs and their characteristics.
Conclusions follow stressing the relevance of occupations in the analysis of firm.
Appendixes present in detail some elements of the empirical work.

2. Demand of occupations and the literature on the firm

Firm's occupational structure depends obviously on what it does and hot it does it. The need for occupations is then related to the extension of the division of labour, internal and external to the firm, but also to its organization. So it's linked to factors like firm's strategy and technology and to its level of vertical and horizontal integration.

Firm's need of occupations has both a static (the stock of job in a given moments) and a dynamic connotation. If firm is in a steady state, its demand of new workers will be a product of his structure and of the rate of turnover.
The eventual entrance of new workers depends, on the other side, also on possible processes of change and/or growth.
In both cases demand can be internal (when and whether it's possible, useful and/or necessary to change the specialization of internal workers[1]) or external. In this last case new employees are engaged (at the same time, there could be workers exiting the firm). The attention is here devoted mainly to the entry of new workers.

An important aspect of firm's evolution is related to processes of growth. Changes of firm's dimension have different effects on the need for jobs. A bigger firm generally requires occupations otherwise not necessary, because of organizational reasons or sometimes even because of legislative duties. In very small firms there is generally a low division of labour and few people doing different tasks. As the firm grows, it's necessary a division of the labour and some workers became specialized[2]. Firm can yet buy some services on the market. As a starting point, it's then necessary to take into account its level of vertical integration.

2.1 Level of integration and hierarchies

The level of integration determines all tasks a firm accomplishes internally.
There is a wide literature on this issue but almost no explicit references to occupations[3].

Stigler (1951) proposes a model in which the firm is presented as a series of complementary but different functions (like design, purchase, production …). All of them are necessary but independent. It's then possible (to reduce costs and/or to increase flexibility to face uncertainty) to break up some of them and acquire the related service or product on the market. The level of vertical integration results in this way, as a product of technology, costs, markets dimensions and uncertainty.

---

1 This is possible only in certain cases. Some workes could, in fact, hardly be converted to new jobs. Generally firms prefer then hiring new persons for new jobs.
2 It's the same process described by Adam Smith at a social level.
3 The choiche to *make or buy* influences also the demand for self-employed workers, another kind of occupation.

Different functions raise then the need for different occupations (even if there isn't always a given relation between a function and an occupations). The choice to outsource part of the production process, determine, for example, a reduced need of blue collars and/or technicians.

Coase (1937) and Williamson's (1975) approach aims at studying the boundary of the firm in relation to the market. A central idea is that of "transaction cost", defined as the "cost for the use of the market", and related to bounded rationality, imperfect knowledge and agents' opportunism.
This costs determines firm's dimension and its relation with the market and with other agents. Firm choose, in fact, to internalise or not a given function with the aim of reducing transaction costs. Different institutional and technological conditions change transaction cost and then also firm's boundaries. All these factors then determine firm's need of workers.
These models suggest also that firm should have workers devoted both to manage external transactions (managing agreements and contracts) and internal organization (for example, looking after opportunism and shirking). Both tasks require different kinds of (administrative and organisational) specialists.
Another important aspect of this theory is the idea that hierarchies take the place of market's spontaneous coordination. Firms need then different hierarchical positions aimed at monitoring workers and avoiding shirking and free riding. Monitoring requires, in fact, that workers share a common knowledge[4].
Even a firm engaged in one production task should then have a minimal occupational structure because of organizational and control needs.

Both Stigler and Coase/Williamson, with a different approach, stress the evidence the relevance of technologies and environment on the boundaries of the firm (and, indirectly suggest basic factors able to influence the demand of occupations). In these views, the characteristics of a firm will be determined mainly by external and general factors, like industrial sectors, technological development, market dimension, institutional factors[5] and, firm's dimension.
These results requires yet different extensions. From one side, the level of vertical integration is, in fact, not the only factor affecting firm's need of jobs. Its internal organization matter too. Aoki (1986) paint two models of firm, showing the importance of internal division of labour. In his view, strong hierarchical levels, rigidly defined jobs and division of the labor characterize American firms. In the Japanese model of firm, there is less specialization, jobs are more homogeneous and hierarchical levels are weaker. Occupations (as well defined jobs description, specified in collective agreement) play, obviously, a major role in the American model.
As we'll see better later, a part from cultural reasons, hierarchies and division of labour are also a product of technological and organizational choices. In other words and more generally, firm's characteristics are not only determined by its environment.

2.2 Knowledge, technology and innovation

Firms are, in fact, in large part, heterogeneous agents, whose features are determined by managerial or entrepreneurial, discretional choices (Contini and Revelli, 1992; Davis and Haltiwanger, 1989). The same dimension and level of vertical integration are, in fact, important strategic choices and can then differ among firms, given technology and market conditions. A firm can or cannot internalise or externalise a given function in relation to its strategies, and not only because of given technological or market constraints. Even transaction and monitoring costs could be influenced by managerial practices (Novarese, 2000).

The idea of agent's heterogeneity is proper of another wide approach of analysis, stressing the role of firm's specific organizational knowledge, stored in routines.
It's not possible to analyse in detail here this stream of study. The works proposed by Pavitt (1998), part of this stream of research, allows, yet, some considerations on occupations demand and enable to put into evidence another features associate with occupations: skills.

---

[4] Then a blue collar cannot be monitored by a supervisor completely unaware of the firms' particular "production function" (Alchian e Demtsetz, 1972).

[5] The term "institution" is used here with a wide meaning, as formal and informal norms and custom that tend to create homogenity between the social actors.
Between institutions there are legal norms, like collective agreement that defines some occupations and the task they should do (and that the should not do).

He identifies two components in big corporate's knowledge: a *body of understanding* and a *body of practice*. The first one is the specific technological knowledge in the various areas in which firm publish and patent. It's then a sort of theoretical knowledge and it's located mainly in its R&D department (but maybe also in other individual departments). The *body of practice* is the practical knowledge, developed trough experimentation and experience. It involves all departments together and then requires collaboration, exchange of information and coordination.
The *body of understanding* is related to the general knowledge of the workers and then also to their occupations. A firm composed mainly by chemicals probably has a different theoretical knowledge than a firm with a high number of administrative clericals.
The *body of practice* should be developed together by the workers of a specific organization and has a more localized nature. Even this kind of knowledge could be influenced by firm's occupational composition. In fact, for example, the occupational structure can influences firm's organization and the way workers interact and communicate. In other words, as the firm is seen here as knowledge, workers' occupations is an important aspect of this knowledge [6].
In the same paper, following Chandler (1991), Pavitt distinguishes two functions of corporate control: "the *entrepreneurial* function of planning for the future health and growth of the enterprise, and the *administrative* function of controlling the operation of its many division" (*ibidem*, p. 445). These two functions require different kinds of occupational profiles. The administrative function, in fact, "is normally exercised through systems of financial reporting and controls" while the entrepreneurial function "is the capacity to recognize and exploit technology-based opportunities" and requires "an ability to evaluate projects and programmes where the normal financial accounting techniques are often inoperable and inappropriate"[7].

An important effect in differentiating firms is played by technological innovations.
Literature deserves a strong attention to the relations between technological innovations and skills demand. Generally, also in this area of research, there is yet no direct attention to occupations.

The idea that technological change tends to stimulate the demand for more skilled workers originates from the work of Arrow (1962) and Nelson and Phelps (1966). More educated and qualified workers are thought to be faster to learn how to use new technologies[8]. Recently, many studies focused on the relationship between Information Technology (IT) and skills demand (see for example Antonelli, 1995). Bresnahan, Brynjolfsson and Hitt (1999) propose a very detailed empirical study at firm level. IT reduces the need for workers to be assigned to repetitive tasks (as computer have been successfully in routine and repetitive duties), but it makes possible wider changes either. It makes it easier, in fact, to accumulate data and information. New opportunities are then offered to the firms. Their exploitation requires "exceptionally talented" workers, autonomous and equipped with management abilities.
To enable the full exploitation of these opportunities, organizational changes (see also Caroli and Van Reenen, 1999; and Colecchia and Papaconstantinou, 1996, p.12) and new human resources practices (Laursen e Foss, 2001) are also required.
Workers with such skills, beyond enabling the implementation of the innovations introduced within the firm, are also necessary to stimulate a process of "creative destruction" and of continuous change. This aspect is evidenced by Thesmas and Thoenig (2000). They connect organizational adaptability and flexibility to technological innovation, workers' skills and market volatility. The organization should face a trade-off between efficiency and adaptability. Efficiency requires specialisation, division of labour, well-defined hierarchies but, in this way, the scope for changes is reduced. Empirically they found that "firms that experience more product turnover or that innovate more tend to have a smaller share of production workers. At the macroeconomic level, we witness a massive shift from unskilled labour-intensive functions like production to skill-intensive ones like R&D, Marketing, and Sales Related Activities" (*ibidem*, p. 1231)

---

[6] Even if firms' specific characteristics tend to reduce the significance of general skills and also of occupations as general concepts because of the stress on localized nature of knowledge and capabilities (Dosi and Egidi, 1991). There is yet a two way action between workers and firm's knoweldge.

7 Using the distinction posed by Knight it's possible to say that enterprenuer should be able to manage *uncertainty* as a distinct idea from *risk*.

8 More recent contibution on this issue are proposed, for example, by Colecchia and Papaconstantinou (1996) and Wolff (1996).

These studies put also in evidence the strong complementarities between worker's skills and firm's capital equipment. Technologies require well-defined skills to become effective.
Innovative firms should then demand:
- more qualified occupations for each function (for example technicians and not blue collars for productive task),
- less workers devoted to productive activities,
- less workers devoted to "monitoring" and "governance" and to the *administrative function* (as there should be less need for them and a more homogeneous structure; besides, there should then be less differences in the formal hierarchical levels);
- more occupations devoted to offer (internal or external) services and to perform the *entrepreneurial function*.
In general terms, than, probably, innovative firms should have more high-level technicians, more commercials and less administrative workers. Innovation is, in fact, not only linked to researchers but require a general structure able to support it.
These results are indirectly confirmed by Aguirregabiria and Alonso-Borrego (2001). Using individual data on Spanish firms in the years 1986-1991, they observe that innovative organisation tend to create commercials jobs and to destroy clericals jobs, while non-innovative firms tend to do the contrary[9]. They also observe that "the reorganization in the production schedule after the introduction of technological capital have exerted an important reduction in the demand for blue collars and a rise in the demand for commercials" (p. 66).

3. Empirical analysis

3.1. The data

The source of the data used for the empirical study is the “Analisi Excelsior” realized in Italy at the beginning of the year 1997.
The "Analisi Excelsior" is a periodical survey on a statistically significant sample of Italian firms, aimed at collecting information on their expected demand of occupations. This data are collected to help public decisors to plan well-fitted educational paths.

At the end of 1996, firms were asked how many workers they were going to engage during 1997 and 1998. They were also asked which kind of occupations they were going to hire and some characteristics of the workers required (e.g. computer skills, experience …)
The major limit of the survey is that we don't know how many workers firms have then later actually engaged. We have just the required number of new workers. It's then possible that firms won't really hire all declared workers (may be because they couldn't find them)[10]. We'll come back later on this aspects.

The stock of different occupations at the time of the survey is also not requested. So we know which occupations are going to enter the firm, but we don't know which are inside it. Nevertheless we know the stock of blue collars, white collars and managers. That is an important information because enable to verify, at least indirectly, if firms are changing their occupational structure.

The dataset here available contains a sub-sample of 446 firms of different dimensions that declared to hire at least one worker in the period under exam. The firms in the sample operate within different industrial sectors (see table 6 and 7 later for details on dimensional and industrial distributions). The industrial composition is not representative of the whole population of Italian firms. Besides, firm with more than 500 employees are over-represented, while very small ones are under-represented.

These data have been merged to a few items extracted by the balance sheet (years 1994-1996) of the same firms[11]. The dataset built allow then to link demand of occupations with some corporate ratios (that will be used as proxy for firms' strategies and behaviors).

---

9 They use am occupational disaggregation thant doesn't comprise technicians.
10 At an aggregate level, the data of the "Indagine Excelsior" have, yet, permitted a very accurate forecasting of employment growth (Martini, 1999).
11 The source of accounts data is Infocamere.

In the original data set, jobs are listed in a very disaggregated classification. Yet, in order to make the analysis possible (as our sample is relatively small), they have been joined in main categories.
Five groups were so built, according to a functional approach: managers; technicians (this groups contains such jobs as engineers, chemicals, biologist …); administrative clericals (all administrative and organisational jobs); commercials (sales, marketing, public relations, Economics studies, advertisement …); blue collars. Appendix 1 describes in detail how groups were built and the problems faced.

3.2. Number of different occupations hired by firms in the sample

Table 1 reports data on the total hiring for each occupation and on the number of firms that, in our sample, hire at least one of them.
Each occupation is required by a relatively small number of firms. Blue collars are the most demanded jobs.

Table 1. Number of firms that hire each occupation and number of hiring by occupation in the sample

occupational groups	total number of workers required	firms that hire at least one worker (1)	firms that don't require the job (2)
managers	99	37	409
technicians	1405	155	291
clericals	467	114	332
commercials	665	94	352
blue collars	5121	341	105

(1)+(2)=446

Table 2 shows the distribution of the number of different occupations hired by the 446 firms in the sample.

Table 2. Distribution of the numbers of different occupations hired by firms

different occupations	number of firms
1	252
2	117
3	58
4	14
5	5
total	446

Most of the firms hire just one or two occupations. These finding obviously depend on the classification and on the period under exam (short, but not too much: two years), but are not at all obvious (even because the mean share of new workers on the stock of employees is not low, equal at about 12% between all firms, as shown in table 3). The five occupational profiles are, besides, aggregated but very differentiated among them.

Table 3. Workers entering firms (on total occupation) by firm's size

firm's dimension (workers)	required workers on total occupation
<10	0.46
10-50	0.14
50-249	0.8
>250	0.7
total	0.12

These tables suggest an interesting direction for the further steps of the analysis. It seems interesting, in fact, to verify if firms hiring just one kind of occupation, concentrate their demand on some peculiar profiles (for example blue collars) or not. Another central point to study is related to the eventual existence of complementarities among hiring of different profiles.

3.3. Cluster analysis

A clusters analysis procedure seems the best way to answer previous questions[12].
The variables used to build clusters are the demand of each occupations[13] and the ratio between the stock of blue collars and the total employment. The stock is necessary to evaluate if firms are changing their occupational structure.

A detailed analysis of the clustering procedure is proposed in the appendix 2. In this section only the final results are proposed. What seems relevant it's, in fact, the existence of different groups of firms, whatever they have been built.
Clustering as been realized with the aim of answering some well-defined questions. Following tables allow giving these answers.

Table 4 reports the mean demand of each occupations and the mean stock of blue collars, for each of the nine clusters (they are numbered from 1 to 4 and from 6 to 10, see the appendix 2).

Single clusters will be analysed in the next paragraph. Here the attention is posed on the general results emerging.
The first aspects to note it's than that clusters with significantly different demand of occupations can be built. Within each clusters there is a strong homogeneity among firms.
An exercise of analysis of the variance confirms that groups are significantly different in regards to the variables taken into account.

Table 5 show the distribution of the number of different occupations hired by firm in different clusters.

Table 4 and 5 confirm the hypothesis that the demand of jobs is specialized. A part form cluster 3 (where almost all firms hire both technicians and blue collars), all other groups are composed by firms requiring practically just one kind of occupations. The demand for other profiles is, in fact, very low.
If firms are just managing turnover, this results mirrors a specialised stock (as the period under exam is short, only hiring of predominant jobs can be observed). Another explanation, partially superimposed on the other, is related to the nature of these data. It could be possible that answering a survey, firms tend to declare just the job they are more interested in. It's, yet, also possible that, in a given moment, firms concentrate their attention only on one profile (and may be their investment are similarly "bounded" to some specific problems or expectations).
These results could then have different implications in relation to the analysis of firm's behavior.

[12] Other statistical devices can be less useful because of the features of this data. For example, a correlation matrix between the demand for the different occupations would be unusless, because of different firms' dimension (that will cause positive relations). The ratio of workers demand for each job on the total demand would drive to an obvious negative correlation. A regression analisys on the demand of each occupation with least squares can have also many problems, because of the low variance of the dependent variable.
13 In order to face the problem connected with different firms' dimensions, we'll consider the ratio between the number of workers required for each jobs and the total number of employees required.

Table 5. Distribution of the number of different occupations hired, by clusters

	1	2	3	4	6	7	8	9	10	total
1	6	4	3	7	18	172	16	14	12	252
2	7	3	43	5	5	32	19		3	117
3	2	3	32		1	16	3		1	58
4			9			4	1			14
5			4			1				5
total	15	10	91	12	24	225	39	14	16	446

Table 6. Distribution of firms by number of employees, by clusters

	1	2	3	4	6	7	8	9	10	total
<10	0	1	2	0	4	11	1	4	4	27
10-50	2	1	8	2	3	73	9	4	3	105
50-249	6	6	51	8	11	97	17	5	8	209
>250	7	2	30	2	6	44	12	1	1	105
tot	15	10	91	12	24	225	39	14	16	

Table 7. Distribution of firms by industrial sectors and clusters

	1	2	3	4	6	7	8	9	10	tot
food and drinks		1	6	2		15			2	26
textile and clothing		2	7	3		28	6		2	48
leather and leather products						1				1
wood and furnishing						8			1	9
paper, paper products printing and publishing						2				2
chemical and artificial fibres	3	2	11	1		4	4			25
rubber and plastic	1		2			15	1			19
non metal products		2	6	2		17			2	29
metals and metal products			9	2	2	34	3		2	52
machinery and mechanical equipment	3	1	26			42	13		2	87
electronics and electrical	5		10		7	14	1		1	38
energy oil and gas			2			1	1			4
construction and infrastructure			6		1	16	7		3	33
transport and logistic	1	2	5	1	2	13		6		30
estate agency						1				1
communication and information technology	2				6		3	2		13
professional and consultancy services					6	12		6		24
social, public and personal services			1	1		2			1	5
total	15	10	91	12	24	225	39	14	16	446

Table 6 and 7 present clusters' compositions in term of dimension and industrial sectors. Almost all clusters are composed by firms with different dimensions and operating in various industrial sectors[14]. Than differences in the demand of occupations cannot be attributed to different dimensional or industrial composition.

[14] While only services firms compose cluster 9, clusters 4, 5, and 10 contain almost only manufacturers firms. But there are no other major composition effects.

The availability of balance data, allow, at this point, to verify if there is a link, and eventually what, between demand of occupations and firm's strategies and behavior[15].

Table 8 compares many corporate ratios among clusters. Most of them show significant differences and let suppose that differences in the demand of occupations are related to different strategies and behaviors among firms. Clusters' general characteristics are synthesized in Box 1.

Table 8. Balance ratio by clusters, mean values

	1	**2**	**3**	**4**	**6**	**7**	**8**	**9**	**10**	**total**	**p-value F test ANOVA**
stock of managers / total workers	0.06	0.02	*0.02*	0.02	0.04	0.01	0.02	0.04	0.04	0.02	0.18
stock of white collars / total workers	**0.87**	0.41	*0.35*	0.31	**0.92**	**0.19**	0.33	**0.82**	**0.49**	0.33	0.00
managers: (total hiring - total exit)/ stock	0.03	0.00	*0.01*	0.03	0.06	-0.05	-0.05	0.02	-0.00	-0.02	0.63
white collars: (total hiring - total exit)/ stock	0.04	0.06	*0.04*	**0.16**	**0.11**	0.01	0.05	**0.13**	0.07	0.04	0.00
blue collars: (total hiring - total exit)/ stock	-0.03	-0.01	*0.03*	-0.03	-0.00	**0.08**	**-0.04**	0.00	0.03	0.05	0.00
(total hiring - total exit) / total occupation	0.04	0.03	*0.03*	-0.01	**0.10**	**0.06**	**-0.01**	**0.12**	0.07	0.05	0.00
new workers* / total hiring	0.03	0.02	*0.03*	0.03	0.01	0.04	0.02	**0.10**	0.03	0.04	0.10
tangible assets / workers	0.07	**0.54**	*0.10*	0.14	0.04	0.12	0.07	**0.27**	0.10	0.12	0.00
total assets / sales	0.17	**1.62**	*0.33*	0.99	0.30	0.53	0.31	**1.34**	0.37	0.50	0.06
intangible assets / total assets	**0.17**	0.07	*0.10*	0.10	**0.22**	**0.06**	0.10	0.13	0.13	0.09	0.00
added value / sales	**0.42**	**0.73**	*0.62*	0.55	**0.83**	0.60	0.61	**0.94**	0.60	0.62	0.00
sales per employees	**0.77**	0.31	*0.33*	**0.51**	0.26	0.34	0.28	0.25	0.46	0.32	0.00
productivity per employees	**0.28**	0.20	*0.19*	0.25	0.18	**0.15**	0.16	0.24	**0.26**	0.17	0.00
rate of growth of debts	1.00	1.22	*1.03*	1.18	**1.77**	1.04	1.07	**1.86**	1.13	1.11	0.00
profit on sales	-0.01	0.02	*0.01*	0.03	0.03	0.01	0.00	-0.01	-0.01	0.01	0.65

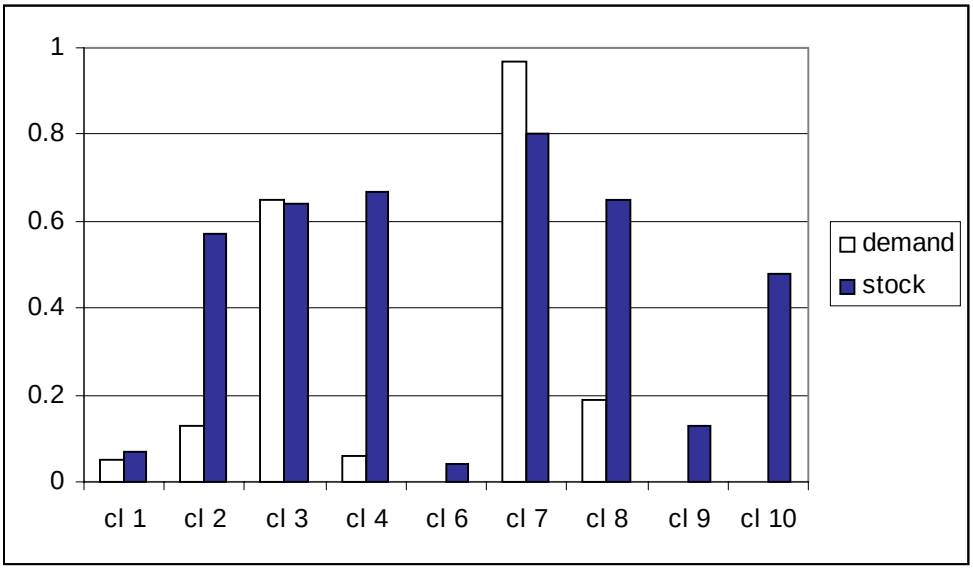
- A bold type shows values significantly different from cluster 3 (benchmark). Last column shows he P-value for ANOVA test F.
- Companies ratios are built as mean value in the years 1994-1996.
** firms are asked if the workers they plan to engage should replace other individuals exiting the firm. "New workers" are those who do not replace anyone.*
*** Hundred millions of Italian liras per employee*

3.4. Firms characteristics and demand of occupation

A first aspect can be observed (see Picture 1): some clusters engagements seem coherent with their occupational composition. Firms in clusters 3, and 7 demand, in fact, almost only the profile that composes the main ratio of their employees (blue collars). Firms in cluster 1 and 6 demand few blue collars and many white collars (respectively commercials and technicians), as in their stock. Then for some of these firms the specialization in the demand of occupations seems to mirror their stock.
On the contrary, other firms show differences between stock and needs. In cluster 4, firms have a high stock of blue collars but are demanding commercials (and then are increasing their stock of white collars). Similarly the ratios of blue collars required in clusters 2, 4, 8, and 10 are quite different from their respective stocks. A reasonable hypothesis is that these firms are undergoing (o planning) a period of change in their occupational composition.
The sample under exam is not representative of the whole population. Nevertheless, it should be observed that the main number of firms in the sample (cluster 7 but also 3) is demanding blue collars and seem not to be interested by processes of change (than this analysis confirms the scarce ratio of innovative firms in Italian industrial structure).

[15] The analysis of firm's strategies using balance data present many problems. This data allows only an indirect and biased foreshight of firm's characteristichs. Combining many indicators it's yet possible to have a significant indication.

Picture 1. Blue collars, stock on total employees and demand on total workers hired by cluster



Cluster 3, 7, and 8 are composed by firms whose main interest seems to be manufacturing and production. They hire mainly productive profiles (blue collars and technicians) to be employed in manufacturing tasks (see table A3 in Appendix 3 showing the micro-areas of destination of workers by clusters). Also firms in cluster 8 seem to perform mainly manufacturing activities, but they hire only technicians. It's possible that these two clusters perform a similar task with a different kind of structure (they have an equal mean level of added value on sales, and of sales per employees; cluster 7 has a lower productivity and a lower level of intangible assets).

Also firms in cluster 6 demand technicians but these workers should probably be employed in non-productive tasks, like design, research and development, information technology, and so on (see again table A3).
These firms have also the highest level of vertical integration. Probably they don't produce goods, but design and/or make research[16], or offer services to other firms (or maybe perform very high specialized productions). The stock of blue collars is, in fact, almost null even if some of these firms belongs to manufacturer industries.

Cluster 1 contains firms with an apparently stable structure. They have a low level of vertical integration[17], probably because of a large recourse to outsourcing for productive tasks. They have, in fact, a low stock of blue collars (and none of the workers will be assigned to manufacturing jobs; see table A3) and are planning to hire employees for marketing and sales. The high stock of intangible assets is probably due to the ownership of trademarks and to marketing expenses.
There is a strong negative correlation between the stock of blue collars and the ratio of intangible assets on total assets. Then, in different words, intangible assets are related to skilled workers.

Firms' productivity seems to be, a little unexpectedly, not too much influenced by differences in occupational demand. A high level of blue collars is yet related to the lowest value of productivity.

---

[16] Available data make it impossible to know directly the technological level or the existence of processes of innovation. The ratio of intangible assets can, yet, give an idea of the relevance of patents, or R&D sunk costs. This cluster show the highest value of this variable.
17 The level of vertical integration is usually proxied by the ratio between added value and sales (known as index of Adelman, see Adelman, 1955). The higher the value, the higher the level of integration. This index has, yet, many possible problems. See for example Caves and Bradburg (1988). The ratio between sales and employees is another possible indicator of the level of vertical integration. A low value is related to a high level of integration. The two indicators suggest in fact, here, similar results. Given the level of vertical integration, sales for employees could suggest also firm's market power.

These results could obviously be due to limitations of the data. It can be difficult to compare the productivity of firms performing different tasks (some of them are producing, other are doing research …).

The variables related to change (in the previous period 1994-1996) don't differ between clusters, a part from the rate of growth of debts (higher in cluster 4 and 6).
The more innovative firms are those with one the highest rate of growth of debt.
There are no differences in profits rates between clusters.

3.5. Clusters and industrial sectors

Table 10 show the results of two exercises of analysis of the variance. Column 1 shows the ratio between explained and residual variance (the value used to perform the F test) using clusters as independents variables. Column 2 shows a similar value computed using industrial sectors (as in table 8) as independent variables.
Clusters are far more able to explain the demand of occupations (that's results could be obvious as cluster are built on these variables) than industrial sectors, but have also a better performance in explaining almost all companies' ratios (all of them a part from *profit on sales*).

Table 9. F: Ratio between explained and residual variance (F value) in the demand of occupations using clusters and industrial sectors as dependent variables

	clusters	industrial sectors
managers (demand)	255.0	1.4
technicians (demand)	385.8	6.6
clericals (demand)	364.2	2.0
commercials (demand)	355.0	1.9
blue collars (demand)	717.1	5.3
blue collars - stock	104.1	10.2
tangible assets / workers	2.8	1.9
total assets / sales	3.7	1.8
intangible assets / total assets	4.2	3.9
added value / sales	10.8	9.8
sales per employees	5.9	3.8
productivity per employees	4.8	2.7
rate of growth of debts	3.9	0.8
profit on sales	0.7	1.1

4. Conclusions

Some interesting results have emerged in the empirical analysis.
Firms express highly specialized demand of occupations. Most of them demand, in fact, consistent ratio of just one kind of occupation. The only significant combination of hiring is that between technicians and blue collars.
It's possible that firms focus their attention (at least in the survey) only on the profiles they are more interested in, in a given moment. This idea is coherent with the hypothesis that firms have a very limited capacity of managing problems, focusing their attention only on one problem for time. Maybe in other periods some firms could then show very different occupational requirements. It would be interesting to analyse their demand in a longer period.
At least for some firms the specialized demand seems yet to be coherent with their occupational structure and with their general organization and strategies.
This idea confirms other results on Italian industrial organization. Arrighetti (1999) shows, for example, that, at a mean level, the tendency to the reduction of the level of integration, going on from the '70s, is still increasing at the end of '90s. Italian industries seem to be characterized by a network structure with a wide diffusion of groups (even between medium and small firms) and of other kinds of agreements and links between them. In these networks each firm tend to be specialized in a small number of tasks and of production phases. Design, finance, R&D are sometimes outsourced to specialized producers but also

centralized in some bigger firms, that manage them for all of the group (Traù, 1999; Gargiulo and Mariotti, 1999, Carone and Iacobucci, 1999; Guelpa, 1999).

Differences in the demand of occupations are then probably often related to different specialization in the productive stream (some firms produce, other do research, other sell products, other distribute them …). These differences are largely independent from industrial or dimensional aspects that seem empirically less relevant.
Some given tasks can, yet, probably be performed with different structures. Some firms probably produce good using mainly blue collars; other produce using both blue collars and technicians. Then a part from specialization, also organization and strategies are important aspects to analyse.
Even if cluster analysis presented is not representative of the whole population, a clear result then emerges: there is a wide heterogeneity in firms' behavior and in their related demand of occupations.
The idea of representative firm is so questioned.

Another important general finding is that the demand of occupations (in particular, the data of the "Analisi Excelsior") can be significantly related to companies ratios that reflect firms' characteristics and strategies.
One of the more important variable related to the demand of occupations is the ratio of added value on sales (taken as a measure of vertical integration).
Firms making a large use of outsourcing require commercials figures (and make consistent investment in trade marks and other kind of marketing expenses). A high level of vertical integration is connected to specialization in activities like research and development, design, and probably also in niche productions, and to the demand of high qualified technicians.
Intangible assets seem to have a strong relevance on the demand of white collars (technicians and commercials, but not administrative clericals). This variable indirectly gives also information on firm's innovative and technological attitude. A firm characterized by a higher technological level, or by a stronger attention to quality or to product differentiation, should, in fact, have a higher rate of such variable[18].

Some of the aspects put into evidence by this study are not only strictly relate to occupations demand but have a wider nature. That's depend on the general applicability of the idea of occupations that can, in fact, give a significant help to analyse, empirically or theoretically, firm's behavior, characteristics, and knowledge.

18 This issue contains surely many differents assets, more or less, related. As we have seen, other indicators suggests its possible contents. For example the high level of intangible assets for firms in cluster 1 is due to trade marks, marketing investments and so on. Firms in cluster 6 have, on the contrary, more patens and expenses in research and development.

Appendix 1: The occupational groups

Firms were asked different questions: (1) "how many blue collars/white collars/managers are going to hire?"; (2) "how many blue collars/white collars/managers have you employed at this moment?"; (3) "how many workers for occupations X are you going to hire in the next two years?".
Question (1) and (2) refer to the kind of contractual agreement for workers. Question (3) refers to the occupation defined according to a standard occupational classification.
For a very small number of occupations it's necessary to be careful when building occupational profiles. For example the job classified as 7.1.0.0 (*plant machinery responsible*) is sometimes hired as blue-collars and sometimes as white-collars. In the Istat classification they are treated as blue-collars.
Than, the problem is that different firms happen to consider a same occupations in different kind of agreements.
For some firms that's means that it's possible to calculate two value for, say, the number of blue collars hired. The first is that directly used in the survey and the second is the one reconstructed taking into account the single disaggregated occupations.
I decided to assign the occupations in exam to the profiles that minimize the global differences between the two values.
The mean error between the two indicators of total blue collars hired is equal to 0.004 than globally very small (it's then like a kind of error of measure) and then not too relevant.
Table A1 shows how each occupational profile was finally built.

Table A1. Composition of the occupational profiles

occupational groups	Istat91 codes
managers	from 1.2.0.0 to 1.2.0.9
Technicians	2.1.1, 2.2.1, 2.3.1, 3.1.1, 3.1.2, 3.2.2, 3.4.4, 7.1.0.0, 3.1.2.0, 3.1.2.2, 3.1.2.3, 3.1.2.4, 3.1.2.5, 3.1.2.6, 3.1.2.7, 3.1.2.8
Administrators	2.5.1.2, 2.5.1.1, 2.5.1.3, 2.5.1.6, 2.5.1.7, 2.5.1.9, 3.3.1.4, 3.3.1.9, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.5, 3.3.1.6, 5.5.3.6, from 2.5.2.1 to 2.5.2.9, from 3.3.2.1 to 3.3.2.9, from 4.1.1.1 to 4.1.3.0, from 4.1.3.2 to 4.2.1.9, from 5.2.2.9 to 5.3.4.1, from 5.5.1.1 to 5.5.1.2
sales and marketing	2.5.1.4, 2.5.1.5, 3.3.1.7, 5.3.4.2, from 2.5.3.1 to 2.5.3.9, from 2.5.4.1 to 2.5.4.9, from 2.5.5.1 to 2.5.5.9, from 2.5.6.1 to 2.5.6.9, from 3.3.3.1 to 3.3.3.9, from 3.3.4.1 to 3.3.4.9, from 3.4.1.1 to 3.4.1.9, from 4.2.2.1 to 5.2.2.2
blue collars	4.1.3.1, 3.1.2.1, 3.1.2.9, 5.2.2.3, 5.2.2.4, 5.4.1.0, from 5.5.4.1 to 6.5.3.9, from 7.1.1.1 to 7.4.4.9, from 8.1.0.0 to 8.6.3.9, from 5.5.2.1 to 5.5.3.3

This way some information about the hierarchical level of the workers is necessarily lost (as differences related to educational level are also partially lost).
Any further desegregation of the data should start from this king of functional classification.

Appendix 2: Cluster Analysis

Table 3 present the results of a cluster analysis realized using the *nearest centroid* algorithm. This algorithm was inspired by Hartigan (1975) and MacQueen (1967) and it's performed by SAS System's Proc Fastclus[19]. It produces disjoint clusters and it's useful for large dataset.

As said, the variables used to build clusters are the demand of each occupations and the ratio between the stock of blue collars and the total employment.

Table 3 reports the mean demand of each occupations and the mean stock of blue collars, by the 8 clusters found.
Pseudo-F Statistic, suggested by Calinski and Harabasz (1974), shows a very high value (equal to 319). The R-squared for predicting the variable from the cluster is also high (0.84). A standard procedure of analysis of the variance also shows significant differences between clusters.

Table A2.1. Cluster analysis, first step

occupational groups	1	2	*3*	4	5	6	7	8	p- value
1. managers (demand)	0.01	**0.70**	*0.02*	0.00	0.00	0.00	0.00	0.01	0.00
2. technicians (demand)	0.11	**0.04**	*0.14*	**0.00**	**0.03**	**0.95**	**0.01**	**0.73**	0.00
3. clericals (demand)	**0.03**	0.08	*0.11*	0.09	**0.96**	**0.02**	**0.01**	**0.04**	0.00
4. commercials (demand)	**0.81**	0.05	*0.08*	**0.85**	**0.00**	**0.04**	**0.01**	**0.03**	0.00
5. blue collars (demand)	**0.05**	**0.13**	*0.65*	**0.06**	**0.01**	**0.00**	**0.97**	**0.19**	0.00
6. blue collars - stock	**0.07**	0.57	*0.64*	0.67	**0.31**	**0.04**	**0.80**	0.65	0.00
N	15	10	*91*	12	30	24	225	39	

The demand of each profession is determined as a share of total hiring. Then, for each cluster, the sum of the ratio in line 1-5 is equal to 1. The stock of blue collars is taken as a percentage on total occupation.
A bold type shows values significantly different from cluster 3 (benchmark) with a standard procedure of analysis of the variance.

As known, there are many different kind of clustering algorithms and, in certain cases, they could produce very different results even with the same data.
There is no particular, *a priori*, reason for choosing this procedure, instead of others. In fact, also other algorithms were tried. This one seems able to produce the more interesting and useful results; yet with other algorithms results aren't generally much different.
Our aim is that of finding eventual significant groups of firms hiring similar combination of occupations in respect to their ratio of blue collars. We want also to see, for example, if blue collars and technicians are hired together or not, if firms with a high stock of blue collars hire also workers for other jobs, and so on … Then cluster analysis is just a way to get this information. No particular meaning should be given to the procedure used.

Clusters algorithms produce always many groups. The problem is if they really differ between them, what they represent, and what's their economic significance.
A first problem to take into account is related to the way groups are built. We know that many firms hire just once occupation. Imagine, for example the firms exemplified in table 4 (that take into account a simplified situation with few occupational profiles). Firm A hire 70% of blue collars and 30% of technicians; firm B hire 70% of blue collars and 30% of clericals and so on.
These firms could be clustered in different ways. Probably there is no doubt that A and D should be joined (as they hire similar ratio of the same jobs). But should we also join A and B (because they have similar ratio of blue collars) or A and C (because they demand the two same kind of profile)?
Different clusters algorithm can differ in the way they join these observations. Some firms would be grouped together by any procedures, while others no.
The proposed procedure tends to build clusters composed by firms that hire similar combinations of occupation but with not too big differences in their percentages. So, for example A, C and D would be joined.

19 See Sas User's Manual (Chapter 27).

Table A2.2. An example of clustering

firm	blue collars	technicians	clericals
A	0.7	0.3	0.0
B	0.7	0.0	0.3
C	0.5	0.5	0.0
D	0.8	0.2	0.0

The choice to define 8 groups depends on many reasons. It's the number of clusters that produce the most significant results using the statistical tests proposed by the software. With a lower number of clusters, not homogeneous groups are created. With more than 8 clusters, small groups of outliers are build. They could be interesting and useful, but would be too small to be studied here.
A further, *ad hoc*, division seems yet necessary to get more similar groups. Table 4, in text, show the new situations, in which cluster 5 was divided into cluster 9 and 10.
Both firms in clusters 9 and 10 require only administrative clericals. They have yet different stock of blue collars. These differences are due to their different industrial sectors. Cluster 9 is composed by firms operating in services, while cluster 10 is composed by industrial firms.

Appendix 3. Table on the Micro-areas of destination of workers demanded by each cluster

Table A3. Micro-areas of destination of workers demanded by each cluster (column percentage)

		1	**2**	**3**	**4**	**6**	**7**	**8**	**9**	**10**	**tot**
11	Managment, coordinations and organisation	1.0	0.0	3.2	4.4	0.0	0.6	4.8	5.6	3.6	2.1
12	Human resources and training	1.0	4.6	0.6	0.0	0.0	0.2	1.0	0.0	0.0	0.5
13	Information technology and ced	0.0	4.6	1.6	0.0	11.5	0.6	5.8	0.0	3.6	2.0
14	R&D	3.1	4.6	1.6	0.0	0.0	0.6	1.0	0.0	3.6	1.3
15	Internal services	2.0	0.0	1.0	17.4	0.0	0.4	0.0	0.0	0.0	1.0
21	Administration, finance, book-keeping	4.1	4.6	7.0	4.4	3.3	5.3	4.8	61.1	50.0	7.4
22	Sales	36.7	13.6	10.6	39.1	8.2	4.7	4.8	0.0	14.3	10.3
23	Customer services	39.8	0.0	0.2	13.0	0.0	0.6	0.0	0.0	0.0	3.5
24	Marketing and communication	7.1	4.6	1.8	4.4	0.0	1.1	4.8	0.0	0.0	2.1
31	Manufacture	0.0	18.2	32.1	8.7	1.6	48.0	26.9	0.0	7.1	31.9
32	Assembling, installation …	0.0	18.2	6.4	0.0	0.0	9.2	12.5	0.0	3.6	7.0
33	Plant Maintenance	1.0	0.0	6.2	0.0	0.0	8.7	1.0	0.0	0.0	5.6
34	Quality	1.0	4.6	6.6	0.0	3.3	5.5	2.9	0.0	10.7	5.2
35	Logistics and wharehousing	0.0	4.6	3.8	0.0	0.0	3.6	1.0	5.6	0.0	2.9
36	Technical and scientific design	3.1	0.0	15.9	0.0	42.6	3.0	24.0	0.0	0.0	11.2
37	Commercials and touristic services	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	3.6	0.2
38-39	Technical assistance and services	0.0	0.0	0.0	0.0	18.0	0.4	2.9	0.0	0.0	1.2
40	Technical services and transpost	0.0	18.2	1.4	8.7	4.9	3.4	0.0	16.7	0.0	2.6
42	Consultancy services	0.0	0.0	0.0	0.0	6.6	3.8	1.9	11.1	0.0	2.0
	total	100	100	100	100	100	100	100	100	100	100

Box 1: The clusters

Cluster 3 (benchmark)
- These firms hire blue collars and technicians (some of them also clericals)
- Many ratios show a mean value between all clusters

Cluster 1
- These firms hire commercials
- The stock of blue collars is very low, while the stock of white collars is high
- The stock of intangible assets is one of the highest
- The level of vertical integration is very low

Cluster 2
- It's the smallest cluster, composed by firms which hire managers (and some of them also blue collars)
- The stock of blue collars is high
- The stock of tangible assets is the highest
- The level of vertical integration is also high

Cluster 4
- These firms hire commercials
- The stock of blue collars is relatively high
- The stock of white collars is increasing
- The level of vertical integration is low (but higher than in cluster 1)

Cluster 6
- These firms hire technicians
- The stock of blue collars is almost equal to zero
- The stock of white collars is the highest and is increasing
- Global occupation is growing
- The stock of intangible assets is the highest
- The level of vertical integration is very high
- The stock of tangible assets is very low

Cluster 7
- These firms hire blue collars
- The stock of blue collars is the highest, while that of white collars is the lowest
- Occupation is growing, because of the grow of blue collars
- The stock of intangible assets is the lowest
- The productivity is the lowest

Cluster 8
- These firms hire technicians (and many of them also blue collars)
- The stock of blue collars is relatively high but decreasing

Cluster 9
- These firms hire administrative clericals
- The stock of blue collars is almost null
- All firms operates in services sectors (mainly logistic)

Cluster 10
- These firms hire administrative clericals
- The stock of blue collars is relatively high
- The productivity is very high

References

- Adelman M.A. (1955), *Concept and Statistical Measurement of Vertical Integration in National Bureau of Economic Research Business Concentration and Price Policy*, Princeton, New York
- Aguirregabiria V. and Alonso-Borregi C. (2001), Occupational structure, technological innovation, and reorganization of production, *Labour Economics*, 8, pp. 43-73
- Alchian A.A and Demsetz H (1972), Production, Information Costs, and Economic Organizations, *The American Economic Review*, 62, p. 777-795
- Antonelli C. (1995), The diffusion of new information technology and productivity growth, *Journal of Evolutionary Economics*, 5, pp. 1-17
- Aoki M. (1986), Horizontal vs. Vertical Information Structure of the Firm, *The American Economic Review*, Volume 76, Issue 5 (Dec.), pp. 971-983
- Arrighetti A. (1999), "Integrazione verticale in Italia e in Europa: tendenze e ipotesi interpretative", in Traù F. (ed) *La questione dimensionale nell'industria italiana*, Bologna, Il Mulino
- Arrow K. (1962), The Economic Implications of Learning by doing, *Review of Economic Studies*, Vol. 29, N. 2, pp. 155-173
- Bresnahan T.F., Brynjolfsson E., Hitt L.M. (1999), *Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence*, NBER working paper series, W.P. 7136, <http://www.nber.org/papers/w7136> (downloaded: November 1999)
- Calinski T and Harabasz J. (1974), *Cluster Analysis for Applications*, New York, New York Academic Press
- Caroli E. and Van Reenen J. (1999), *Organization, Skills and Technology: Evidence from a Panel of British and French Establishments*, The Institute for Fiscal Studies, Working Paper Series, W99/23
- Carone A and Iacobucci D. (1999), "I gruppi di piccole e medie imprese nell'industria italiana", in Traù F. (ed) *La questione dimensionale nell'industria italiana*, Bologna, Il Mulino
- Caves R.E, and Bradburd R.M. (1988), The Empirical Determinants of Vertical Integration, in *Journal of Economic Behavior and Organization*, vol. 9, n. 3, April
- Chandler A. (1991), The function of the HQ Unit in the Multibusiness Firm, in *Strategic Management Journal*, 12 pp. 31-50
- Coase R. (1937), The Nature of the Firm, *Economica*, n.s. IV, pp. 386-405
- Colecchia A. and Papaconstantinou (1996), *The Evolution of Skills in OECD Countries and the role of Technology*, STI working papers, 8, OECD, Paris
- Contini B. and Revelli R. (1992), *Imprese, occupazione e retribuzioni al microscopio*, Bologna, Il Mulino
- Contini B., Garrone G. and Novarese M. (2000), *Uno studio micro-econometrico sulla domanda di professioni*, Centro studi Unioncamere
- Davis S.J and Haltiwanger J. (1989), Gross Job Creation, Gross Job Desctruction and Employment Reallocation, NBER working paper, October
- Dosi G. and Egidi M. (1991), Substantive and Procedural Uncertainty. An exploration of Economic Behaviours in Complex and Changing Environments", Journal of Evolutionary Economics, 1, pp. 145-168
- Gargiulo T. and Mariotti S. (1999), "Natura e ruolo degli accordi di collaborazione tra piccole e medie imprese: un'indagine esplorativa nel settore legno-arredo", in Traù F. (ed) *La questione dimensionale nell'industria italiana*, Bologna, Il Mulino
- Guelpa F. (1999), Specializzazione per area funzionale e performance d'impresa, in Traù F. (ed) *La questione dimensionale nell'industria italiana*, Bologna, Il Mulino
- Hartigan J.A. (1975), *Clustering Algorithms*, New York, John Wiley & Sons
- Laursen K and Foss N.J. (2000), *New HRM Practices, Complementarities, and the Impact on Innovation Performance*, working paper 2000-5, Department of Industrial Economics and Strategy
- MacQueen J.B. (1967), "Some Methods for Classification and Analysis of Multivariate Observations", *Proceedings of the Fifth Berkeley Symposium on Mathematical Statics and Probability*, 1, pp. 281-297
- Martini M. (1999), *Quell'aumento imprevisto dell'occupazione*, Il sole24ore, January the 6th, n.5, p. 9
- Nelson R.R. and Phelps E.S. (1996), Investment in Humans, Technological Diffusion and Economic Growth, *The American Economic Review*, Vol. 61, N. 2, pp. 62-75
- Novarese M. (2001), Lealtà, organizzazioni e innovazione nella teoria eterodossa dell'impresa, paper presented to the "VI Convegno Aispe, Associazione Italiana per la Storia del pensiero economico", Università degli studi di Lecce, May 24–26
- Novarese M. (2002), Occupations: the possible discover of a neglected institution
- Pavitt (1998), Technologies, Products and Organization in the Innovating Firm: What Adam Smith Tell Us and Joseph Schumpeter Doesn't, *Industrial and Corporate Change*, 7, 3, pp. 433-452
- SAS/STAT, User's Guide, Version 8, Volumes 1, 2, and 3, Sas System
- Smith A (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, London, W. Strahan & T. Cadell
- Stigler G. (1951), *The Division of Labour is Limited by the Extent of the Market, in Journal of Political Economy*, June

- Thesmar D. and Thoenig M. (2000), Creative Destruction and Firm Organization Choice, *The Quarterly Journal of Economics*, November, pp. 1201-1237
- Traù F. (1999), "Fattore organizzativo e scala produttiva", in Traù F. (ed) *La questione dimensionale nell'industria italiana*, Bologna, Il Mulino
- Williamson O.E. (1975), *Markets and Hierarchies. Analysis and Anti-trust Implications*, New York, Free Press
- Wolff E.N. (1996), Technology and the demand for skills, *STI Review*, N. 18, OECD Paris