

# Technological Innovation in 21<sup>st</sup> Century Enterprises



INSTITUTO NACIONAL DE ESTADÍSTICA

D. Fernando Cortina García

D<sup>a</sup>. Belén González Olmos

**Subdirección General de Estadísticas  
de los Servicios**

Enero, 2008

---

## Introduction

Today, the innovation process is considered both as the main source of economic growth in countries with advanced economies, as well as being an important factor in social and cultural development. Throughout the years, innovation and technological changes have become more important matters for economic analysis and for taking decisions in developed countries. These are aspects for which there is a lack of available information due to the lack of reliable systematic data..

The aim of the study is based on the current interest on evaluate the influence of technological innovation on the national economy, so as to be able to evaluate the suitability of its implementation in enterprises to contribute to its economic development and expansion.

The Survey on Technological Innovation in Enterprises and Statistics on Scientific Research and Development have been carried out and coordinated by INE since 2002.

The common sample of these statistical operations is made up of approximately 8.000 fixed enterprises every year, which develop R&D activities. They are included because either there is information of them from previous years or they asked for public funds for R&D activities in the year in question.

Annually, INE asks State bodies and Autonomous regions for information on the units receiving public funds for R&D activities so as to update its directory. This information is finally crossed with last years directory and finished by adding new enterprises, modifying the existing ones and removing others.

In addition, this directory of 8.000 enterprises is completed with another 16.000 enterprises which have been randomly selected from the Central Enterprise Directory (DIRCE), forming a final sample of 24.000 enterprises.

These 16.000 enterprises are obtained from a stratified population of 165.649 enterprises of 10 or more employees by means of crossing the following variables:

- Enterprise size ( where the stratum of enterprises with 200 or more employees are exhaustively analyzed ).
- Activity branch according to CNAE-93.Rev.1. (54 divisions of table 1 are being considered)

This report analyses the period between 2000-2003. Having crossed its samples, 2.331 common enterprises are obtained where their results will be analysed on this panel. Of 2331 enterprises, 1431 correspond to the industrial sector, while 900 belong to services sector.

This analysis will study enterprises that have carried out innovative activities ( positive technological innovation expenses) during this period. They are considered technological innovation activities; those scientific, technology, business or financial steps, including any investment of creating new knowledge target to the introduction of new products( services or goods) or new or considerably improved processes

Aiming to complete our research, we have obtained information from other variables such as Employment, Gross value added at factor cost (VAB). These come from the following information sources:

- Industrial Statistic: includes around 35.000 enterprises of the spanish industrial economic network..
- Annual Services Survey: includes around 130.000 enterprises.

This review looks at the observed variations of certain indicators that may be useful for reaching conclusions about the effects of enterprises adoption (or not) of technological innovations..

The considered indicators are:

- Sales Volume.
- Employment
- Gross value added at factor cost (VAB)
- Expenses
- Output/Productivity (VAB/Employment)

---

## Main results

The following results are obtained from the group of 2.331 enterprises: a relative increase of sales volume and employment as Table 1 indicates.

**Table 1**

Group of enterprises studied by the Industrial and Services statistics:

years	Incr. S.V. %	Incr. Emp. %	Incr. VAB/emp %	Incr. Exp. %
2000-2002	9,4	10,1	4,2	3,8
2002-2003	4,8	5,3	0,0	3,4
2000-2003	14,6	15,9	4,2	7,4

The Sales Volume increase appears to remain constant, with a relative growth of 4,76% per year and 14,6% during the three years. Employment seems to behave alike in these enterprises, that is to say, the relative growth of Sales Volume and employment remains constant.

Looking at this group of enterprises, the Sales Volume/Employment relationship, its behaviour can not be considered positive (Table 2) since there is an output decrease. This could also indicate that the employment variable has risen more than enterprise goods or service sales.

**Table 2**

Year	Sales Volume/Employment
2000	190,96
2002	189,77
2003	188,81

On the other hand, looking at the VAB/Employment quotient as an Output indicator, we found a relative increase close to zero between 2002-2003 that rises to 4.2% during the 2000-2003 period (Table 1)

Moreover, If we consider the difference between Output value and VAB as the Expenses indicator, we see how Expenses increase to 7.4% during the three year period.

Considering this time only the subset consisting of enterprises having innovative activity in every year of the period 2000-2003 (being only 949 enterprises from the total number), we can see that the relative increase of Sales Volume compared with the total sample from Table1 does not show any better behaviour of innovative enterprises than other non-innovative units. (See Table 3)

**Table 3**

Group of innovative enterprises all three years

Years	Incr. S.V. %	Incr. Emp %	Incr.VAB/emp %	Incr. Exp %
2000-2002	6,2	1,1	12,8	0,4
2002-2003	3,2	0,0	6,6	3,6
2000-2003	9,6	1,1	20,2	4,0

Employment has not grown, but also its development is considerably less than the total of same period enterprises.

Despite that, when comparing enterprise Output (VAB/employment), the innovative enterprise behaviour is markedly better (Table 3). It indicates a 20,2% for 2000-2003 period, whereas the relative increase resulting for the same period of total enterprises is 4,2%.

It seems clear this happens because there is less employment growth, that is to say, those enterprises dedicating a significant amount to innovative activity later show better behaviour in terms of employee output. Despite not increasing the number of employees.

It is possible to obtain different conclusions from an Expenses analysis, such as that of the production expenses in innovative enterprises, which are much less (4%) compared to the total for all enterprises (7,4%).

If we analyse the same indicators referring to the non innovative enterprises within the three year period (702 units), we will see (Table 4) that while the Sales Volume and Employment indicators present a notable growth (Sample 4), the Output indicator shows worse results (-2.8%), far less than the 20.2 % of the innovative enterprises.

**Table 4**

Group of non inovative enterprises within the three years

years	Incr. S.V. %	Incr. Emp %	Inc. VAB/emp %	Incr. Exp. %
2000-2002	17,5	13,1	3,4	10,6
2002-2003	8,4	10,0	-5,9	6,1
2000-2003	27,4	24,5	-2,8	17,3

The same can be said of Expenses, where non innovative enterprises have slightly bigger production expenses (17,3%) than innovative enterprises (4,0%) on account of their lesser increase of employment.

It is not possible to make any conclusion for enterprises which have had some innovative activities only in part of the years 2000-2003, perhaps owing to the fact that the innovation process, which gives them the chance of having a wider set of products and services as well as enlarge their target market or improve the quality of their products and services, require continuity.

All of the above seems to point to the conclusion that every innovative activity must be developed continuously, otherwise it will not be helpful to the enterprise to compete with innovative enterprises, despite having improved their cost/production ratio..

If we consider the Industrial and Services sectors separately from the total of 2331 enterprises, we get 1431 units in Industry and 900 in Services.

The indicators to be analysed relating to Industrial sector are presented in Table 5

**Table 5**

years	Incr. S.V. %	Incr. Emp %	Incr. VAB/emp %	Incr. Exp %
2000-2002	4,8	2,0	5,3	2,7
2002-2003	1,2	-1,2	6,8	3,4
2000-2003	6,0	0,7	12,4	6,2

The relative increase of Sales Volume related to industry enterprises (2000-2003) is 6%, while this increase becomes 14,6% when the total enterprises sample is being considered

Neither Employment indicator applied to the Industrial sector gives good results (0,7%) when being compared to the total sample of units (15,9%)

If we consider industrial enterprise Outputs, their increase (12,4%) is markedly higher than total enterprise Output(4,2%). It can be deduced that increased output in the industrial sector is due to Employment..

Increase of Expenses for industry sector (6,2%) is also less than the relative increase of total enterprise expense (7,4%)

If we compare the innovative enterprises (781) in the industrial sector to those non innovative, we find the results in Tables 6&7.

**Table 6**

Industry—innovative enterprises

Years	Incr. S.V. %	Incr. Emp %	Incr. VAB/emp %	Incr. Exp %
2000-2002	2,9	1,8	8,1	1,4
2002-2003	1,7	-1,4	7,7	3,1
2000-2003	4,7	0,4	16,4	4,6

**Table 7**

Industry – non-innovative enterprises

<b>Years</b>	<b>Inc. S.V. %</b>	<b>Incr. Emp %</b>	<b>Inc. VAB/emp %</b>	<b>Incr. Exp %</b>
2000-2002	10,5	6,3	5,4	15,5
2002-2003	-0,2	-2,5	3,6	6,2
2000-2003	10,3	3,7	9,2	22,7

We see that although the increase of Sales Volume and Employment of innovative enterprises do not show good behaviour when compared with those non innovative, it is in the indicators of Productivity and Expenses where we see the difference in favour of enterprises showing some innovative activity.

The analysis results for the service sector, made up of 900 enterprises, can be seen in Table 8

**Table 8**

<b>Years</b>	<b>Inc. S.V. %</b>	<b>Incr. Emp %</b>	<b>Inc. VAB/emp %</b>	<b>Incr. Exp %</b>
2000-2002	17,3	16,3	7,4	8,7
2002-2003	10,1	9,7	-4,2	3,5
2000-2003	29,1	27,6	2,9	12,5

The behaviour of the service sector in relation to Sales Volume and Employment is much better than that of industry and also that of the total of enterprises.

As far as Productivity is concerned in services, the relative increase of this indicator is less than in that of industry (12.4). Expenses, on the other hand, are higher than that of industry (6.2).

The results of the comparison of indicators in this sector for innovative (168) and non innovative (460) enterprises are shown in Tables 9&10.

**Table 9**

Service – Innovative enterprises

<b>Years</b>	<b>Inc. S.V. %</b>	<b>Incr. Emp %</b>	<b>Inc. VAB/emp %</b>	<b>Incr. Exp %</b>
2000-2002	21,1	-0,4	24,0	-7,8
2002-2003	8,9	3,0	3,9	7,6
2000-2003	32,0	2,6	28,9	-0,8

**Table 10**

Service – non-innovative enterprises

<b>Years</b>	<b>Incr. S.V. %</b>	<b>Incr. Emp %</b>	<b>Incr. VAB/emp %</b>	<b>Incr. Exps %</b>
2000-2002	19,9	14,2	3,9	5,1
2002-2003	11,2	11,9	-6,8	5,9
2000-2003	33,3	27,8	-3,1	11,3

The same conclusions arrived at previously were reached. Innovative enterprises do not show better behaviour with respect to Sales Volume increase and much less with respect to Employment increase. What is obtained, however, are better results with respect to Productivity per employee and a significant decrease in Expenses. .

## Indicators of innovative enterprises by activity branch

Activity branches	Increase of sales Volume%	Increase of employment %	Increase of outputs %	Increase of Expenses %
Extrative	-7,1	-24,0	20,0	-2,0
Oil	19,2	7,0	171,2	-29,1
Diet,drinks and tobacco	16,1	-2,3	26,0	21,1
Textile, clothing and leather	-7,8	-15,1	-2,9	-4,7
Lumber, paper, and graphic arts	12,9	13,7	-20,8	21,5
Chemical products	-1,6	-4,4	-4,4	-8,9
Pharmaceuticals	40,6	12,3	18,4	61,3
Rubber	11,9	2,1	7,3	14,2
Non-metalic minerals	-8,5	-4,6	12,8	14,2
Metallurgy	4,9	3,0	-19,6	3,0
Metallic manufacturing	19,4	7,2	8,8	23,6
Machinery and equipment	29,3	12,5	9,6	29,7
Office supplies and computers	13,8	30,7	-71,6	-6,0
Electricity	20,2	5,0	17,4	14,1
Electronics	43,4	2,3	19,1	7,6
optic Instruments	-2,5	-1,6	-2,8	-3,5
Motor	-14,7	-6,7	16,9	5,2
Other transport material	71,0	16,4	4,8	78,8
Manufacturing diverse	8,0	3,5	6,5	17,5
Recycling	-18,5	-15,4	38,0	-19,2
Energy and Water	-19,4	-6,1	28,0	-15,5
Catering	60,0	20,6	-2,2	-49,5
Transports	8,9	-3,6	12,2	19,8
Communications	60,9	17,6	83,2	14,3
Real Estate and company service	13,0	2,3	32,3	40,7
Public, social and collective services	5,0	9,2	-31,4	-0,3

Ordered by productivity increase, these branches present better results: Oil, Communications, Recycling, Company Services, Energy and Water. In relation to Expenses; Catering, Oil, Recycling, Energy and Water, and Chemical are the branches that show a bigger decrease.

Employment indicator shows that the enterprises with a higher relative increase are those of Lumber, Other transport material, Communications, Catering and office supplies.

As far as Sales Volume is concerned, the higher increase is shown by Pharmaceuticals, Electronics, Communications and Other transport material.

Communications branch stands out for having a significant increase on every indicator, such as Volume sales and Employment. Also, Output result is higher than in other branches and well as it do not have a very high Expenses rate.

### Non- innovative enterprises indicators by branch of activity

Activity Branches	Incre S.V%	Incre Emp %	Incre Output %	Incre Exp %
Extractive	56,1	-11,2	-8,7	31,9
Oil	0,0	0,0	0,0	0,0
Diet,drinks and tobacco	23,9	-4,6	16,8	27,7
Textile, clothing and leather	4,3	-1,8	4,4	7,7
Lumber, paper and Graphic arts	3,9	3,0	6,4	6,2
Chemicals products	34,5	19,4	10,9	32,4

Pharmaceuticals	20,7	18,3	-14,1	57,3
Rubber	25,6	-1,4	2,0	37,1
Non-metallic minerals	28,2	10,0	8,0	27,3
Metallurgy	40,6	5,9	12,0	7,8
Metallic manufacturing	5,1	-3,0	-0,9	-1,7
Machinery and equipment	-23,1	-2,6	4,6	-11,9
Office supplies	-72,4	-56,1	-28,3	-56,8
Electricity	42,3	15,8	45,4	432,5
Electronics	-6,8	3,0	-12,4	-7,4
Optic instruments	29,1	18,5	-1,1	28,8
Motor	-47,9	-8,9	-3,5	14,9
Other transport material	27,9	-5,8	116,7	44,6
Diverse manufacturing	-3,5	-4,1	95,3	-17,9
Recycling	40,6	63,2	-40,4	26,0
Energy and water	98,9	87,7	6,6	100,2
Catering	38,8	33,7	-6,5	27,9
Transports	4,9	11,1	-3,4	-0,1
Communications	2,0	-7,2	35,7	-8,7
Real Estate and company services	18,9	24,4	3,4	-47,0
Public, social and collective services	24,1	13,0	3,5	-0,2

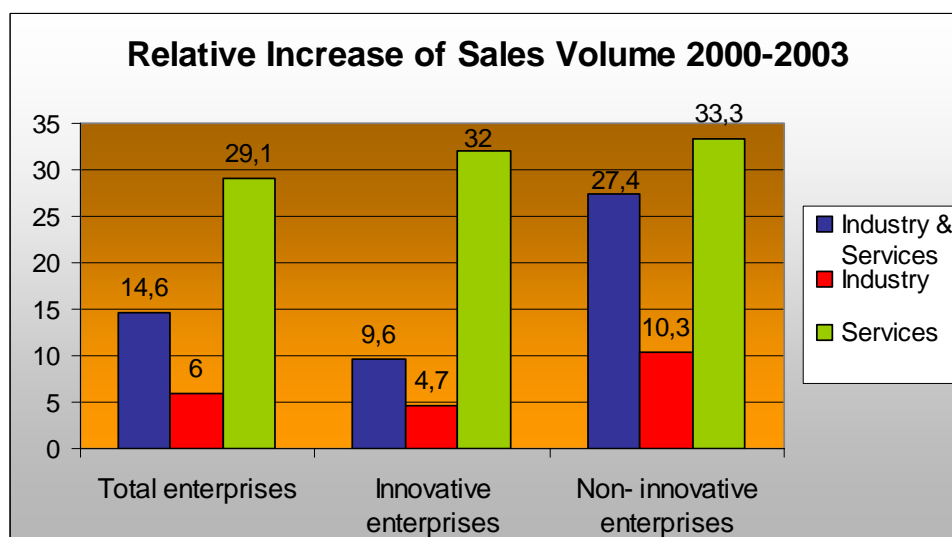
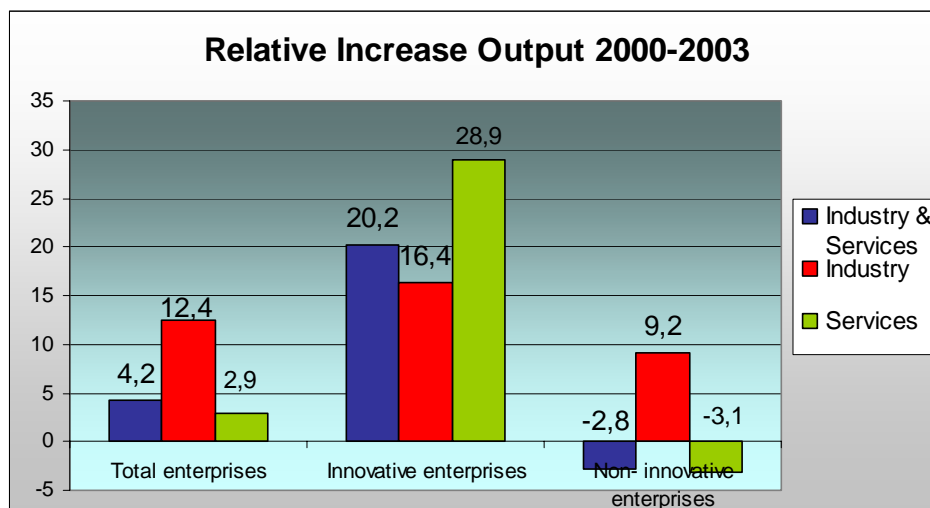
These are the branches which show a higher increase relating to Output indicator: Other transport material. Diverse manufacturing, Electricity and Communications .

Branches that have reached a higher Expenses increase are: Electricity, Energy and water, Pharmaceuticals and Other transports material, Besides, these branches show an increase on Output, apart from Pharmaceuticals which present a negative result.

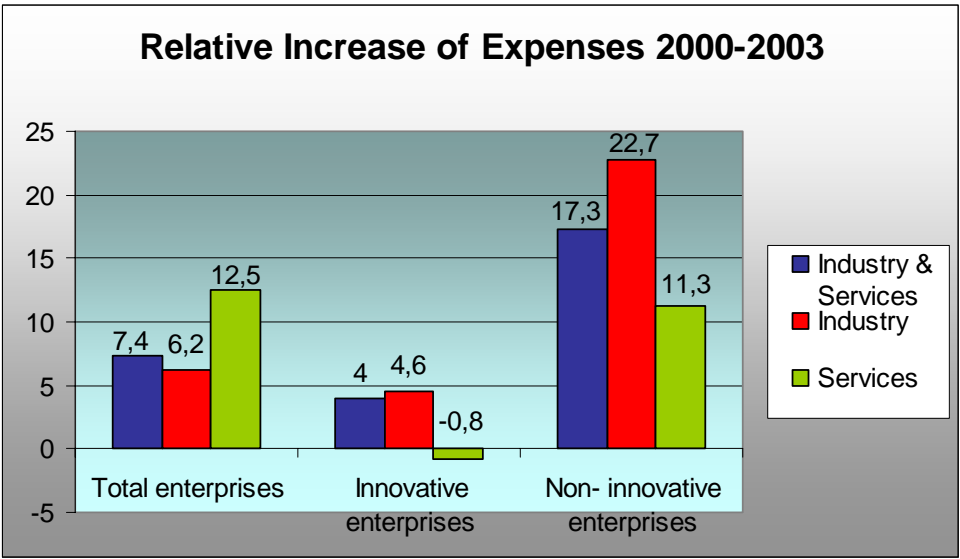
Employment indicator behaves itself better on Energy and Water, Recycling, Catering and Company services branches. These branches do not present good results regarding Output.

Energy and Water, Extractive, Electricity and Recycling present different results regarding Sales Volume to Output.

## Annexe. Graphics of Studied variables



**Relative Increase of Expenses 2000-2003**



**Relative Increase of Employment 2000-2003**

