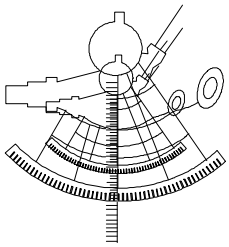
European Trend Chart on Innovation



2004 Trend Chart Statistical Papers Series

IB RESULTS

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Highlights

Although all EU member states provide a range of support programmes for innovation, there is a lack of comparable data on the percentage of innovative firms that use different types of innovation support programmes or the characteristics of these firms. The 2004 Innobarometer survey provides relevant data on these issues through a survey of 4,534 innovative firms in the 25 EU member states with between 20 and 499 employees. The survey focuses on two general policy areas of importance to innovation: 1) the use and value of eight types of programmes to support innovation and 2) the effect of product and process regulation on firm competitiveness.

A firm must have a relevant innovation activity to make use of specific policies. For example, only firms that perform research in-house will be eligible for research support. Once eligibility is taken into account, there is almost a four-fold difference between the highest and lowest use rates for innovation support programmes. The highest rates are in Austria and Cyprus, where the average firm uses over 20% of available policies for which it is eligible, while the lowest rates (below 7.2%) are in Latvia, the Czech Republic, and Luxembourg. The percentage of firms that use at least one innovation support programme ranges from a high of 60.6% in Cyprus to a low of 16.7% in Latvia.

Who receives policy support?
An important policy issue concerns the types of firms that receive policy support for innovation – are these programmes used more intensively by highly innovative firms, or are less innovative firms that are trying to increase their innovative capabilities also benefiting from these programmes? In order to examine this issue, all firms were assigned to one of four sequential levels of innovative capability: 'minimal' (13.3% of the firms), 'minimal plus' (30.2%), 'research based' (13.5%) and 'research plus' (43.0%).

One question, for the use of advice services, asks firms if they obtained advice from private and from public advice services. At all levels of innovative capability, a higher percentage of firms seek private instead of public advice services. There is no tendency for less innovative or more innovative firms to prefer private over public services, with the preferences roughly constant across innovative capability.

The more innovative firms are more likely to use each type of innovation support programme and they use more of them. On average, minimal innovators use 1 programme compared to 1.6 programmes used by the most innovative firms. Regression analysis that controls for the effect of several factors shows that an increase in innovation capability is strongly correlated with the use of any innovation support programme, with the most innovative category of firms over seven times more likely to use at least one programme than firms that are only minimal innovators.

Firm size has no effect on the use of most programmes, but larger firms are more likely than smaller firms to use programmes that benefit higher innovative capabilities, such as research and collaboration. By sector, innovation support programmes are more likely to be used by manufacturing firms, with firms in 'other services' (software and R&D services) benefiting as well.

How valuable are innovation support programmes?
A second policy issue is the value of innovation support programmes. The survey asks firms if any innovation support programme was "*crucial to any of your innovation projects, such that the innovation would not have been developed without the support*." There is no difference in the percent of firms by innovative capability that report that programmes were 'crucial'. Since the less innovative firms use fewer programmes, this suggests that the policy

payoff to less innovative firms is greater than the payoff for policy support to more innovative firms.

Although subject to several caveats, the analyses indicate that the most crucially important type of innovation support programme is for collaboration, followed by programmes to support research and thirdly the adoption of process technology. Firms rarely find programmes to support market research of crucial importance.

Do innovation policies increase outputs?
One of the goals of innovation policy is to encourage and support firm competitiveness, which can partly be measured through improvements in employment, sales and profitability. The Innobarometer 2004 survey includes data on sales growth between 2002 and 2003. Our main interest is if any policy use is correlated with an increase in sales share (after controlling for other factors) and if firms that find policy use to have had a crucial impact on their ability to innovate are more likely to have an increase in sales share than firms that use policies but did not find them to be of crucial importance. These questions are evaluated through regression analysis.

The results show that the use of at least one innovation support programme is positively and significantly correlated with sales growth, although separate analyses for each type of innovation programme find no effect on sales growth, indicating that there is only a weak relationship. Firms that find policy support to be crucial are significantly *less likely* to report higher growth rates than firms that use policies but do not find them of crucial importance. The negative correlation with crucial policy support could be due to these firms turning to support because of a failure so far to benefit from their innovation investments.

Are innovation support programmes meeting their goals?
The positive correlation between programme use and an increase in sales is encouraging, but whether or not innovation support programmes are succeeding or failing depends on the goal of programmes to support innovation among SMEs. If the goal is to encourage less innovative SMEs to increase their innovative capabilities, then the results would be discouraging because programme use is much greater among the more innovative SMEs. Given that the main beneficiaries are highly innovative SMEs, it is surprising that these programmes are not positively correlated with activity in global markets and only weakly with sales growth. This suggests that programme use is greatest among SMEs with high innovative capability but which have difficulties in entering global markets or rapidly increasing sales. This suggests widespread policy failure if the goal is to target the "winners".

Conversely, if the goal of innovation policy is to support innovative firms that have been unable, so far, to turn their innovations into commercial successes, then these policies have successfully reached their target. This is also supported by the negative correlation between sales growth and the 'crucial' importance of innovation support programmes, which indicates that these programmes are most valuable to firms that are experiencing difficulty with increasing sales. It remains to be seen if this policy support can increase future sales or assist firms that are active in local and regional markets to break into larger more competitive markets.

Do product and process regulations create competitive disadvantages?
Innobarometer 2004 asks if national product and process regulations placed 'your firm at a competitive disadvantage compared to your competitors." Over 45% of product innovators in the UK, Ireland and Germany report a competitive disadvantage from product regulation, while the lowest rates, below 17%, are in Slovakia, Estonia and Spain. Process regulations are most problematic for firms in Ireland, Belgium and the UK (over 39% reporting a competitive disadvantage) and the least problematic in Estonia, Slovakia and Spain (less than 15% of

firms). In most countries, process regulations are more likely to create competitive disadvantages than product regulations.

Multivariate regression finds that the largest firms (250 – 499 employees) are less likely than the smallest firms (20 – 49 employees) to find that product and process regulations create a competitive disadvantage, indicating that small firms have the greatest difficulty in meeting regulatory requirements. The most consistent factor that increases the probability that regulation creates competitive disadvantages is the firm's innovative capability, which is particularly important for product regulation. Of note, there is no relationship between sales growth and problems with regulation. The regression analyses also find that the differences by country are not due to confounding by other factors, such as differences in firm size or innovative capability by country. Only 10% of the variation in the rank order by country for product regulation and 6% of the variation for process innovation is due to country differences in the distribution of other firm characteristics that are correlated with competitive disadvantages from regulation.

1. Introduction

Although all EU member states provide a range of support programmes for innovation, there is a lack of comparable data on the percentage of innovative firms that use different types of innovation support programmes or the characteristics of these firms. The 2004 Innobarometer provides relevant data on these issues through a survey of 4,534 innovative firms with between 20 and 499 employees. The number of sampled firms varies by country, ranging from approximately 100 respondents in each of the smaller member states to 300 respondents in each of the four larger states.

Innobarometer 2004 contains questions on two general policy areas of importance to innovation: 1) the use and value of eight types of programmes to support innovation and 2) the effect of product and process regulation on firm competitiveness.

The main *Flash Eurobarometer* report of November 2004 by EOS Gallup Europe provides response frequencies for all of the policy and regulation questions for each of the 25 member states. Many of the results in the *Flash Eurobarometer* report can be adapted to produce indicators for the use of innovation support programmes.

This report takes the analyses in the *Flash Eurobarometer* report a step further by taking an analytical rather than a descriptive approach to the Innobarometer 2004 results, mainly by looking more closely at the factors that are correlated with policy use. Some of these factors, such as firm size, or sector, have been evaluated in the *Flash Eurobarometer* report. However, firm size or sector can be confounded by other firm characteristics. To overcome this problem, this report uses regression techniques, where relevant, to simultaneously control for multiple factors.

1.1 Limitations of Innobarometer 2004

The methodology of Innobarometer 2004 places strict limitations on the interpretation of the results.

First, as with all *Flash Eurobarometer* surveys, Innobarometer 2004 is a cross-sectional survey. It collects data on policy use and the activities of firms for the same two-year period. Therefore, correlation and regression results provide no information on causality. For example, the use of policies to support research may be positively associated with an increase in sales, but we cannot interpret the results as indicating that the use of this policy *caused* an increase in sales. The results only indicate that the two are positively correlated.

Second, Innobarometer 2004 is limited to *innovative* small and medium sized enterprises (SMEs) with between 20 and 499 employees. This limitation can easily create misunderstandings if not kept in mind. For instance, there is strong policy interest in the relationship between the use of specific policies and innovative capabilities at a *national* level. This suggests correlating national Innobarometer 2004 indicators for policy use with measures of national innovative performance, such as the summary innovation index (SII) from the European Innovation Scoreboard (EIS). The expectation is that good performance on the SII would be positively correlated with a high use of innovation support programmes by SMEs.

Unfortunately, Innobarometer 2004 can only provide a poor test of the possible correlation between policy use and SII performance. This is because the SII is strongly influenced by both population characteristics (such as the percentage of the working age population with a tertiary degree) and the role of large firms with 500 or more employees in innovation, which will heavily influence EIS performance on indicators such as BERD (Business Expenditures on R&D) or total innovation expenditures share. Only a few EIS indicators are limited to SMEs, while Innobarometer 2004 provides no information on either population characteristics or on large firms.

Furthermore, many EIS indicators cover both innovative and non-innovative firms combined, whereas Innobarometer 2004 only captures policy use by innovative SMEs. For these reasons, we can only expect to find weak correlations between policy use as measured in Innobarometer 2004 and the SII from the European Innovation Scoreboard.

The limitation of Innobarometer 2004 to innovative SMEs also prevents comparability with the CIS indicators because the latter include both *innovative and non-innovative firms* in the denominator. For example, the EIS indicator for the percentage of SMEs that innovate in-house includes the number of in-house innovators in the numerator and the total number of innovative and non-innovative SMEs in the denominator[1], whereas the denominator for Innobarometer 2004 is always limited to innovative SMEs only.

However, similar groups from the CIS and Innobarometer surveys are comparable and can consequently be used as a check of the quality of the Innobarometer sampling method. The size classes in Innobarometer were intentionally selected to match at least one size category in the CIS: 50 to 249 employees. Both surveys also collect data on sector of activity and whether or not the firm performs R&D. The most comparable sector is manufacturing. Data on R&D performance are available for both surveys for 10 identical countries from the original EU-15 (due to confidentiality restrictions, these data are not available from the CIS for the other 5 EU countries). The average percentage (for the 10 countries) of innovative manufacturing firms with between 50 and 249 employees that perform R&D is very similar: 68.0% in the 2004 Innobarometer survey and 72.2% in the 2000 CIS survey. This indicates that the Innobarometer sample is a good match of the CIS sample of innovative firms.

Please note that although all analyses in this report are for innovative firms with between 20 and 499 employees, for simplicity this report simply refers to them as 'firms', without the qualifier that they innovate or that they are SMEs.

[1] It would have been prohibitively costly to include non-innovators in Innobarometer 2004. For example, assume that only 20% of SMEs in country *x* innovated. Since all Innobarometer 2004 questions are only relevant to innovative firms, a sample size five times larger would have been required to obtain a sufficient sample of innovators.

2. Use of Programmes to Support Innovation

This report uses the Innobarometer 2004 results to develop three indicators for the use of innovation assistance programmes by firms:

1. The policy uptake rate, or the average percentage of innovation support programmes available in country *x* and used by firms that are *eligible* for assistance.
2. The percent of all firms that use one or more innovation support programmes.
3. The percent of all firms (eligible and non-eligible combined) that use each innovation support programme.

The IB questionnaire asks about each respondent firm's use of eight types of innovation support programmes, depending on the firm's eligibility for each programme. In order to be eligible for a specific programme, a firm must have innovation activities that could be supported by the programme. No other criteria are used to determine eligibility. For example, firms that introduced a process innovation in the previous two years are assumed to be eligible for a subsidy for process innovation and are therefore asked if they received "public assistance or a subsidy to introduce new or significantly improved processes". Of note, eligibility is only defined here by the firm's innovation activities. Actual eligibility will depend on other factors for each assistance programme and which some innovative firms may not meet. The eight innovation activities and the 'eligible' innovation support programmes are summarized in Table 1.

Whether or not a respondent firm will use a specific form of policy support will depend on three factors in addition to simple eligibility. First, the programme must be available to the firm from regional, national or supra-national Governments. Second, the firm must be aware of the programme. Third, the firm must decide to participate after weighing the expected benefits of participation versus the costs.

The Innobarometer 2004 survey, due to space constraints, does not provide information for each EU member state on programme availability, awareness, or eligibility. Additional data on programme availability and eligibility requirements would need to be obtained from other data sources.

As a proxy for both availability and awareness, we assume that a programme is not available in country *x* (or if available very poorly advertised) if less than three firms in country *x* report its use. We use a minimum of three user firms in each country because some respondents may incorrectly report programme use or eligibility may be so strict that most firms cannot take advantage of the support. This method estimates below average programme availability rates in Slovakia (only two programmes are available), Ireland (five available programmes) and in Estonia and Latvia (six available programmes). Only two programmes are available in all countries: advice and research support.

After adjusting for innovation activities, the majority of firms (79.1%) are eligible for between 2 and 5 innovation support programmes, with a mode of three programmes (24.0% of the firms). However, 70.0% of firms use zero programmes for which they are eligible and an additional 17.7% use only one programme.

Table 1. Innobarometer coverage of innovation support programmes

	Firm innovation activity	Relevant programme
1.	**Advice services**: Used advice services for innovation activities.	Obtained such advice from a public technology or innovation center.
2.	**Market research**: Conduct one or more market research studies for introducing new products or services	Assistance to conduct market research for new products or services
3.	**In-house research**: Carry out in-house research or contract out research to other firms, universities or research institutes	Assistance for R&D within your firm or for contracted-out R&D
4.	**Collaboration**: The questionnaire does not ask if each firm collaborated on innovation. Firms are assumed to be eligible for collaboration support if they have one or more of the following activities that are associated in the literature with collaboration: patenting, product innovation, process innovation, in-house research and contract research.	Assistance to collaborate on innovation with other firms, universities or research institutes
5.	**Hiring**: Hired at least one new university graduate.	Subsidy to hire new university graduates
6.	**Training**: Staff attended formal training to support the firm's innovation activities.	Assistance for training.
7.	**Networking**: Participation in an innovation network including other firms, universities or research institutes.	Assistance or subsidy for the network.
8.	**Process innovation**: Introduced new or significantly improved processes in delivery systems, production or logistics.	Assistance for the introduction of new or significantly improved processes in delivery systems, production or logistics

2.1 Policy Uptake Indicator

The indicator, P-uptake, equals the average percent of all eligible programmes that each firm uses. For example, a firm that hired new university graduates and introduced a process innovation, but reported no other innovation activities would be eligible for two of the eight possible programmes. If this firm reported using one of these two programmes its P-uptake value would be 50%. A second firm that is eligible to use all eight policies in Table 1 but only reports the use of two of them would have a P-uptake value of 25%. A third firm that is eligible for all eight programmes, reports the use of one, but is based in a country where only six programmes are available, would have a P-uptake value of 16.7%.

Figure 1 gives the average policy uptake rate (p-uptake) in each EU member state. There is almost a four-fold difference between the highest and lowest policy uptake rates by country. The highest rates are in Austria and Cyprus, where the average firm uses over 20% of available policies for which it is eligible. The lowest rates are in Latvia, the Czech Republic, and Luxembourg.

Eligible policy uptake rate for innovative SMEs (20 - 499 employees) by country

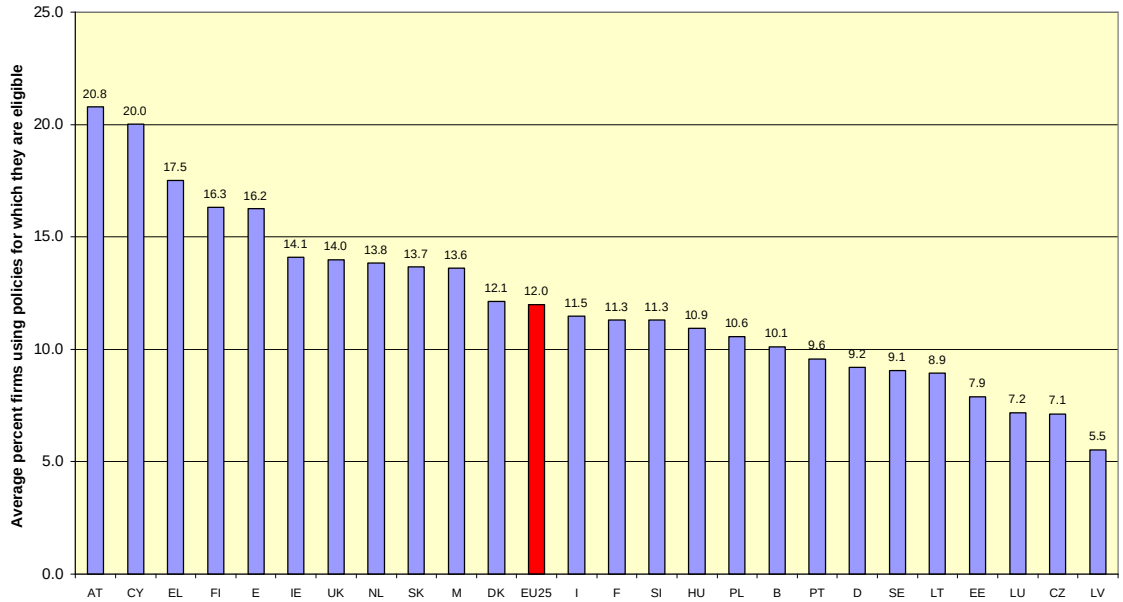

Figure 1

Percent of Innovative SMES (20 - 499 employees) that report using at least one form of public support for their innovative activities in 2002-2003

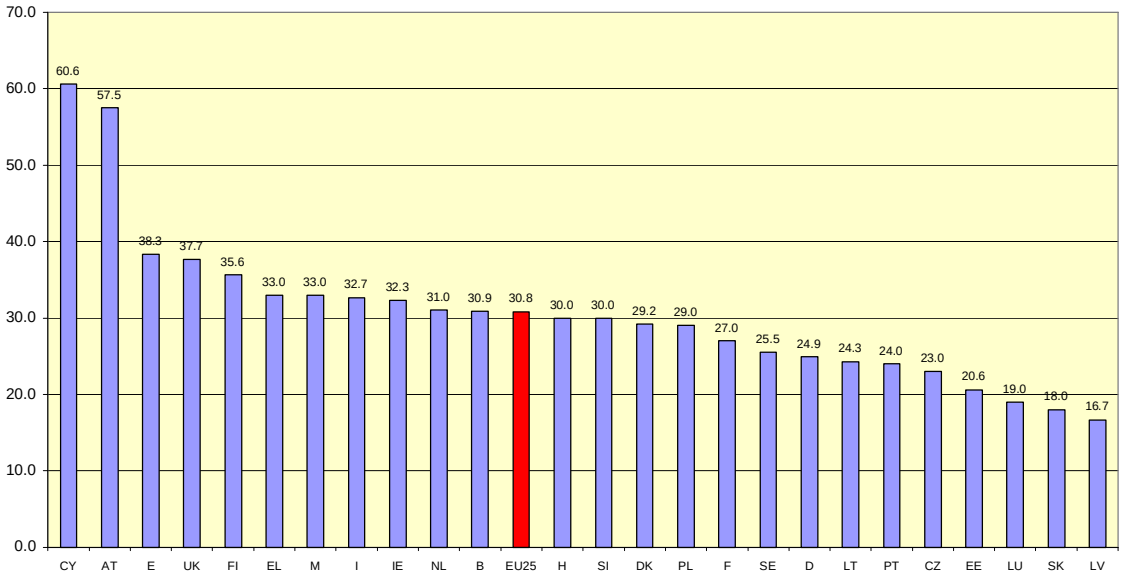

Figure 2

There is no correlation at all between the policy uptake rate and the SII for each country. As an example, Finland has almost twice the policy uptake rate as Sweden, even though both countries are the best performers on the SII.

In so far as the design of innovation support programmes should encourage their use by innovative firms, these results suggest that Austria, Cyprus, Greece and Finland have had more success in encouraging uptake than Lithuania, Estonia, Luxembourg, the Czech Republic and Latvia.

2.2 Any use of an innovation support programmme

Figure 2 above gives the percent of all eligible firms that report using at least one of the eight possible innovation support programmes. Over half of firms in Cyprus and Austria use at least one programme, compared to less than twenty percent of firms in Luxembourg, Slovakia and Latvia.

2.3 Use of each programme among all respondent firms

This specific indicator is provided in order to be able to correlate policy use with the 2004 Summary Innovation Index (SII) from the European Innovation Scoreboard. The indicator determines policy use among all respondent firms, including 1.2% of firms that were not eligible for any form of policy support. Therefore, the indicator is a combined measure of both specific types of activity and support for each activity. In theory, all firms could be eligible for every type of policy support if they were involved in the full range of innovation activities. The results are given in Table 2. The last row of table 2 gives the R^2 values for a correlation between policy use rates and the SII for each country.

There is no correlation between any policy use and the SII, between the percentage of firms that find policy support 'crucial' and the SII, and the correlation is not significant for four innovation support programmes: market research support, research support, support for training, and advice services. Two programmes are weakly and negatively correlated with the SII: hiring subsidies and assistance with process innovation. This could be because these types of programmes are used to support catch-up strategies. There is a weak positive correlation between the use of collaboration support programmes and a moderately strong positive correlation between the use of networking support programmes and the SII.

The positive correlations between the SII and collaboration and networking suggest that support for these two innovation activities contributes to national innovation performance, but this is partly due to the strong correlation between these two activities regardless of policy support and innovation performance. The prevalence of networking among all firms (both firms that receive policy support for networking and those that do not) is correlated with the SII with a R^2 of 0.653. Innobarometer 2004 does not include an indicator for the prevalence of collaboration. However, the data suggest that policy support for networking has an independent contribution to the SII that is not due to the correlation between all firms that network and the SII. This is because there is only a weak correlation between the percentage of all firms that network and the percentage that receive a subsidy for this innovative activity. This

Table 2. Percent all firms by country that use any innovation support programme, each type of programme, and which report that policy support was crucial to their ability to innovate

	Any	Market	Research	Hiring	Training	Networking	Processes	Collaboration	Advice	Crucial
BELGIUM	30.9	1.4	11.6	1.0	9.2	4.8	1.9	4.3	8.2	4.3
DENMARK	29.2	1.0	5.7	2.4	7.2	9.1	6.2	8.6	11.5	6.7
GERMANY	24.9	4.0	7.3	2.2	6.7	6.7	2.9	6.9	9.7	8.3
GREECE	33.0	3.0	12.0	2.0	22.0	3.0	8.0	1.0	3.0	9.0
SPAIN	38.3	6.7	14.0	4.3	15.0	3.0	9.3	10.7	10.6	5.0
FRANCE	27.0	5.7	10.0	1.7	11.7	5.4	4.3	4.0	7.7	6.7
IRELAND	32.3	10.1	9.1	0.0	16.2	2.0	1.0	3.0	13.1	4.0
ITALY	32.7	4.7	15.3	3.0	10.6	3.0	6.7	6.0	5.0	7.3
LUXEMBOURG	19.0	1.0	5.0	0.0	7.0	5.0	3.0	3.0	4.0	3.0
NETHERLANDS	31.0	3.0	20.5	0.0	7.0	5.5	3.5	7.5	14.5	5.5
AUSTRIA	57.5	4.0	11.5	2.0	33.5	7.0	7.0	11.0	19.5	13.5
PORTUGAL	24.0	4.0	4.0	9.0	12.0	3.0	1.0	5.0	3.0	5.0
FINLAND	35.6	6.0	14.9	0.0	2.0	14.9	3.0	10.9	15.8	7.9
SWEDEN	25.5	2.9	6.4	0.0	5.4	7.4	2.0	8.8	8.8	5.9
UNITED KINGDOM	37.7	8.0	5.6	2.3	17.7	4.0	6.0	7.3	18.3	10.0
CYPRUS	60.6	2.0	10.0	3.0	46.0	0.0	11.0	5.1	21.0	15.0
CZECH REPUBLIC	23.0	2.0	4.0	3.0	4.5	1.0	4.5	4.5	7.0	3.0
SLOVAKIA	18.0	1.0	5.0	0.0	4.0	1.0	0.0	0.0	9.0	1.0
HUNGARY	30.0	2.3	8.3	7.0	5.3	2.3	5.7	5.7	11.0	12.0
LATVIA	16.7	3.7	3.7	0.9	4.6	1.9	4.6	3.7	7.4	4.7
LITHUANIA	24.3	1.9	1.9	0.0	4.9	1.9	1.9	3.9	17.5	2.9
MALTA	33.0	12.0	9.0	4.0	17.0	4.0	8.1	6.1	8.1	9.1
POLAND	29.0	1.7	4.7	10.0	11.3	2.7	7.7	5.7	7.3	6.0
ESTONIA	20.6	7.8	4.9	1.0	4.9	1.0	2.9	3.9	7.8	6.9
SLOVENIA	30.0	5.0	10.0	4.0	2.0	5.0	7.0	8.0	11.0	3.0
EU-25	**31.2**	**4.1**	**9.0**	**3.0**	**11.3**	**4.3**	**5.1**	**6.3**	**10.5**	**7.0**
R^2 with 2004 SII	0.000	0.026	0.061	-0.188	-0.071	0.638	-0.148	0.285	0.049	0.000

Notes: Small differences in any use of a support programme in Table 2 and elsewhere in this report (ie. Figure 2) is due to the inclusion here of firms that are not eligible for any programme.

Table 2a. Percent of all firms that report each type of innovative activity

	Market research	In-house research	Hiring	Training	Networking	Process innovation	Sought advice
BELGIQUE	40.4	74.4	19.8	37.7	14.0	45.9	27.1
DENMARK	39.7	25.4	13.9	42.6	24.4	67.0	28.2
GERMANY	22.9	55.5	32.7	81.4	16.8	62.2	28.6
GREECE	36.0	59.0	47.0	51.0	7.1	46.0	37.0
SPAIN	36.3	52.0	37.3	58.7	10.0	64.7	23.7
FRANCE	42.8	56.0	23.3	45.7	9.0	44.5	16.4
IRELAND	33.3	69.7	33.3	79.8	21.2	59.6	38.4
ITLALY	36.7	77.0	30.2	52.0	10.0	60.7	29.0
LUXEMBOURG	22.0	61.0	15.0	41.0	8.0	52.0	20.0
NETHERLANDS	33.8	80.0	21.0	32.5	23.0	43.8	26.5
AUSTRIA	32.0	68.0	31.3	78.0	14.5	71.1	31.5
PORTUGAL	37.0	29.0	41.0	46.0	10.0	60.0	15.0
FINLAND	45.5	84.2	8.0	22.8	28.0	42.6	33.7
SWEDEN	43.1	37.7	47.8	57.1	36.6	50.0	36.3
UNITED KINGDOM	35.5	67.7	26.9	67.7	12.7	50.0	34.7
CYPRUS	49.0	60.0	34.0	64.6	5.0	60.6	55.0
CZECH REPUBLIC	24.0	44.5	27.5	73.0	3.5	49.0	17.0
SLOVAKIA	37.0	55.0	19.0	48.0	8.0	42.0	26.0
HUNGARY	40.7	54.8	39.0	50.5	5.7	31.0	21.7
LATVIA	44.4	76.9	38.0	69.4	13.9	54.6	26.2
LITHUANIA	37.9	28.8	35.6	67.0	17.3	42.7	46.6
MALTA	48.5	73.0	33.0	71.7	15.2	59.0	46.0
POLAND	38.3	56.0	58.1	57.3	6.7	62.7	17.9
ESTONIA	53.9	48.0	28.4	41.2	4.9	43.1	24.5
SLOVENIA	41.6	58.0	22.0	46.0	14.0	63.0	41.0
EU-25	**37.3**	**58.2**	**31.5**	**56.0**	**13.3**	**53.4**	**28.0**
R-square with SII	0.000	0.002	-0.153	0.053	0.653	0.003	0.001

Note: The Innobarometer survey does not have a direct question on collaboration.

suggests that both the share of all firms that network and the share of firms that receive subsidies for networking contribute independently to the SII.

Table 2a above gives the percentage of all firms that are eligible for each type of innovation support programme by reporting the relevant innovation activity. For example, 40.4% of firms in Belgium report that they conducted one or more market research studies for introducing new products or services. The last line of Table 2a gives the correlation results with the European Innovation Scoreboard's SII. There is no correlation between the SII and the percentage of all firms active in market research, research, training, process introduction, and which seek advice services. There is only a weak negative correlation between the SII and the percentage of all firms that have hired a new graduate in the previous two years (R^2 of – 0.153).

2.3.1 Programme use by eligible firms

An important question for policy is the effectiveness of each innovation support programme in reaching its intended target, or the percentage of eligible firms that receive policy support. Although this information would be very useful by country, the Innobarometer sample is not large enough to produce reliable results at the national level. Instead, Table 3 provides the percent of eligible firms that use each innovation support programme for the original 15 EU countries combined and for the 10 new member states combined. The last column gives the ratio of the policy use rate between the EU15 and the EU10. A ratio greater than 1 indicates that the policy use rate is higher in the EU15 countries.

Table 3. Policy use rate for eligible firms only

	EU 15	EU 10	EU15/EU10
1. Advice services	38.5%	39.2%	0.98
2. Market research	15.4%	6.6%	2.33
3. Research	16.4%	9.3%	1.76
4. Collaboration	6.9%	5.3%	1.30
5. Hiring	8.4%	16.0%	0.53
6. Training	18.2%	13.7%	1.33
7. Networking	37.2%	33.8%	1.10
8. Process innovation	8.7%	11.3%	0.77

The highest use rates for specific policies are for advice services and networking. For example, 37.2% of EU15 firms that are active in networking (and therefore eligible for policy support) report that their network receives some policy support. The lowest rates of policy use are for collaboration, process innovation, and hiring. Policy use rates are higher in the EU15 than in the new member states for five programmes: market research, research, collaboration, training, and networking, very similar for advice services, and less than that of the new member states for hiring and process innovation subsidies.

2.4 Programme use by Innovative Capability

The use of some innovation support programmes may depend on the innovative capabilities of the firm. Some programmes may be of use to all types of firms, others may be particularly attractive or useful to weakly innovative firms, while others may be of value only to firms with high innovative capability.

Innovative capability refers to the ability of a firm to develop new products, processes, and other forms of innovation in-house. These require creative effort on the part of the firm. Firms can also innovate by adopting new technologies or ideas developed outside their firm as part of a process of innovation diffusion. The latter activity can require some creative effort by the firm to adapt new technologies or ideas to its own requirements. R&D performance or applying for a patent are good proxies for the presence of creative innovation activities, but there are a lack of proxies for creative activities to adapt innovations developed outside the firm. The best option is to use firm investment in skilled human resources or contracting out R&D. The latter requires the ability to identify a problem and implement the proposed solution.

All firms were assigned to one of four levels of innovative capability based on 1) signs of creative innovative activity through applying for a patent or performing R&D in-house, 2) contracting out R&D, and 3) investment in human resources either through hiring recent university graduates or investing in staff training for innovation. The four levels are as follows:

1. Level 1 (*minimal*): the firm shows no signs of creative innovation activity such as applying for a patent or performing R&D in house and it has not recently invested in other capabilities, such as hiring or training staff or contracting research to other institutes or firms.
2. Level 2 (*minimal plus*): the firm shows no signs of creative innovation activity such as applying for a patent or performing R&D in house but it has either invested in staff capabilities (hiring or training) or contracted out R&D.
3. Level 3 (*creative research*): the firm has creative innovative activity through either applying for a patent or performing R&D but it has not invested in staff capabilities.
4. Level 4 (*creative research plus*): the firm has creative innovative activity through either applying for a patent or performing R&D and it has invested in staff capabilities (hiring or training).

Table 4 gives the distribution of all respondent firms by innovative capability and for four other firm characteristics: the percent of firms active on international markets outside the EU, the percent of firms with sales turnover growth between 5% and 25% and the percent with sales growth over 25% in the previous two years, the percent with more than 250 employees, and the percent that have sold products or services to government agencies.

For all firms, 13.3% are level 1 minimal innovators, 30.2% are level 2 minimal plus innovators, 13.5% are level 3 research-based innovators, and 43.0% are level 4 research based innovators with investments in staff capabilities. The interpretation of the results for each characteristic depends on a comparison with the distribution of all

firms by innovative capability. For example, 43% of all firms are in the research plus category of innovative capability, compared to 60.7% of firms with over 250 employees. This indicates that the larger SMEs are much more likely to be research plus innovators than the smaller SMEs.

In addition to firm size, the probability of being in level 4 (research plus) versus all other levels of innovative capability increases for firms that sell in international (non-EU) markets, sales growth over 5% and over 25%, and slightly for firms that sell products or services to government agencies (Gov't procurement). For example, only 8.5% of firms that sell in international markets are level 1 minimal innovators compared to the average of 13.3% of all firms, while 51.6% of firms that sell in international markets are level 4 research plus innovators, compared to 43.0% of all firms.

Table 4. Distribution of firm characteristics by innovative capability

	Level of innovative capability				
	Non creative		Research based		
	Minimal	Minimal plus	Research	Research plus	
All firm distribution	*13.3%*	*30.2%*	*13.5%*	*43.0%*	*100%*
Sell in Int'l markets	8.5%	24.9%	15.9%	51.6%	100%
Sales growth 5%-25%	11.2%	28.4%	12.6%	47.8%	100%
Sales growth > 25%	7.7%	33.0%	9.5%	49.8%	100%
> 250 employees	4.2%	23.8%	11.3%	60.7%	100%
Gov't procurement	11.4%	30.4%	11.6%	46.7%	100%

Notes: There are statistically significant differences in the distribution or each firm characteristic by the level of innovation capability ($p < .000$).

As expected, a lower percentage of firms based in the EU-15, 41.7%, are minimal innovators (levels 1 and 2 combined) than firms based in the 10 new member states (52.4%).

2.4.1 Innovative capability by use of advice services

The Innobarometer 2004 question on the use of advice services uniquely covers the use of both private and public advice services. It therefore permits an evaluation of differences in the use of public and private services by the innovative capabilities of the firm. This is not feasible for many other innovation support programmes because they lack private sector equivalents[2]. Since advice services often provide very basic assistance, one expectation is that these would be more popular among minimal innovators than among research-based innovators. To the extent that public advice services are less expensive than private services, and therefore less risky for firms with little experience with innovation, we would also expect minimal innovators to be more likely than research based innovators to use public services.

[2] For example, there is no private equivalent for public subsidies to hire new university graduates. However, it is possible to imagine private alternatives to public R&D subsidies or support for collaboration networks, such as when an SME enters into a joint research agreement with a larger firm to reduce the costs of R&D.

The results for the use of advice services are given in Table 5. Neither expectation is supported by the results. The use of private and public advice services increases with the level of innovative capability, with the percentage of non users declining from 89.9% of minimal innovators to 61.7% of research plus innovators. At all levels of innovative capability, a higher percentage of firms seek private instead of public advice services. There is no tendency for less innovative or more innovative firms to prefer one or the other, with the ratios roughly constant across innovative capability. For example the ratio of any public (only public plus both) versus any private (only private plus both) is 0.49 for minimal innovators (3.8/7.8), 0.41 for minimal plus innovators (6.3/15.5), 0.49 for research innovators (7.2/14.7) and 0.51 for research plus innovators (15.6/30.4).

Table 5. Use of private and public innovation advice services by innovative capability (results for all firms)

	Level of innovative capability			
	Non creative		Research based	
Advice service	**Minimal**	**Minimal plus**	**Research**	**Research plus**
None used	89.9%	80.7%	80.9%	61.7%
Public only	2.5%	3.8%	4.2%	7.9%
Private only	6.3%	13.0%	11.7%	22.7%
Both public and private	1.3%	2.5%	3.1%	7.7%
	100.0%	100.0%	100.0%	100.0%

2.4.2 Use of each form of public support by innovative capability

Table 6 gives the percentage of firms by innovative capability that use each type of public support for innovation. In contrast to Table 5, the results for advice services are limited to eligible firms, defined as those that use public or private advice services. The column 'N' gives the unweighted number of firms that are eligible to receive support for each programme type, but all other results are weighted to reflect the total population of firms.

For example, 37.7% of firms with minimal creative ability and which were eligible to receive support for advice services received support for this innovation activity[3]. Similarly, 11.8% of research plus firms that introduced a process innovation and were therefore eligible for support received public support for this form of innovation.

With the exception of the use of advice services and hiring subsidies, a higher percentage of the more innovative firms use each public support programme than the less innovative firms. For example, only 4.6% of minimal innovators that conducted market research for an innovation obtained a public support for this activity, compared to 16.9% of 'research plus' innovators.

[3] In reference to Table 4, this is 37.7% of the 10.1% of minimal innovators that use advice services, or (2.5% + 1.3%)/10.1%.

These results show that most forms of public support benefit the most innovative firms. However, the small difference in the percent of firms that find public support to have been 'crucial' to their ability to innovate (last row in Table 6) is not statistically significant, suggesting that the policy payoff to less innovative firms is greater than the payoff for policy support to more innovative firms. This is because the minimal innovators use, on average, approximately half the number of support programmes than the research-plus innovators (1.03 versus 1.97 programmes), indicating that the probability for minimally innovative firms to find policy support to be crucial to their innovative activities is almost double that of the research-plus firms.

Table 6. Percent of eligible firms by innovative capability using each type of public subsidy

		Level of innovative capability			
		Non creative		Research based	
Area of public support	N[1]	Minimal	Minimal plus	Research	Research plus
1. Advice services	1312	37.7	32.8	37.9	40.8
2. Market research	1647	4.6	11.8	11.2	16.9
3. Research	446	-[2]	8.7	12.5	17.0
4. Collaboration	303	2.3	6.1	5.2	9.7
5. Hiring	145	-	9.9	-	10.0
6. Training	520	-	14.8	-	19.3
7. Networking	207	5.3	23.5	47.5	41.3
8. Process innovation	254	2.8	6.4	11.4	11.8
Mean no. programmes used	1454[3]	1.03	1.52	1.57	1.97
% reporting support crucial	1454[3]	18.8	20.0	26.5	25.9

1: Unweighted number of firms *eligible* for each type of innovation support programme by undertaking the relevant innovation activity. There are statistically significant differences by innotype in the distribution of the percentage of firms that use each form of public support except for advice services. The differences in the percent of firms that find support 'crucial' is also not statistically significant.
2: Not relevant - the type of innovation activity excludes the use of the specific form of public support.
3: Eligibility determined by receiving at least one form of public support for innovation activity.

3. Benefits of Policy Support for Innovation

An important policy issue is the value of innovation programmes for SMEs. The goal is to support policies with the largest benefits per Euro of programme cost. Innobarometer 2004 cannot directly answer this question, but it does provide alternative estimates of the value to firms of innovation programmes through two relevant questions. The first question was used in the last row of Table 6:

1. Was public support in the last two years crucial to any of your innovation projects, such that the innovation would not have been developed without the support?
2. [For respondents that used two or more innovation programmes] Which was the first and second most valuable to your firm?

Of note, a particular programme can be useful to a firm (option 2 above) without being crucial to the development of the innovation (option 1). This section only provides results for the first option of crucial support. The results for the second option are available in the *Flash Innobarometer 2004* report.

Overall, 24% of firms responded that public support was crucial to the development of at least one of their innovations. Not surprisingly, the percentage of firms that report "crucial policy support" increases with the number of policies used: 15.5% of firms that used one policy, 29.8% of firms that used two, 27.5% of firms that used three, 58.3% of firms that used four, and 63.6% of firms that used five policies. The percentage is roughly in multiples of 15% for using two (29.8%) and four programmes (58.3%), implying that the probability of finding policy support crucial is roughly constant per number of programmes used.

For space reasons, the question on crucial policy support does not ask *which* policy was found to by the respondents to be crucial, but an estimate of the value of each policy can be obtained from the results for 59.1% of programme users that used only one programme. In this case, the response is likely to refer to this programme alone, although it could also refer to a programme that is not mentioned in the survey[4]. The results are given in Table 7.

Table 7: Estimated success rates by programme (programme 'crucial' for innovation)

	1	2	3	4
Programme assistance for:	**Users rating programme as 'crucial'**	**Number of programme users[1]**	**Est. number 'crucial' in total sample[2]**	**Percent of all est. 'crucial'[3]**
Innovation advice	11.7%	458	53.6	14.3%
Market research	4.5%	209	9.4	2.5%
Research	23.0%	407	93.6	25.0%
Collaboration	40.1%	295	118.3	31.5%
Hiring new university graduates	5.0%	138	6.9	1.8%
Training for innovation	9.6%	489	13.2	3.5%
Networking	12.4%	210	26.0	6.9%
Adopting process technology	24.0%	224	53.8	14.3%
		2430	375	100.0%

1: Includes firms that only use this programme plus firms that use this programme plus other programmes.
2: Column 1 times column 2.
3: Column 3 / 375.

[4] An alternative method is to use correlation or cluster analysis to identify groups of policies that are frequently used in combination. However, both methods did not identify high enough levels of programme clustering to make this feasible. The highest level of correlation is between the use of programmes to support collaboration and to support research. Of 400 firms that use either programme, 140 or 35% use both of them. On average, the percentage of firms that use both of all two programme combinations is 17.2%.

The first column of Table 7 gives the percentage of firms, by programme, that stated that public support was 'crucial'. We assume that a response of 'crucial' indicates programme success. The second and third columns give estimates of the value of each programme based on 1) the distribution of programme users and 2) the distribution of the total number of firms that would be eligible to use the programme. To be eligible, the firm must report relevant activity, for example only firms that conducted market research would be eligible to receive programme assistance to conduct this type of research.

The most successful programme is support for collaboration, with 40.1% firms that used this programme stating that assistance had been crucial to them. For comparison, 23.0% of firms that used a programme to support research report success. Although the programme success rate for collaboration assistance is almost double that of research assistance, more firms used research assistance than collaboration assistance (407 firms versus 295 firms). The third column adjusts for this effect by multiplying the success rate by the number of users of each programme type. The fourth column standardizes the result as the percentage of the total number of firms that reported 'success' with a programme. This gives an estimate of the percentage of all successes due to a specific programme. For example, 31.5% of all estimated 375 "successes" are due to collaboration assistance.

The results in Table 7 need to be interpreted cautiously because they rest on two assumptions:

- Identical success rates among firms that use one versus multiple programmes,
- The question on programme success (crucial) refers to this one programme and not to other programmes that were not evaluated in the questionnaire.

If we accept these caveats, the results show that the highest success rate is for programmes to support collaboration, followed by programmes to support research and the adoption of process technology. Programmes to support market research stand out as having very low success rates.

Another factor needs to be considered in any evaluation of these results. Although collaboration support has a high success rate and assistance for market research has a very low success rate, there is a substantial difference in the cost of these two types of assistance programmes, with the former substantially more costly than the latter. This would influence the cost-benefit ratios of programme evaluation.

The estimated programme success rates in Table 6 will probably be most useful when programme costs are approximately equivalent. For example, the cost of supporting research or collaboration could be roughly the same, but collaboration has a much larger success rate. Similarly, the cost of support programmes for innovation advice and market research are likely to be roughly comparable, but a higher percentage of firms find advice programmes of crucial importance.

Of note, the *Flash Eurobarometer* report finds that 50% of firms that used more than one programme report that innovation support for staff training was the most important form of support, followed by support for process innovation (42% of users) and in-house research (36% of users). In contrast, the results in Table 7 for crucial

programme assistance (an innovation project would not have been developed without the support) ranks support for collaboration first, followed by support for in-house research and thirdly support for process innovation. Very few firms find support for training to be of crucial importance. The difference in the two sets of results for training programmes highlights the disparity in firm expectations. Training support is clearly very useful to many firms but is rarely of crucial importance, in the sense that the firm would not have been able to complete an innovation project without it. This could be due to the low cost of many training programmes, whereas the higher cost of participation in collaboration or in-house research may make these activities financially out of reach for SMEs without programme support.

3. Logit Model Results for the Use of Innovation Support Programmes

A main disadvantage of the descriptive results given above is that programme use will be influenced by a range of factors, some of which may act as confounders. For example, firm size and innovative capability are positively correlated. Part of the increase in the use of innovation programmes with increasing innovative capability could simply be due to confounding by the fact that the more innovative firms are larger, on average, than the less innovative firms.

Multivariate regression analysis provides a statistical technique for evaluating the effect of each of several variables while controlling for the effect of all other variables. This technique makes it possible to identify whether innovative capability, for example, influences programme use after controlling for the effect of other characteristics of the firm.

This section summarizes the results of logit regression analysis to simultaneously evaluate a range of firm characteristics on the use of:

1. Any innovation support programme, and
2. The use of each of the eight separate innovation programmes covered in Innobarometer 2004.

All regressions are limited to firms that are eligible for each programme. The firm characteristics include the country of location, firm size, the largest market (national, other EU, global), the firm's innovative capability, sales growth, whether or not it introduced a product or a process innovation, and the firm's sector of activity. Of note, many of the variables for the firm characteristics are what are called 'dummies' that can take only one of two possible values: the firm has the characteristic or it does not. For example, a firm is either active in the manufacturing sector or it is not. When dummies are used, the reference category for comparison is set to a specific characteristic. In this model, the reference category for sector consists of wholesale and retail trade. Therefore, programme use by firms active in other sectors, such as transportation or finance services, are compared against programme use by firms active in the trade sector.

The technical details and full results for the logit regressions are given in the Annex. This section summarizes the main findings.

3.1 Results by Programme Use

This section summarises firm characteristics that are significantly correlated with the use of any innovation support programme and for each of the eight individual programmes.

Any use of an innovation support programme: The use of at least one programme increases with firm size, sales growth, process innovation, product innovation, and is higher in three sectors (extraction and construction combined, manufacturing, and other services) than in the reference category of trade services. Of particular note, an increase in innovation capability is strongly correlated with the use of any innovation support programme, with firms that perform research and invest in human resources (research +) over seven times more likely to use at least one programme than firms that are only minimal innovators with no research activity and no investment in the innovative capabilities of their staff. Overall, the firm's largest market has no effect on the use of any innovation support programme ($p = 0.07$), but firms active in national markets are less likely to use innovation support programmes than firms active only in regional and local markets.

Use of a programme to support market research: Sales outside of a regional or local market decreases the probability of receiving support for market research, suggesting that use of such programmes is more prevalent among firms that might wish to enter new markets. Sales growth is positively correlated with the use of programmes to support market research, but the strongest effect is by innovative capability. Firm size and whether or not the firm is a product or process innovator has no effect. These programmes are most likely to be used by firms in manufacturing and other services.

Use of a programme to support research: Only firm size and activity in the manufacturing and other services has a significantly positive effect on the probability that the firm uses programmes to support research. The firm's market and sales growth have no effect.

Use of a programme to support hiring: Firms active in larger markets are less likely to use this form of subsidy, while process and product innovators are more likely to use these programmes. There are few differences by sector, with the exception of greater use by firms active in extraction and construction.

Use of a programme to support collaboration: The most important predictor of use of these programmes is innovative capability and sector, with firms active in manufacturing, other services and transportation more likely to use these programmes than firms active in trade. The largest firm category is also more likely to use these programmes compared to firms with 20 to 49 employees.

Use of a programme to support training: The only differences in the use of these programmes are by sector, with higher probabilities of use among firms in extraction and construction, manufacturing, and other services compared to the trade sector.

Use of a programme to support networking: The use of these programmes is strongly correlated with innovative capability. All sectors, other than finance, are more likely to use these programmes than firms in the trade sector.

Use of a programme to support process innovation: Firm size and innovative capability are strongly correlated with the use of these programmes. There are also expected sector effects, with use highest in manufacturing and other services.

Use of a public innovation advice services: None of the firm characteristics influence the use of advice services, except for sector effects. Except for finance, all sectors are more likely to use these services than firms in the trade sector.

3.2 Results by Selected Firm Characteristics

Section 3.1 gives the logit results for each programme type. This section summarizes the effect of each firm characteristics on the use of innovation support programmes.

Firm size has no effect on the use of most programmes, but larger firms are more likely than smaller firms to use programmes that benefit higher innovation capabilities such as research and collaboration. Firm size is also positively correlated with the use of programmes to support process innovation, possibly because larger firms are more likely to have complex and/or processes.

The firm's largest *market* area has no significant effect on the use of most programmes, except for hiring, where firms that are only active in a local or regional market are more likely to receive a subsidy for hiring. The lack of an effect for the firm's market suggests that innovation subsidies do not preferentially support firms that face greater international competition.

Innovative capability is the strongest predictor of the use of innovation support programmes. The only programme where more innovative firms are no more likely than less innovative firms to receive a subsidy is the use o public advice services. Of note, it is not possible to fully evaluate the effect of innovative capability on research, hiring and training because these factors are either fully or partially included in the definition of innovation capability.

High *sales growth* is only associated with the use of any support programme and with the use of support for market research. The latter is encouraging and suggests that such policies may assist firms with increasing their markets.

3.3 Policy Use and Sales Growth

One of the goals of innovation policy is to encourage and support firm competitiveness, which can partly be measured through improvements in employment, sales and profitability. The Innobarometer 2004 survey only includes data on sales growth between 2002 and 2003. In the logit model analyses summarized in section 3.2, sales growth is one of several independent variables that are correlated with policy use. This section looks directly at the effect of the use of any innovation support programme on sales growth itself. As with the logit model, the use of an identical two-year period for the use of policies and the change in sales limits interpretation to a simple correlation. Complete results are given in Annex B.

The variable for sales growth is measured on an ordinal scale with five levels: 1) decrease in turnover, 2) no notable change, 3) increase up to 5%, 4) increase between 5% and 25%, and 5) an increase of over 25%. This requires the use of a different regression model, but the interpretation of the results is similar. Annex B provides a full description of the model and gives the complete results. Two models are used. The first model includes all firms while the second is limited to firms that used one or more innovation support programmes.

Our main interest is if any policy use is correlated with an increase in sales share (after controlling for other factors) and if firms that find policy use to have had a crucial impact on their ability to innovate are more likely to have an increase in sales share than firms that use policies but did not find them to be crucial[5].

The two models for sales share include two different independent variables compared to the logit models in section 3.2 for programme use.

First, the models include a variable for recent hiring of a university graduate. Not surprisingly, this factor is positive and significant, since firms are most likely to hire when sales are increasing. However, the models do not include a variable for innovative capability because this partly depends on hiring activity.

Second, the model results combine countries into four groups based on their innovative capability as measured by the Summary Innovation Index for 2004 in the European Innovation Scoreboard. The reference category includes the leading innovative countries of Sweden, Finland, Germany, Denmark, and the UK[6]. The analysis shows that there is no difference in sales growth among firms located in the medium and medium-low countries compared to the reference category of the leading innovative countries. In contrast, sales growth is positive and highly significant in the 'low innovative' countries, all of which are new member states with the exception of Greece. This effect is likely to be due to the ability of innovative firms in the new member states to benefit from higher economic growth rates.

Our key interest here is in the two policy indicators: the use of any programme to support innovation in the first model and the finding that policy support was crucial in the second model, which is limited to firms that used one or more innovation support programmes. Any policy use is positively and significantly correlated with sales growth, but the firms that find policy support to be crucial are significantly less likely to report higher growth rates than firms that use policies but do not find them of crucial importance. These results are also true when the models include the full set of country dummy variables (results by country not shown in Annex B). The negative

[5] Of note, it is not possible to look at the effect of specific policies on sales share because these are based on conditional probabilities. For example, the use of a policy to support research is conditional on the firm conducting research. Therefore, the reference category for a variable for policy use for research (yes or no) includes both firms that perform no research and firms that perform research but did not receive policy support. This makes it difficult to interpret results for specific policies.

[6] The medium innovative countries include Belgium, France, Netherlands, Ireland and Austria; the medium-low group includes Estonia, Slovenia, Italy, Spain, Portugal and Luxembourg, and the low innovative group includes Malta, Czech Republic, Lithuania, Hungary, Slovakia, Greece, Latvia, Cyprus, and Poland.

correlation with crucial policy support could be due to these firms turning to support because of a failure so far to benefit from their innovation investments.

3.4 Are Innovation Support Programmes Succeeding?

The results of the multivariate analyses show that any use of an innovation support programme is positively correlated with an increase in sales, which is an encouraging result. However, whether or not support programmes are succeeding or failing depends on the goal of programmes to support innovation among SMEs. If the goal is to encourage less innovative SMEs to increase their innovative capabilities, then the results would be discouraging because programme use is much greater among the more innovative SMEs. Given that the main beneficiaries are highly innovative SMEs, it is surprising that these programmes are not positively correlated with activity in global markets and rarely with sales growth. This suggests that programme use is greatest among SMEs with high innovative capability but which have difficulties in entering global markets or rapidly increasing sales. This suggests widespread policy failure if the goal is to target the "winners".

Conversely, if the goal of innovation policy is to support innovative firms that have been unable, so far, to turn their innovations into commercial successes, then these policies have successfully reached their target. This also supported in Table A-2 by the negative correlation between sales growth and crucial importance of innovation support programmes, which indicates that these programmes are most valuable to firms that are experiencing difficulty with increasing sales. It remains to be seen if this policy support can increase future sales or assist firms that are active in local and regional markets to break into larger more competitive markets.

The sector results for the use of innovation support programmes show that policy support continues to be directed towards the manufacturing sector, although other services have been benefiting as well.

4. Effect of Regulation

Survey questions on the effect of regulation on firm activities always raise the problem of biased responses. This can be due to the respondent's wish to influence policy in a direction that is favourable for his or her firm or due to a general belief that any form of regulation is undesirable. In order to minimize this effect, Innobarometer 2004 did not directly ask if regulation was a problem for the firm itself. Instead, Innobarometer 2004 asks if national product and process regulations placed 'your firm at a *competitive disadvantage compared to your competitors*."

A high level of 'yes' responses to a regulatory question in a specific country indicates that the regulation gives an advantage to one group of firms over another. For example, strict national process regulations could treat all domestic firms equally, but give a competitive edge to firms that manufacture products in countries with more lenient process regulation. Alternatively, firms that are unable to invest in the most efficient clean production technology, either due to high equipment costs or a lack of innovative capability, may be placed at a competitive disadvantage compared to national competitors that have already made such investments. In the former case the regulation unfairly places domestic firms at a disadvantage while in the latter case the

result might suggest that process innovators could benefit from national programmes to encourage innovation that meets regulatory requirements, such as advice services or subsidies for process innovation. The second possibility, which could be of concern to policy, is that a high level of 'yes' responses indicates that many innovative SMEs are unable to respond to the challenges of the regulation.

The Innobarometer 2004 questions on regulation include four sub-questions on specific product regulations (environmental, consumer protection, safety, and product design characteristics) and three sub-questions on specific process regulations (environmental, consumer protection, and safety).

The Flash Eurobarometer report of November 2004 provides the percentage of product and process innovators in each EU member state that report a competitive disadvantage from each type of regulation. This report goes a step further by providing descriptive results for the percentage of product innovators and all innovators that report *any* regulatory disadvantage and uses multivariate regression to evaluate the effect of several variables of interest.

4.1 Competitive disadvantage from any product or process regulation

Figure 3 gives the percentage of firms, by country, that find at least one of the four types of product regulations to place them at a competitive disadvantage compared to their competitors. The results are given both for firms that 1) introduced a product innovation on the national market and 2) for all innovative firms. Product innovators in the UK, Ireland and Germany are most likely to report a competitive disadvantage from product regulation, while the lowest rates are in Slovakia, Estonia and Spain.

The second set of columns in Figure 3 gives the rate for all innovators, many of whom have not introduced a product innovation. These results show the background level of product regulation problems for all innovative firms. Of note, the UK is no longer in first place (this position is taken by Poland). This is because product innovation is less prevalent among UK firms than firms in other countries such as Germany, Poland or the Netherlands.

Figure 4 provides the same results for the percentage of process innovative firms and all innovative firms that report that one or more process regulations places them at a competitive disadvantage. Process regulations are most problematic for firms in Ireland, Belgium and the UK and the least problematic in Estonia, Slovakia and Spain.

There is no correlation between the SII and the percentage of product and process innovative firms that report that regulation creates competitive disadvantages[7].

[7] The R2 values with the SII are as follows: 0.025 for product innovators only and 0.024 for process innovators only; 0.021 for product regulation using all innovative firms and 0.007 for process innovation using all innovative firms.

Percent of innovative SMEs (20 to 499 employees) who report that one or more PRODUCT or SERVICE regulations placed them at a competitive disadvantage compared to their competitors

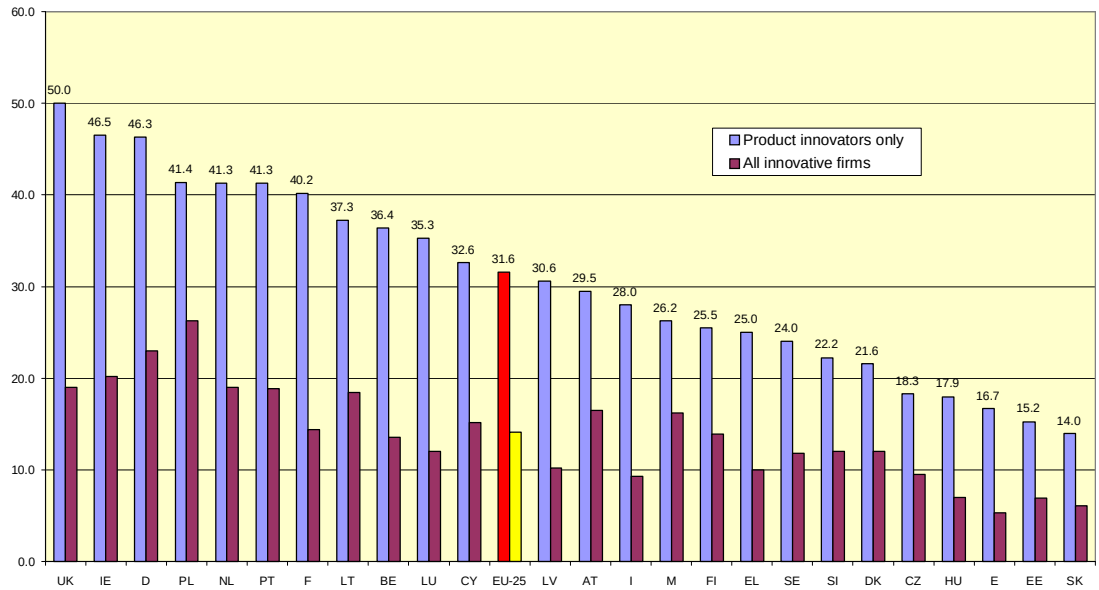

Figure 3

Percent of innovative SMEs (20 to 499 employees) who report that one or more PROCESS regulations placed them at a competitive disadvantage compared to their competitors

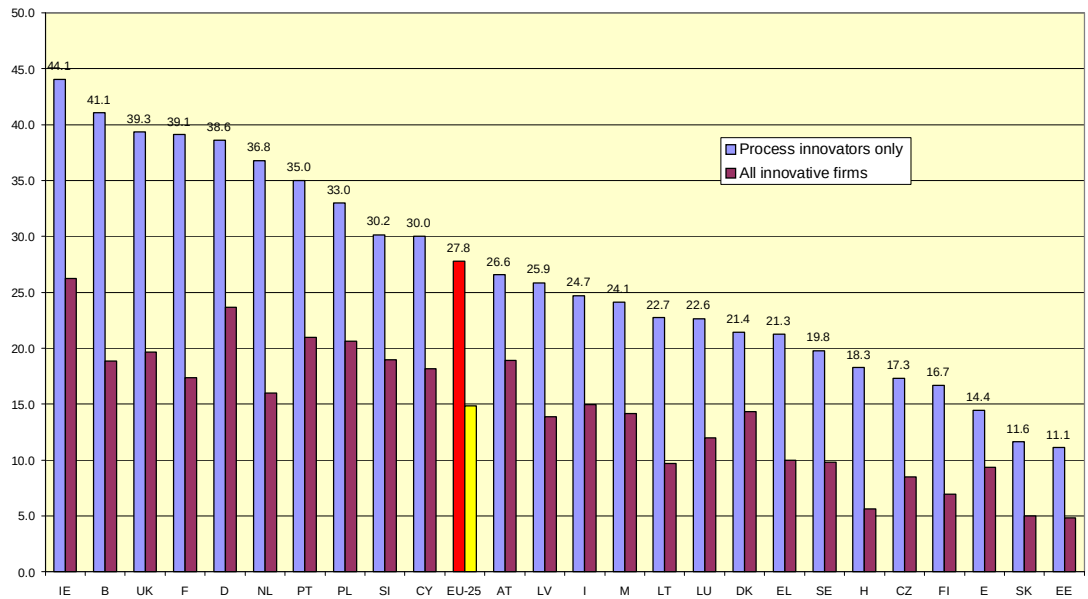

Figure 4

A comparison of the results in Figures 3 and 4 might suggest that product regulations are more frequently cited as creating competitive disadvantages than process regulations. However, this comparison is inaccurate because there are four different types of product regulation, versus only three for process innovation and there could be differences in the types of firms that develop only product or only process innovation. Figure 5 provides a more accurate test of which type of regulation creates greater comparative disadvantages. The results are from 1,913 (unweighted) firms that introduced *both* a product and a process innovation. In addition, the percentages for both product and process regulation are limited to an identical set of three regulatory types that are asked of both product and process innovators: environmental, consumer protection, and safety regulations. Process regulations create more difficulties for firms in countries above the diagonal line while product regulations are more problematic in countries below the diagonal line. Figure 5 shows that process regulation is more likely to create competitive disadvantages than product regulation in the majority of EU countries. The two are also correlated, with an R^2 of 0.47.

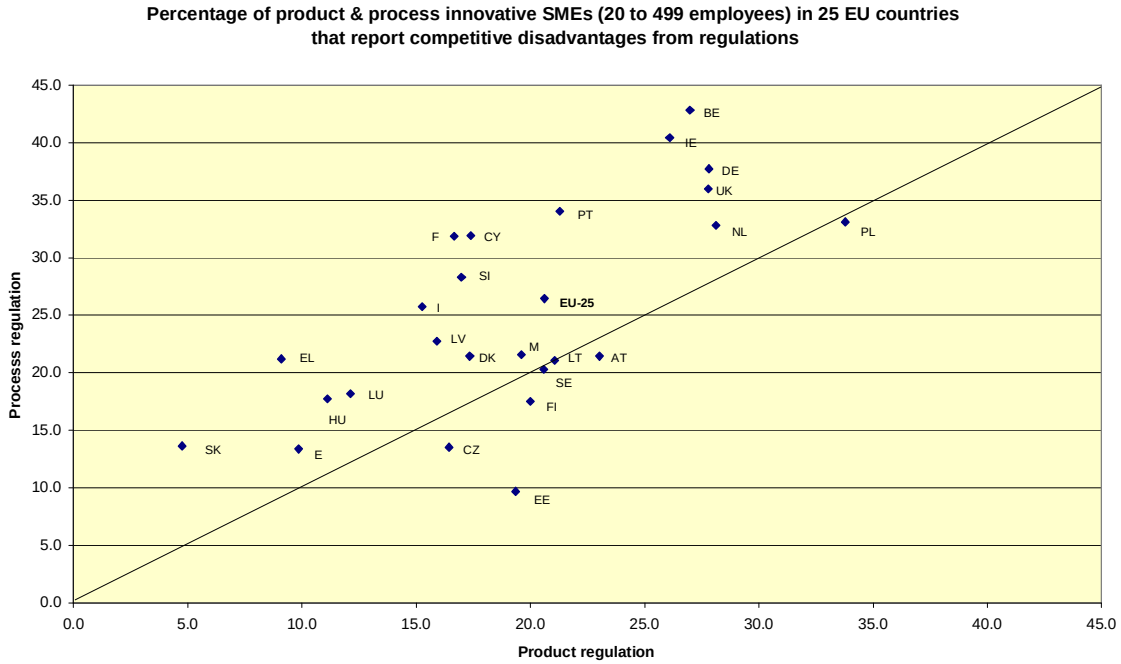

Figure 5

4.2 Regression results

Table 8 gives logit model results (See annex A for a description of logit model techniques and interpretation) for the effect of several factors on whether or not a firm reports that at least one product regulation creates a competitive disadvantage and if at least one process regulation creates a competitive disadvantage. Each model includes variables for firm size, the firm's largest market area (regional, national, other EU, and outside of the EU), innovative capability, sales growth, the firm's sector of activity, and the country of location. In addition, the model for process innovation includes a variable for whether or not the firm participated in an innovation support programme for process innovation.

A simple interpretation of Table 8 is as follows. An exponent (Exp(B)) greater than 1.0 and which is statistically significant (Sig. < 0.05) indicates that the factor increases the probability that firms find that regulation creates a competitive disadvantage. Conversely, an exponent less than 1.0 shows the opposite. In each case, the effect of the factor is compared to a reference category.

Table 8 Logit model results for competitive disadvantages due to product or process regulations

	Product regulations		Process regulations	
	Exp(B)	Sig.	Exp(B)	Sig.
Firm size		0.058		0.084
50 – 249 emps	1.001	0.992	0.998	0.984
250 – 499 emps	0.714	0.024	0.738	0.033
Market		0.313		0.526
National	0.771	0.131	0.823	0.187
Other EU	0.991	0.960	0.947	0.737
Other world	0.883	0.454	0.960	0.780
Innovative capability		0.002		0.058
Minimal +	1.623	0.014	1.549	0.009
Research	1.385	0.148	1.421	0.075
Research +	1.975	0.000	1.506	0.012
Sales growth		0.601		0.181
Up to 5%	0.870	0.313	0.936	0.596
Over 5%	0.945	0.621	0.821	0.068
Process innovation support			1.102	0.530
Sector of activity				
Extraction/construction	1.572	0.015	1.426	0.027
Manufacturing	1.394	0.015	1.252	0.083
'Other services'	0.891	0.447	0.876	0.371
Transportation services	1.610	0.097	1.184	0.437
Finance services	0.896	0.648	0.830	0.487

Notes: Model chi-squares statistically significant ($p < .000$). Reference categories: 20 – 49 employees for firm size, regional markets, minimal innovative capability, sales change of less than 5%, wholesale and retail trade for sector. Both models include controls for the firm's country of location (results not shown).

Neither the firm's market area or sales growth has any correlation with comparative disadvantages from product and process regulation, while receiving innovation support for process innovation has no effect on the comparative disadvantage of process regulation, indicating that such support is not used to reduce comparative disadvantages. The largest firms (250 to 499 employees) are less likely than the smallest firms to find that product and process regulation creates a comparative disadvantage. Firms active in the construction/extraction and manufacturing sectors are more likely to report product regulation as a problem, while only firms active in the construction/extraction sectors are more likely to report a problem with process regulation.

The most consistent factor that increases the probability that regulation creates competitive disadvantages is innovative capability, which is particularly important for product regulation. The more innovative firms could be introducing new products (and processes) that represent a larger technological leap, require additional investment to ensure that the new technology meets regulations.

Table 8 does not give the results by country, but the rank order of the regression coefficients by country is strongly correlated with the results in Figure 3 for product innovation ($R^2 = 0.90$) and Figure 4 for process innovation ($R^2 = 0.94$)[8]. This indicates that only 10% of the variation in the rank order by country for product regulation and 6% of the variation for process innovation is due to other potentially confounding factors. For example, the fact that a higher percentage of UK firms report competitive disadvantages from regulation is not due to UK firms being smaller, more innovative, and more likely to be active in manufacturing compared to firms in other countries (three factors that increase the probability of reporting competitive disadvantages from regulation).

[8] In this analysis, the reference country for product regulation equals the UK (the highest rate of problems with product regulation) and the reference country for process innovation equals Ireland. Since all coefficients are dummy variables compared to the reference country, the distance between the coefficients approximates the relative ranking of each country compared to all other countries.

Annex A: Logit Model results for the Use of Innovation Support Programmes

A logit model is suitable when the dependent variable can only take one of two options. In the results given here, the dependent variable *y* is either set equal to zero (the specified programme is not used) or 1 (the specified programme is used). The independent variables X_i influence the probability that *y* equals 1. Since all independent factors are measured at the same point in time, the results can only be interpreted as correlations (X_i is correlated with programme use). This means that the direction of the relationship is undefined. For instance, we do not know if factor X_i led firms to adopt the programme, or if programme use led to factor X_i.

The logit model assumes that there is an unobservable variable y_i^* such that

$y = 1 \quad if \quad y_i^* > 0$
$y = 0 \quad if \quad otherwise,$

and y_i^* is defined by

(1) $\quad y_i^* = \beta' X_i + \varepsilon_i,$

where ε_i has a distribution function *f* derived from the logistic cumulative distribution function:

(2) $\quad F(x) = \dfrac{1}{1+\exp(-x)}.$

Then, given the characteristics X_i of individual *i*, we have:

(3) $\quad \text{Prob}\ (y_i = 1) = 1 - F(-\beta' X_i) = \dfrac{\exp(\beta' X_i)}{1+\exp(\beta' X_i)}.$

The independent variables, or factors of interest (*X*), include firm size, the firm's market, innovative capability, sales growth, whether or not the firm has introduced a product and a process innovation, and the firm's sector of activity (trade is the reference category). The results are given in Table A-1. Of note, although it would be of great interest to evaluate the effect of firm characteristics on policy use within each country, for many countries there are an insufficient number of cases for a logit model analysis.

Table A-1. Logit model results for use of innovation support programmes

	ANY USE		MARKET		RESEARCH		HIRING		TRAINING		NETWORK		PROCESS		ADVICE		COLLABORATE	
	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.
Firmsize		0.037		0.232		0.008		0.810		0.645		0.834		0.037		0.200		0.118
50 - 249 emps	**1.19**	0.034	0.97	0.863	**1.43**	0.005	1.10	0.680	1.08	0.510	0.95	0.813	**1.41**	0.039	0.85	0.249	1.21	0.196
250-499 emps	**1.24**	0.046	0.66	0.096	**1.41**	0.023	0.93	0.771	1.14	0.407	1.11	0.672	**1.53**	0.026	0.73	0.094	**1.40**	0.048
Market		0.070		0.072		0.056		0.029		0.366		0.548		0.296		0.711		0.305
National	**0.77**	0.013	0.73	0.219	0.76	0.144	**0.54**	0.023	0.90	0.502	0.99	0.967	0.94	0.805	0.84	0.375	0.75	0.163
Other EU	0.82	0.090	**0.44**	0.008	0.79	0.223	**0.42**	0.012	0.98	0.891	1.11	0.747	0.75	0.293	0.83	0.395	1.01	0.953
Other world	0.90	0.316	0.69	0.138	1.09	0.613	**0.51**	0.013	0.78	0.120	1.40	0.273	1.13	0.597	0.95	0.803	1.04	0.852
Innov. Capability		0.000		0.002		0.002						0.106		0.011		0.350		0.000
minimal +	**4.25**	0.000	**3.61**	0.019					1.00	0.976	2.72	0.107	**2.15**	0.018	0.81	0.440	**2.68**	0.002
Research	**3.01**	0.000	**3.74**	0.021	0.68	0.102	**1.55**	0.046			**4.25**	0.027	**3.05**	0.001	1.11	0.731	**2.23**	0.020
Research +	**7.00**	0.000	**5.81**	0.001	1.16	0.463					**3.67**	0.032	**2.56**	0.003	1.05	0.848	**4.10**	0.000
Sales growth		0.003		0.060				0.469		0.144		0.024		0.336		0.296		0.557
up to 5%	1.18	0.087	1.42	0.124	1.02	0.870	1.35	0.271	0.91	0.502	0.61	0.066	1.27	0.203	1.30	0.119	0.86	0.397
over 5%	**1.32**	0.001	**1.58**	0.019	1.26	0.068	1.26	0.294	1.18	0.173	1.26	0.273	1.23	0.202	1.12	0.426	1.04	0.808
Process innov	**1.32**	0.000	1.42	0.055	1.05	0.681	**1.50**	0.050	1.03	0.804	0.73	0.122			0.93	0.594	**1.46**	0.006
Product innov	**1.30**	0.002	0.89	0.618	1.30	0.058	**1.75**	0.039	1.08	0.552	0.91	0.694	1.10	0.611	1.35	0.060	1.13	0.441
Sector dummies																		
extraction/const.	**1.79**	0.000	1.63	0.132	1.35	0.178	**2.03**	0.036	**1.49**	0.030	**2.45**	0.025	1.40	0.211	**2.21**	0.000	1.52	0.125
Manufacturing	**1.94**	0.000	**2.17**	0.001	**2.23**	0.000	1.50	0.194	**1.41**	0.031	**1.98**	0.037	**2.01**	0.001	**1.82**	0.001	**2.63**	0.000
other services	**1.75**	0.000	**2.02**	0.005	**1.98**	0.000	1.71	0.098	**1.45**	0.018	**2.86**	0.001	**1.79**	0.011	**1.68**	0.006	**2.83**	0.000
Transportation	1.29	0.177	1.52	0.424	0.99	0.981	1.44	0.548	1.22	0.488	**3.44**	0.025	0.71	0.431	**2.56**	0.005	**3.06**	0.000
Finance	1.02	0.921	1.17	0.720	0.84	0.606	1.40	0.435	1.29	0.349	0.95	0.939	0.32	0.066	0.69	0.294	1.80	0.102
R square		0.180		0.140		0.12		0.090		0.150		0.150		0.150		0.140		0.100

Reference categories for categorical variables: firm size: 20 – 49 employees; Market: regional market only, Innovative capability: minimal, level 1; Sales growth: decreased or unchanged combined. All models are statistically significant with $p < 0.000$. Coefficients with a significance of $p < 0.05$ are marked in **bold** font.

All regressions are limited to firms that are eligible for each programme and include dummy variables for each of 24 EU member states (Germany is the reference country) to control for differences by national innovation systems[9].

All of the independent variables in the regression have a reference category for comparison that is not given in Table A-1. For example, the variable "market" equals the largest market in which the firm is active. The reference category consists of firms that are only active in the smallest market, which is a regional market. The odds ratio for each market type is the probability that firms in this particular market will use the innovation support programme compared to firms that are only active in the regional market. The variable ' market' covers increasing market size, with 'Other EU' including firms that sell products or services in other EU countries, while 'Other world' includes firms that sell products or services in countries outside the EU.

The reference category for the sector dummies consists of ' trade and distribution', which includes both wholesale and retail. The sector 'other services' includes all business services other than trade, transport and finance. 'Other services' therefore includes communications, real estate renting and business activities; and hotels and restaurants. The largest share of innovative firms in 'other services' are likely to come from highly innovative service sectors such as computer and related activities and firms specializing in research and development.

Table A-1 gives the odds ratio or the exponent of each coefficient because the odds ratio is simpler to interpret. The odds ratio is the relative probability that the characteristic increases or decreases programme use compared to the reference category. Odds ratios above 1.0 give the percentage increase while odds ratios below 1.0 show a percentage decrease compared to the reference category. In the analysis of the use of any innovation support programme, the odds ratio of 1.24 for firms with over 249 employees indicates that these firms are 24% more likely to use any innovation support programme than the reference category of firms with 20 to 49 employees. In the analysis of hiring, the odds ratio of 0.54 for activity in a national market indicates that these firms are 46% *less* likely (1 - 0.54) to receive support for hiring than firms that are only active in a regional or local market.

[9] In order to obtain unbiased significance values, the analyses are unweighted. The inclusion of country dummies adjusts for different sampling fractions.

Annex B: Ordered Logit Model results for the Effect of Innovation Support Programmes on the Change in Sales Share

In the logit model analyses in Table A-1, sales growth is one of several independent variables that are correlated with policy use. This section looks directly at the effect of these factors on sales growth itself.

The variable for sales growth is measured on an ordinal scale with five levels: 1) decrease in turnover, 2) no notable change, 3) increase up to 5%, 4) increase between 5% and 25%, and 5) an increase of over 25%. In this case, a logit model can not use all of the available data and would require collapsing categories into two outcomes, such as in a comparison between sales growth over 5% ($y = 1$) and growth less than 5% ($y = 0$). The alternative is to use an ordered logit (or probit) model that can use the full range of ordinal outcomes. The model assumes that the dependent variable y is generated by a continuous latent variable y^* whose values are unobserved. The model assumes a set of ordered values ($\bullet_1, \bullet_2, .. \bullet_{n-1}$) and a variable y^* such that:

$$
\begin{aligned}
& y = 1 \quad if \quad y^* < \mu_1 \\
(4) \qquad & y = k \quad if \quad \mu_{k-1} < y^* < \mu_k \quad for \quad 1 < k < n \\
& y = n \quad if \quad \mu_{n-1} < y^*
\end{aligned}
$$

The unobserved variable y^* is modeled as a linear function of the (N,k) vector of exogenous variables X:

$$(5) \qquad y_i^* = \beta X_i + \varepsilon_i, \quad i = 1,....N,$$

Given the characteristics X_i of individual i, the probability that y_i is found in category k is:

$$
\begin{aligned}
(6) \qquad & \text{Prob } (Y_i = 1 / X_i) = F(\mu_1 - \beta X_i) \\
& \text{Prob } (Y_i = k / X_i) = F(\mu_k - \beta X_i) - F(\mu_{k-1} - \beta X_i) \\
& \text{Prob } (Y_i = n / X_i) = 1 - F(\mu_{n-1} - \beta X_i)
\end{aligned}
$$

with n number of categories. As shown in (6), the model calculates a separate equation for each level of the dependent variable (sales share), which gives the probability of being in category k plus any category below this level.

As with the logit model, the use of an identical two-year period for the use of policies and the change in sales limits interpretation to a simple correlation.

The results for two ordered logit models are given in Table 8. The first model includes all firms while the second is limited to firms that used one or more innovation support programmes.

Table 8. Ordered Logit model results for sales growth (2002 to 2003)

		All firms		Programme users only	
		Coefficient	**Sig.**	**Coefficient**	**Sig.**
Threshold	[μ = .00]	**-1.118**	0.000	**-1.608**	0.000
	[μ = 1.00]	0.064	0.543	**-0.415**	0.049
	[μ = 2.00]	**1.026**	0.000	**0.601**	0.004
	[μ = 3.00]	**3.270**	0.000	**2.922**	0.000
Firm size	50 - 249 emps	**0.247**	0.000	0.189	0.094
	250 - 499 emps	-0.040	0.647	-0.149	0.297
Market	National	0.065	0.426	0.017	0.909
	Other EU	0.092	0.312	0.084	0.613
	Other world	-0.054	0.518	-0.052	0.721
	Process innovator	**0.208**	0.000	0.132	0.199
	Product innovator	**0.268**	0.000	**0.339**	0.004
	Hired recently	**0.456**	0.000	**0.432**	0.000
Policy factors	Any policy use	**0.189**	0.002		
	Policy use crucial			**-0.311**	0.008
Sectors	Extraction/constr.	-0.129	0.167	-0.282	0.107
	Manufacturing	-0.139	0.078	-0.168	0.257
	Other services	**-0.204**	0.013	**-0.375**	0.017
	Transportation	0.093	0.495	-0.345	0.210
	Finance	**0.452**	0.002	0.545	0.059
Country	Medium innovative	-0.056	0.487	-0.188	0.176
	Med-low innovative	0.070	0.385	0.070	0.631
	Low innovative	**0.401**	0.000	**0.376**	0.006
	R square		0.057		0.068
	N		4341		1464

Note: All model chi-squares are significant with $p < 0.000$. Significant results in **bold**.

Our main interest is if any policy use is correlated to an increase in sales share (after controlling for other factors) and if firms that find policy use to have had a crucial impact on their ability to innovate are more likely to have an increase in sales share than firms that use policies but did not find them to be crucial[10].

The threshold values (μ) give the coefficients for a change from one level to another of the sales share. The fact that the threshold values increase consistently and are statistically significant is an indicator of a good model fit.

[10] Of note, it is not possible to look at the effect of specific policies on sales share because these are based on conditional probabilities. For example, the use of a policy to support research is conditional on the firm conducting research. Therefore, the reference category for a variable for policy use for research (yes or no) includes both firms that perform no research and firms that perform research but did not receive policy support. This makes it difficult to interpret results for specific policies.