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AUSTRIA'S PERFORMANCE IN THE AREA OF INNOVATION AND RESEARCH

AN INTERNATIONAL COMPARISON

Received opinion in the economic and technology policy debate has it that Austrian companies make insufficient investments in research and development. An analysis of the Community Innovation Survey (CIS) performed by WIFO arrived at different conclusions.

Expenditure on innovation, and particularly spending on R&D (one of the key indicators to fuel technology policy debates), is used as a yardstick to judge the technological potential and standing of countries and enterprises alike. The importance of R&D expenditure for economic and productivity growth is documented in a large number of studies¹.

By their effect on productivity and economic growth, innovation activities also have an impact on employment at both company and sectoral level, and on the qualifications to be met by the workforce.

R&D is also present in economic and technology debates through the effect emanating from it: innovators are rarely able to internalise every gain from their innovative activities. The knowledge generated and the product and process improvements implemented will yield profits not just for the innovator but also for other businesses and the buyers of the products thus improved or made cheaper. Such effects, while desirable at the macroeconomic level, are not of direct interest to the innovator. The economic gain might be clearly positive while the company itself might find itself unable to earn the cost of innovation on the market and will therefore refrain from putting an innovation into practice.

¹ "Growth accounting" studies have shown that a large part of any growth in productivity can be explained and is induced by R&D. More recent approaches – known as "new or endogenous growth theory" – while putting the analysis on a new theoretical foundation basically confirm the findings of earlier studies (see, e.g., *Klenow – Rodriguez-Clare, 1997*, pp. 597-617).

This article is based on a WIFO study commissioned by Eurostat and the Austrian Federal Ministry of Economic Affairs (Hannes Leo, Bernhard Dachs: *Die Innovationsaktivitäten der österreichischen Wirtschaft*, 2 volumes of 70 and 50 pages, respectively, ATS 900 or EUR 65,41, ATS 500 or EUR 36.34 per volume). Hannes Leo is an economist at the Austrian Institute of Economic Research. The author wishes to thank Gernot Hutschenreiter for his valuable suggestions and contributions. The data were processed and analysed with the help of Sonja Patsios and Gerhard Schwarz.

Looking at this – in macroeconomic terms – highly positive evaluation of innovation, it is only obvious that we ask whether business invests sufficiently in innovative activities. An ongoing debate since the 1960s produced a majority view that innovative activities in any given national economy may well be insufficient and that incentives need to be provided to encourage companies to increase their innovative activities to a macroeconomically desirable level (see, e.g., *Hutschenreiter – Leo, 1998*); such considerations furnish justification for the public promotion of innovative activities.

In recent years it has been repeatedly stressed that rather than assessing and promoting the innovative activities of companies on a case-to-case basis, it is important to put the national innovation system (i.e., all institutions in an economic area which may affect innovative activities) in any given national economy at the centre and focus of technology policy.

Economic policy discussion in Austria has pointed out that Austrian companies tend to invest insufficiently in R&D and that the components of the national innovation system do not co-operate. Such judgements are mostly based on the last official survey of 1993, and are thus open to criticism, not only because data have become quite obsolete (see the discussion of R&D expenditure below) but also because figures on R&D expenditure are limited in their meaning for the issue.

- Companies spend only part (about 40 percent) of their innovation expenditure on R&D. In order to be marketable, a product requires several other inputs (such as design and construction, or changes in the production process).
- The innovatory process differs in its efficiency between enterprises, the consequence of their differing capacity to organise the process, and of their different specialisations and access to relevant sources of knowledge, all of which have a critical impact on the probability of success and thus on the efficiency of their monetary input.
- Expenditure on R&D may have different effects on a firm's development depending on how risky the innovation is. Projects which are neither particularly innovative nor "simple routine" tend to be less likely to succeed.

These restrictions apart, econometric estimates (at least when using Austrian data) show that implemented innovations are better able to indicate a company's performance than variables which measure input (*Leo – Steiner, 1994*).

The Community Innovation Survey (CIS) attempts to close these gaps in terms of obtaining both new data and an indication of their meaning. The survey was carried out si-

Benchmark data of the Community Innovation Survey in Austria

In 1997, Austria for the first time participated in the Community Innovation Survey (CIS) organised by Eurostat. The survey was carried out simultaneously in all EU countries, and it provides a detailed database on innovation activities in Europe in 1996. It covered manufacturing enterprises and also – for the first time – included some services sectors.

The survey supplied the first innovation data for Austria which can be used for comparison at a European scale and which go beyond recording R&D expenditure. WIFO had already performed similar surveys, among them a survey in 1985 (*Volk, 1988*) and a technology and innovation test for industry in 1990 (*Leo – Palme – Volk, 1992*). Considering that the CIS questionnaire differs from the WIFO surveys solely in a few details, rough comparisons are permissible.

The CIS response rate was about 40 percent, which means that 1,017 enterprises of the manufacturing sector provided the analytical base. The data were weighted in order to supply information on the entire manufacturing sector.

multaneously in all EU countries, and it furnishes a comparable and detailed database on innovative activities in Europe in 1996 (see box "Benchmark data of the Community Innovation Survey in Austria"). In Austria, the survey was performed by WIFO on behalf of Eurostat and in cooperation with the Federal Ministry of Economic Affairs, and published both for the manufacturing sector (*Leo, 1999*) and the services sector (*Dachs – Leo, 1999*).

Below, some preliminary international comparisons of innovative behaviour (rate of innovators, innovation expenditure, new and/or improved products as a proportion of total turnover) are given, and the structure of R&D expenditure by the Austrian manufacturing sector is highlighted.

INNOVATIVE CAPACITY AND PERFORMANCE OF MANUFACTURING IN AN INTERNATIONAL COMPARISON

The international comparison of Austria's innovation performance is based on the preliminary CIS figures published by Eurostat (figures for Denmark, Italy, Greece and Portugal are not yet available). Considering that current data are based mainly on the most innovative countries, their average, which was used for comparison with Austrian data, appears to be well above the ultimate EU average.

Today, innovation is a permanent feature of Austrian manufacturing companies. About 67 percent of respondents had introduced some product and/or process innovation between 1994 and 1996 (Figure 1). For more than half of those, innovation activities spanned both product and process innovation. Accordingly, the Austrian propensity to

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innovate is noticeably higher than the EU average of 53 percent. Looking at employment categories, we generally see a higher innovation rate than the EU average in all categories, although the gap narrows with increasing company size.

The survey once again confirmed that the innovation rate rises with company size: it was 60 percent for enterprises of up to 49 employees, and rose to 90 percent for the largest enterprises.

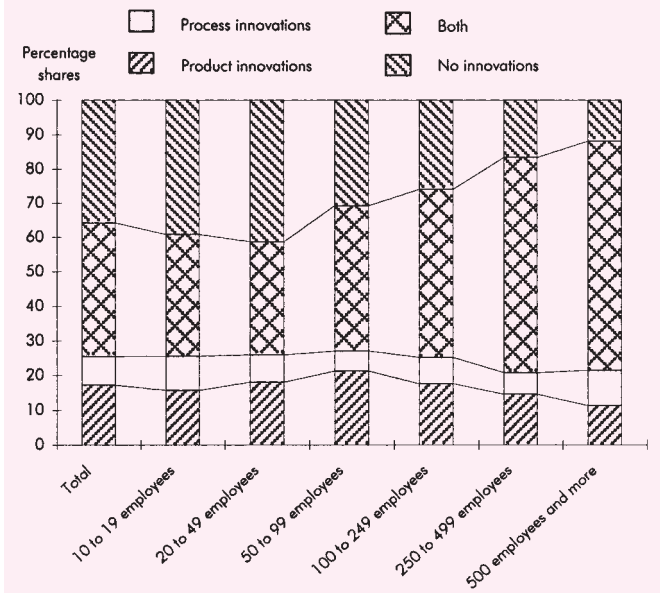
The differences between SMEs and large enterprises are the result of:

- higher entrance barriers faced by SMEs in introducing and implementing innovations,
- less need for SMEs to be constantly innovation-driven.

A larger-sized enterprise may well have 50 or more product types on offer, and in order to retain its competitive edge it needs to be constantly innovative. A small firm, which may produce and sell two or three products, on the other hand is not likely to introduce innovations every year. Its innovative efforts will be irregular, and it will depend on the timing of a survey whether or not it is categorised as innovative. The size of the product range also makes it clear that larger enterprises are more likely to introduce product and process innovations simultaneously. The survey took account of this trend by collecting data from a relatively long time span (three years), a circumstance which explains the large proportion of innovators among SMEs.

Both at the sectoral level and by size category, the rate of Austrian enterprises which reported having introduced product or process innovations is considerably above average (Table 1). It is thus safe to say that Austrian enterprises tend to have turned away from mostly process-oriented innovation: up to the late 1980s, Austrian firms were much more likely to emphasise improving and renewing process technologies, but the innovation survey of

Figure 1: Product and process innovation by employment categories



1990 already provided signs of change (Leo – Palme – Volk, 1992, see also Hutschenreiter, 1994). The latest results indicate that the trend is continuing.

Austrian companies are among the most innovation-gearred enterprises in the European Union.

The innovative propensity of Austrian enterprises about equals that of Ireland, Germany or the U.K. Except for coke, chemicals, rubber and plastic, other non-metallic minerals (NACE 23 to 26), and electricity, gas and water distribution (NACE 40 to 41), the innovation rate, while generally above the EU average, shows similar patterns.

Altogether, Austrian enterprises strongly emphasise the continuous improvement of their products and processes, focusing on incremental innovation, a rather risk-averse but nevertheless promising strategy. Austrian companies carry out a relatively large number of low-funded innovation projects and tend to be cautious with regard to introducing novelties².

Austrian manufacturing enterprises spent about ATS 46.5 billion, or almost 2 percent of GDP, in 1996 to introduce innovations. Almost half of this sum was spent by companies with more than 500 employees. Yet, the innovative performance of SMEs should not be underestimated: firms of 10 to 19 employees invested ATS 3.4 bil-

² When it comes to introducing novelties, Austrian companies usually remain below the EU average.

Table 1: Innovation rates in EU countries

		Belgium ¹	Germany	Spain	France	Ireland	Luxem- bourg	Nether- lands ²	Austria	Finland	Sweden	U.K.	Norway	EU
Innovating enterprises as a percentage of total enterprises														
Total manufacturing		27	69	29	43	73	42	62	67	36	54	59	48	53
Size categories														
Small enterprises	20 to 49 employees	22	63	21	34	68	21	54	59	26	43	54	39	44
Medium-sized enterprises	50 to 249 employees	29	70	43	48	78	52	71	73	40	61	59	56	59
Large enterprises	250 or more employees	50	85	76	75	85	85	84	88	77	79	81	77	81
NACE														
15 to 19	Food products, beverages and tobacco, textiles and leather	17	66	20	38	62	15	56	62	30	40	57	47	45
20 to 22	Wood, pulp and paper, publishing	21	59	21	32	68	43	53	62	30	45	51	36	45
23 to 26	Coke, chemicals, rubber and plastic, other non-metallic minerals	34	69	40	55	79	52	73	50	49	59	62	60	58
27, 28	Basic metals and fabricated metal products, except machinery and equipment	30	59	25	31	68	44	53	68	31	41	56	43	47
29 to 33	Machinery and equipment NEC, electrical and optical equipment	44	81	50	62	88	61	78	83	44	74	70	64	71
34 to 37	Transport equipment and manufacturing NEC	25	70	30	43	77	0	59	82	28	58	52	47	52
40, 41	Electricity, gas and water distribution	60	37	37	24	.	.	58	22	19	.	64	24	36

Enterprises which have marketed new or improved products or processes. – ¹ Preliminary results. – ² Medium-sized enterprises: 50 to 199 employees, large enterprises: over 200 employees.

lion into developing new products and processes. At the industries level, it is mostly companies in the radio, TV and telecommunications sectors (ATS 7.1 billion), mechanical engineering (ATS 5.1 billion), and chemicals sector (ATS 4.8 billion) which have allocated substantial budgets to innovation.

Innovation budgets are mostly spent on intramural R&D (44.9 percent), followed by the acquisition of machines and equipment (34.1 percent), market introduction (6.3 percent), extramural R&D (5.7 percent), employee training (3.2 percent), design and construction (3.0 percent), and other external technologies (2.8 percent).

Expenditure on innovation by Austrian enterprises in terms of turnover is below the European average.

Internationally viewed, Austria still needs to catch up to EU levels. Austrian companies spent about 0.3 percentage points less in terms of turnover on innovation than the EU average (3.8 percent; Table 2):

- Innovative intensity is below the EU average in the NACE sectors 29 to 33 (machinery and equipment NEC, electrical and optical equipment), 34 to 37 (transport equipment and manufacturing NEC, other products, and 40 to 41 (electricity, gas and water distribution).
- It is above the EU average in the NACE sectors 23 to 26 (coke, chemicals, rubber and plastic, other non-metallic minerals), and 27, 28 (basic metals and fabricated metal products, except machinery and equipment).

The only firms to invest disproportionately less in innovation are large enterprises (with more than 250 employees) – at 3.4 percent of turnover, their innovation intensity is about 1 percentage point lower than the EU average. Innovation expenditure by SMEs on the other hand is clearly higher than in the EU at large. The incriminated gap is thus found primarily in R&D-intensive sectors and the large enterprises operating in them. Companies in France, the Netherlands, Ireland and the U.K. invest about the same in innovation as their Austrian equivalents, while those in Sweden, Finland and Germany have a higher innovation intensity.

The importance of indicators showing innovation input is matched by that of output indicators. It is the market success and efficiency of an innovation which decides on the development of a company. The CIS measured the output of innovation activities through the share that new and improved products and novelties had in a company's turnover. On average, innovative Austrian enterprises in the manufacturing sectors achieved 31 percent of their turnover from new and improved products, a rate that is exceeded only by Germany (43 percent) and equalled by Sweden and Ireland (Table 3).

New and/or improved products hold about the same share of turnover as in the EU average. The share is markedly higher (29 percent) for small enterprises, but below average for market novelties. Companies with more than 250 employees perform marginally better than European companies of equal size. Considering that this group is behind in terms of expenditure for investments, these enterprises appear to be quite efficient innovators. Medium-sized companies, on the other hand, remain somewhat below the EU average for their category, in spite of their

Table 2: Innovation intensity in the EU countries

		Belgium ¹	Germany	Spain	France	Ireland	Netherlands ²	Austria	Finland	Sweden	U.K.	Norway	EU
Innovation expenditure as a percentage of turnover													
Total manufacturing		2.2	4.1	1.8	3.9	3.3	3.8	3.5	4.3	7.0	3.2	2.7	3.8
Size categories													
Small enterprises	20 to 49 employees	1.5	3.3	1.0	1.4	2.8	3.0	4.4	1.6	2.6	3.3	2.2	2.3
Medium-sized enterprises	50 to 249 employees	1.2	2.4	1.6	2.2	3.2	1.8	3.1	1.6	2.7	2.9	2.8	2.3
Large enterprises	250 or more employees	2.6	4.7	2.2	4.8	3.7	4.6	3.5	5.1	8.2	3.2	2.8	4.4
NACE													
15 to 19	Food products, beverages and tobacco, textiles and leather	0.5	2.0	1.0	1.0	1.2	1.2	1.5	1.0	1.2	2.4	1.2	1.6
20 to 22	Wood, pulp and paper, publishing	2.8	1.7	1.4	0.9	2.2	3.2	2.3	5.7	3.7	3.6	2.5	2.5
23 to 26	Coke, chemicals, rubber and plastic, other non-metallic minerals	2.7	5.0	1.7	3.2	4.2	4.4	4.9	2.7	6.3	2.9	4.5	3.8
27, 28	Basic metals and fabricated metal products, except machinery and equipment	2.7	1.7	1.4	1.6	4.6	1.7	2.8	1.3	1.8	2.5	2.4	1.9
29 to 33	Machinery and equipment NEC, electrical and optical equipment	5.0	5.6	3.1	8.9	4.9	9.9	5.7	7.4	10.4	6.1	4.2	6.4
34 to 37	Transport equipment and manufacturing NEC	1.3	4.6	2.7	6.2	5.2	5.3	3.3	1.4	10.2	1.7	2.5	4.5
40, 41	Electricity, gas and water distribution	1.0	0.6	0.8	1.5	.	2.6	0.4	1.5	.	0.4	0.3	0.8

¹ Preliminary results. – ² Medium-sized enterprises: 50 to 199 employees, large enterprises: over 200 employees.

above-average expenditure on innovation, and thus need to catch up with regard to the efficiency of their innovation processes.

Innovation output, in terms of the share held by new and improved products in turnover, corresponds to the EU average.

At the sectoral level, Austria differs from the EU average mostly in that the groups NACE 15 to 19 (food products, beverages and tobacco, textiles and leather), NACE 20 to 22 (wood, pulp and paper, publishing), and NACE 27 to 28 (basic metals and fabricated metal products) show an innovation performance noticeably above the average.

R&D EXPENDITURE IN AUSTRIA

The Community Innovation Survey looked into expenditures for intra- and extramural R&D³ as part of a company's overall innovation expenditure. By weighting resultant figures, an extrapolation of the total R&D expenditure by Austrian businesses in 1996 was obtained. When compared with the official R&D survey, deviations were found not just in terms of greater expenditure by enterprises but also as a result of the calculation method:

- With regard to the 1993 survey, "the highly representative sampling allows assuming that non-responding companies spend negligibly on R&D, so that extrapolation is not necessary" (*Austrian Economic Chamber, 1993*). For the current study, on the other hand, figures were weighted and extrapolated (see box "On the

³ R&D activities obtained from other enterprises or institutions.

On the methods used for the Community Innovation Survey

Enterprises were chosen by the Austrian Central Statistical Office (ÖSTAT) as stratified random samples from size categories and two-digit NACE classification levels. In addition to the survey itself, a non-response analysis was carried out by a market research company in order to identify any systematic distortions between the structures of responding and non-responding enterprises.

The data were analysed by using consistency checks, estimating missing values and calculating weights for the extrapolation of variables. These steps were performed by Eurostat, to ensure that data would be comparable internationally.

An extrapolation was obtained by multiplying the data supplied in the responses by a computed weight so as to arrive at values for the parent population. The weight was calculated on the basis of the ratio of responding firms to total enterprises in the parent population. For this purpose, the parent population was divided into cells by size categories and NACE two-digit classification levels, and a weight was assigned to each cell. The aim was to have relatively homogeneous enterprises in each cell, to keep the risk of over- or underestimating values for the parent population as low as possible. The weights thus derived were corrected by information from the non-response analysis, especially with regard to innovating companies as a proportion of the parent population, a figure which considerably differed between the sample of responding enterprises and the sample of the non-response analysis.

Table 3: New or improved products as a proportion of turnover, 1996

	Belgium ¹	Germany	Spain	France	Ireland	Netherlands	Austria	Finland	Sweden	U.K.	Norway	EU	
	In percent												
Total manufacturing	14	43	27	21	32	25	31	25	31	23	20	31	
Size categories													
Small enterprises	20 to 49 employees	7	30	9	8	21	15	29	6	11	14	8	15
Medium-sized enterprises	50 to 249 employees	10	31	16	14	26	20	20	13	22	21	16	22
Large enterprises	250 or more employees	16	47	37	25	43	28	37	28	34	25	26	35
NACE													
15 to 19	Food products, beverages and tobacco, textiles and leather	8	27	15	8	12	20	23	11	16	16	14	17
20 to 22	Wood, pulp and paper, publishing	5	16	13	12	20	15	26	10	16	18	6	15
23 to 26	Coke, chemicals, rubber and plastic, other non-metallic minerals	15	38	26	20	25	29	25	19	19	19	24	26
27, 28	Basic metals and fabricated metal products, except machinery and equipment	10	24	17	13	26	14	28	12	19	22	23	20
29 to 33	Machinery and equipment NEC, electrical and optical equipment	32	54	42	36	69	40	47	54	51	44	37	49
34 to 37	Transport equipment and manufacturing NEC	14	62	46	28	22	28	38	27	39	19	21	39

¹ Preliminary results. – ² Medium-sized enterprises: 50 to 199 employees, large enterprises: over 200 employees.

methods used for the Community Innovation Survey”). Otherwise, the considerable sums spent on R&D by the large number of SMEs would have been ignored.

- The comparison with the official statistics discussed here comprises the manufacturing sector as well as the services sector, which latter reported intramural R&D expenditure of about ATS 1.4 billion (see *Dachs – Leo, 1999*).

According to the CIS extrapolation, spending on R&D has grown briskly over the past years.

The last study of R&D expenditure in Austria dates back to 1993. Compared to then, spending on R&D by enterprises rose by about ATS 8.1 billion (46.0 percent) to about ATS 25.7 billion (Table 4). The substantial increase is the result of a general rise, a broader reporting base and, not least, of the fact that R&D spending by part of the services sector was for the first time included. R&D spending by enterprises thus increased at a distinctly faster pace than public expenditure on research or the GDP. As a proportion of GDP, R&D spending therefore appears to be about 0.2 percentage point higher than the figure given in official statistics.

The steep growth of spending on extramural R&D points to more intense networking between industries and other sectors of the national innovation system. The lack of cooperation between components of the Austrian innovation system had always been a serious failure, and it is encouraging to find that their mutual isolation has been somewhat breached. The trend is confirmed by the data given by enterprises on their sources of information for innovation projects: according to them, scientific sources (uni-

versities, research institutes, etc.) are providing essential information to a number of sectors, a practice of which little had been observed in the 1990 survey.

Next to the official R&D figures from 1993 and the CIS, two other studies are of interest in this connection: the census of 1995 in which ÖSTAT collected data on intramural R&D spending, and regular statistics by the Research Promotion Fund (FFF) on R&D expenditure by firms supported by it. According to the ÖSTAT figures, manufacturers spent about ATS 18 billion on R&D in 1995. The FFF arrived at ATS 20.8 billion for 1995 (1,396 reporting companies) and at ATS 23.6 billion for 1996 (1,185 reporting companies). The CIS findings (ATS 22.3 billion for 1996) fit in between these two surveys.

The surveys do not lend themselves to direct comparison: contrary to CIS and FFF, ÖSTAT considers only the manufacturing sector. The FFF figures focus on the financing of R&D activities, while ÖSTAT and CIS investigate intramural R&D expenditure. Yet all these sources confirm the impression that spending on R&D had gone underreported in the past. A full census of R&D expenditure – one of the key parameters for economic policy decision-making – by ÖSTAT would make up a serious deficiency: even though the data collected by the CIS are based on a representative sample, there is no way to assess the extent of over- or underestimation from data weighting. A full census would have to be designed especially to ensure that small enterprises supply realistic figures rather than returning empty questionnaires – it is well known that they report a greater propensity to innovate and also to research in innovation surveys than in an official census.

By using the CIS as a basis, the structure of R&D expenditures can now be further analysed (ÖSTAT and FFF figures

Table 4: Comparison of CIS results with the 1993 R&D survey

		1993		1996		Change 1993-1996	
			Manufacturing sector	Services sector	Total	Absolute	In percent
R&D expenditure	million ATS	17,629	23,524	2,210	25,734	+8,105	+46.0
Intramural ¹	million ATS	15,756	20,864	1,463	22,327	+6,571	+41.7
Extramural ²	million ATS	1,873	2,660	747	3,407	+1,534	+81.9
GDP	million ATS	2,125.3			2,421.6	+ 296.3	+13.9
R&D expenditure as a proportion of GDP	in percent	0.83			1.06		

Source: 1993: Austrian Economic Chamber (1993), 1996: CIS. – ¹ R&D spending within a company. – ² R&D activities commissioned by other companies and institutions.

have so far not lent themselves to in-depth analysis). Like expenditures on innovation, spending on R&D by manufacturing enterprises strongly varies across size categories and sectors:

1. The proportion of enterprises engaged in R&D increases with size: one out of four companies with 10 to 19 employees, but three out of four large companies with more than 500 employees reported internal spending on R&D. The ratio is similar, although at a lower level, for external spending.
2. Variations in internal R&D expenditures are also considerable between sectors, ranging from 10 percent to almost 80 percent of enterprises in a given sector.
3. It is mostly major enterprises which spend on intramural R&D: companies with more than 100 employees account for 88 percent of such spending. About 66 percent of internal expenditures on research is made by enterprises with more than 500 employees. A similar concentration can be found at the sectoral level: 32 percent of all internal R&D expenditures is made by radio, TV and telecoms enterprises; chemicals and chemical products, and machinery and equipment each contribute 13 percent.

Neither the proportion of enterprises engaged in research nor absolute figures on their own allow drawing conclusions on R&D activities. It is also necessary to take into account the intensity of R&D efforts (as measured by turnover). The manufacturing sector spends 2.55 percent of its turnover on R&D. This figure is significantly lower than in the 1990 innovation survey (3.1 percent; *Leo – Palme – Volk*, 1992) or the official survey of 1993 (3.6 percent). The change from 1993 is not so much due to an increase in R&D spending (as a proportion of turnover) but rather to a substantially broadened sampling basis which adequately takes into account R&D activities of SMEs⁴. If no extrapolation had been made, R&D expenditure would – as already noted – have gone seriously underreported.

⁴ Austria counts about 2,800 enterprises with 10 to 19 employees. Of the approximately 500 companies in this category contacted for the survey, 153 returned the questionnaire.

Similar effects, albeit at a lesser scale, are found for larger companies.

CONCLUSIONS

According to current thinking in the economic and technology policy debate, Austrian enterprises lag behind in their R&D investments. A different picture was, however, obtained from the findings of the Community Innovation Survey (CIS) carried out by WIFO (commissioned by Eurostat and in co-operation with the Austrian Federal Ministry of Economic Affairs): their performance has generally improved as compared to other European countries and also to former surveys on R&D expenditure.

Innovation has become a standing feature of Austrian manufacturing enterprises. About 67 percent of respondents introduced some product and/or process innovation between 1994 and 1996, pushing the innovation propensity in Austria perceptibly above the EU average of 53 percent. Similarly, the Austrian innovation rate by size categories is generally higher than the EU average, even though differences diminish with increasing size.

Austrian manufacturing enterprises spent about ATS 46.5 billion, or almost 2 percent of GDP, on introducing innovations in 1996. Almost half of this amount was spent by companies with more than 500 employees. Small enterprises (10 to 19 employees) invested ATS 3.4 billion into developing new products and processes. Innovation budgets are substantial in the radio, TV and telecoms sector (ATS 7.1 billion), machinery and equipment (ATS 5.1 billion), and chemicals and chemical products (ATS 4.8 billion).

Compared to the EU level, Austria's innovation expenditures (3.8 percent of turnover) still lag somewhat behind. Total spending on innovation by Austrian enterprises is about 0.3 percent less in terms of turnover than the EU average. The innovation intensity is below average only for large companies (over 250 employees; 3.48 percent of turnover, or about 1 percentage point lower than the EU average), while SMEs spend markedly more on innovation than the EU average. The innovation gap so frequently referred to in the debate thus opens primarily in R&D-in-

tensive sectors and the large enterprises of those sectors. Innovation investments by manufacturers in France, the Netherlands, Ireland and the U.K. approximately equal those of Austrian manufacturers; investments by their counterparts in Sweden, Finland and Germany, on the other hand, are distinctly higher.

Austrian enterprises tend to concentrate on ongoing improvement of their products and processes. As a consequence they are implementing a relatively large number of low-budget innovation projects and tend to be rather cautious when introducing novelties.

The Community Innovation Survey measured innovation output (as an indicator of the efficiency of innovations) in terms of the turnover achieved by new and improved products and novelties. On average, new and improved products accounted for 31 percent of the turnover by manufacturers in Austria, which corresponds to the European average). It is only in Germany that firms manage a significantly higher rate of turnover (43 percent) for their new or improved products, while Sweden and Ireland are about par with Austria.

Because of its extrapolation of R&D expenditure, the Community Innovation Survey furnished a foundation for assessing the performance of the Austrian economy in 1996. Spending on intramural R&D rose by about ATS 6.6 billion (41.7 percent) to ATS 22.3 billion relative to the last available official survey (from 1993). Some of this increase was due to the fact that the research expenditures made by parts of the services sector (about ATS 1.4 billion) was for the first time included in a survey. Altogether, R&D expenditures by enterprises grew at a significantly more rapid

pace in 1993 to 1996 than public expenditures for research or Austria's GDP.

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Austria's Performance in the Area of Innovation and Research An International Comparison – Summary

The new evidence collected by WIFO through the Community Innovation Survey (CIS) shows that Austria's performance in the area of innovation is significantly better than could be suggested based on current statistics and the views brought forth in economic and technology policy debates. When it comes to the introduction of process and product innovations, Austrian firms are among the most innovative within Europe. Austria lags only slightly behind the European average of expenditures on innovation (3.5 percent of revenue in Austria versus 3.8 percent in Europe), mainly because Austrian firms are rather risk averse and are implementing small scale but numerous innovative projects. However, when relying on an output indicator in order to measure Austria's innovative strength, Austrian firms are up to par with Europe: 31 percent of the generated revenues stem from new

and improved products, which corresponds to the European average. Only in Germany do firms manage to generate more revenue with their new or improved products (43 percent).

The Community Innovation Survey was also used as a framework to determine the level, and to make projections, of R&D expenditures for the year 1996. The results indicate that here too, expenditures increased significantly relative to the last available statistics in 1993. R&D expenditures by firms reached about ATS 22.3 billion in 1996, which corresponds to an increase of 46 percent relative to 1993. However, these numbers include some service sector R&D expenditures, which amount to about ATS 1.4 billion and which for the first time were included in the survey.