Innovation and social security. An international comparison[1]

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> „There is no more of paradox in this (in intellectual property protection;: MH) than there is in saying that motorcars are traveling faster than they otherwise would *because* they are provided with brakes." (Josef A. Schumpeter 1976: 88)

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A central characteristic of modern society is the crucial importance of innovations. In the current knowledge society, welfare and economic prosperity are based to a lesser extent on *territorial* barriers erected along national borders for the free trafficking of people, goods, capital and services and to a larger extent on *temporary* advantages gained through innovation. This poses the question if current forms of welfare – which are closely connected to national governance structures – can be maintained.[2] This would be especially true if social expenditures were to slow down the innovation dynamics of a country. On the other hand, if social security facilitates the acceptance of innovations, then even increasing social expenditures should be expected since the uncertainties associated with innovations thus would be compensated.

The relationship between innovations and social security is crucial especially for Europe, as most European countries are characterized by high social expenditures.[3] If social security systems should prove to be an impediment to innovation, this, in the long term, could lead to an erosion of the European social model. Otherwise, the European welfare states could even envisage competitive and innovative advantages due to their specific production and innovation capabilities (cf. Heidenreich 1999, Hall/Soskice 2001). Thus, in the following, the relationship between innovations and social security will be examined on the basis of internationally comparable data.

First of all, we will develop two opposed hypotheses capturing the relationship between innovation and social security (1). Then we will explain the research design used to test these hypotheses (2). Finally we will analyze the relationship between public spending on social security and education and three different groups of innovation indicators (research, development and education expenditure, international patents, relative weight of knowledge-based industries and services) (3) and summarize shortly our results (4).

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1 I am grateful to Johannes Schwarze for his methodical support and to Marc Rohr for the translation of this paper.

2 A central result of the debate regarding the relationship between globalization and social security is that neither a race to the bottom nor a further extension of the welfare state as a compensation for losses due to globalization can be observed (cf. Kittel/Obinger 2003, Alber/Standing 2000, Genschel 2003). Garrett/Mitchell (2001: 176) summarize their empirical analyses as follows: "Globalization has not induced a pervasive race to the bottom in welfare state regimes. Nor have governments responded to market integration by increasing their welfare state effort across the board. The reality surely lies somewhere between these two extremes …"

3 The public social spending in the EU countries amount to 24,2 % as a percentage of the gross domestic product (GDP) in 1998 in comparison with 20.8 % in all the OECD countries

1. Social Security: A prerequisite or a barrier to innovation?

For market economies, social security is in no way an external factor imposed from the outside. Since the end of the 19th century, market economies have learned to counterbalance the destructive potential of a disembedded industrial society whose traditional ties have been eroded by new forms of social security "beyond the family and village" (Schmidt 1988).

The current welfare state was not the only possible answer to the demands for new forms of social security. Whilst Europe had favored collective work relationships and the welfare state since the 1880s in order to cushion the social effects of a long period of fundamental industrialization (Therborn 1995), the USA, at a very early stage, had already decided upon the expansion of the educational sector as a means of raising individual employability. Furthermore, private and voluntary forms of social security and protectionist trading policies can also be interpreted as an answer to the demand for new forms of social security (Rieger/Leibfried 2001). In Japan, the demand for new forms of social security was covered above all by corporate welfare, by a system of life-long employment guarantees for the employees of bigger firms. Employees and citizens therefore were protected from the uncertainties of the market economy by entrepreneurial, educational, commercial and welfare state correction of market results. Social security therefore is an integral part of the public, family, economic and labour market structures of developed countries.

There is one common factor linking the different forms of social security: Education, laws against unfair dismissal, or social security payments can be interpreted as insurance against risks to employment and income (Sinn 1995). However, this insurance is provided in very different ways (cf. Table 1). On the one hand, it can be provided on the basis of individual rights, on the other hand, it can be provided to collectivities without individual rights. In this dimension, individually assessed income compensation payments (social assistance, unemployment and sick pay, pensions) but also education can be distinguished from innovations and laws against collective dismissals. Laws against collective dismissals reduce the risk of loss of employment in selected companies. Through innovations, the competitiveness and capability of businesses, industries, regions and countries is enhanced; thereby the risks of loss of employment and income to the corresponding groups of employees are reduced.

Furthermore, one can distinguish between ex ante and ex post types of social security.[4] On the one hand, the citizens of a country can be protected from the vagaries of the market ex post, by the correction of market results. The social effects of a modern economy seen as problematic will be compensated for by supplementary welfare state income payments and benefits. The ex post correction of market incomes is in general seen as a central task of the welfare state. On the other hand, the provision of the conditions for a successful participation in working life, for instance through education and innovations, can also be considered as part

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4 The distinction between two concepts of fairness, or solidarity, characterized as result-equity and opportunity-equity by Münch (2001) focuses on the same issue: *Result-equity* is intended to equalize, to some degree, the market compensation, between people who have achieved different results on the basis of unequal performance – for example, the redistribution of wealth in a family, or a welfare state. Such redistributions require a feeling of unity, or “mechanical solidarity.” The stronger members of a society must be prepared to share, while the weaker members may not take advantage of the situation. A shared understanding of members rights and privileges must effectively counter free-riders. In *opportunity-equity* societies the emphasis is on the definition of procedures and the creation of prerequisites, which ensure that every one has the same opportunity to achieve his or her goals through individual performance – without hindering others. In the first instance inequality is addressed ex post, while in the second, an attempt is made to correct inequality ex ante.

of public security. In this sense, already during the 1950s Thomas H. Marshall has emphasized that social rights can be guaranteed not only through social security systems, but also through the education system:

> „Education is a necessary prerequisite of civil freedom (...) It was increasingly recognized, as the nineteenth century wore on, that political democracy needed and educated electorate, and that scientific manufacture needed educated workers and technicians. The duty to improve and civilize oneself is therefore a social duty, and not merely a personal one“ (Marshall 1977: 90)

Marshall already refers to the fact, that the principal goal of welfare state arrangements is not primarily to guarantee a fair distribution of income – a hopeless task in view of conflicting standards of justice -, but the inclusion of the population in the different, functionally-differentiated subsystems of a modern society (Kaufmann 1999: 806): Inclusion instead of justice. Taking the example of entrepreneurial human resource policies, R. Kanter describes this as a shift from employment guarantees to an employability-centred strategy:

> "If security is no longer comes from being employed, it must come from being employable. Large organizations can no longer guarantee long-term employment (…) But employability security – the knowledge that today's work will enhance the person's value in terms of future opportunities – is a promise that can be made and kept. Employability security comes from the chance to accumulate human capital – skills and reputation – that can be invested in new opportunities as they arise." (Kanter 1995: 157)

Employment chances do not depend no longer on the inclusion in a specific organization but on the inclusion in the labour market as a whole. This can be generalized: In a knowledge society, social security does not depend only on the ex post protection against income and employment risks, but also on the individual employability of the labour force and on the innovativeness of nations. Innovations can be considered also as a collective protection against income and employment risks. Whilst education can be interpreted as a means of reducing the employment and income risks of individuals, the competitiveness and innovativeness of businesses can be interpreted as a collective provision against employment and income risks (cf. Table 1).

Table 1: Different forms of social security

	Individual Security	**Collective Security**
Parity of Results	Income replacement schemes (sickness and unemployment benefits etc.)	Collective protection against dismissals, family ties
Equal Opportunity, Employability and Competitiveness	Educational facilities	Research and development facilities and innovations

Social security cannot therefore be equated with the welfare state organised redistribution of resources (Esping-Andersen 1994: 726). The inclusion into the labour market by enhancing the employability of individuals and the competitiveness of firms can also be considered as functionally equivalent solutions to the demand for social security. This raises the question of the relationship of these different forms of social security.

This question will be discussed in the following taking the example of the relationship between social security expenditures and innovation expenditures. Concerning the relationship of these two types of expenditures, two different theses can be formulated, which will be reconstructed in the following as *efficiency and compensation hypotheses* (Schwarze/Härpfer 2003). On the one hand, on the basis of neoclassical assumption (cf. for example Siebert 1997) it can be predicted that a higher level of social security has a negative

impact on the innovation dynamics of a country, since the incentives for potential innovators will be reduced. Potential “innovation losers” are offered "side payments" and institutional guarantees (for example protection from dismissal and co-determination possibilities) in order to avoid possible resistance to innovations. Such guarantees act like a tax on innovations. Hereby, the advantages of innovations decrease. If the anticipated benefits of innovations are less than the anticipated costs of innovations, then potential innovators will stop their activities. Therefore, in neoclassical perspective, a trade-off between innovations and social security is expected (cf. in a somewhat similar vein the relationship of efficiency and social security, Esping-Andersen 1994).

This efficiency hypothesis can be formulated also from a different, more sociological perspective. Innovations are processes of creative destruction; therefore, they endanger previous securities. “The transformation of an idea into a marketable product or service, a new or improved manufacturing or distribution process, or a new method of social service"[5] threatens previous investments, competences and sources of influence: "Capitalist innovation means creation of new combinations of methods and machines and at the same time radical devaluation of all produced values, including well-functioning machines, effective production methods, and highly qualified workforce.“ (Rammert 2000: 3). This process of creative destruction could be made more difficult by social protection rights for less efficient employees and businesses.

On the other hand, a complementarity or even a reciprocal reinforcement of innovations and social security can be assumed. This hypothesis can be developed on the basis of the works of Schumpeter (1976)[6]. The underlying argument is known as compensation hypothesis; is has been developed taking the example of the relationship between globalization and social security. Sinn (1995), Rodrik (2000) and Rieger/Leibfried (2001), for example, analyse social security as a counterpart to economic globalization and liberalization processes: „There is a striking correlation between an economy’s exposure to foreign trade and the size of its welfare state (...) This is not to say that the government is the sole, or the best, provider of social insurance. The extended family, religious groups, and local communities often play similar roles. My point is that it is a hallmark of the postwar period that governments in the advanced countries have been expected to provide such insurance.” (Rodrik 2000: 324-5) The welfare state was the prerequisite which has allowed governments “to lower import barriers, to moderate them or lift them completely” (Rieger/Leibfried 2001: 75). Sinn (1995: 524) analyzes the welfare state „as a device for stimulating risk taking, thereby liberating productive forces and increasing aggregate income.”

These considerations can be applied to the relationship between innovations and social security: It could be expected that innovations can be pushed through more easily, the more potential innovation losers are protected from the negative consequences of innovations. This supposition is supported by the positive correlation between the capability of national innovation regimes in Europe and an egalitarian distribution of income. The European

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5 This is the definition of the term “innovation” which can be found in the green paper on innovation published by the European Commission (1995: 4). This definition is based on the Frascati Handbook of the OECD. The subsequently-developed Oslo Handbook (1997), also published by OECD, limits the concept of innovation to technical innovations.

6 Innovations undermine not only the basis of existing technologies and businesses, but they threaten also the customs, qualifications, the social status and the sources of influence of employees and professional associations. Schumpeter has already stated, that those affected by innovations offer resistance to them; “ it was (...) in general not the postmasters, who founded the railways” (Schumpeter 1935: 101). Schumpeter therefore defines innovations as the pushing through of new combinations *against resistances* (Schumpeter 1935: 124-126).

commission therefore surmises: „The outstanding innovation performances of the small welfare economies in Europe could partly be due to giving their citizens more economic security. A more conservative interpretation would be that policies preventing social exclusion need not interfere with innovation..“ (European Commission 2001: 18) An appropriate social safeguarding could therefore be a central prerequisite for the innovation ability of a country - as well as conversely a distinctive technical, scientific and economic capability is a necessary (even if not adequate) condition for a developed social state.

Therefore the relationship between innovations and social security can be predicted in two completely different ways: While the efficiency hypothesis and its sociological counterpart point to a conflict between innovations and security and does therefore expect a trade-off between social security and innovations, on the basis of the compensation hypothesis a reciprocal increase in the relationship between welfare state social security payments and public innovation expenditure can be expected.

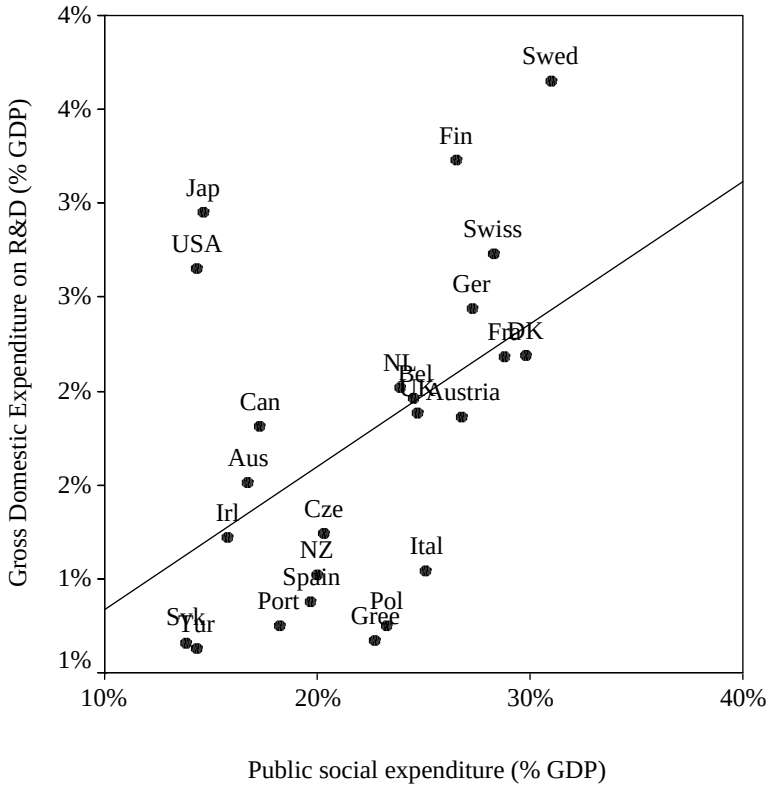
For each of these two hypotheses, empirical evidence can be found: Whilst the USA and Japan are characterized by a high share of research and development (R&D) expenditures and a low level of social security expenditures, some Scandinavian countries - especially Finland and Sweden - combine high research and development expenditures and a high proportion of research-intensive industries with high social expenditures. The controversy outlined above therefore cannot be decided on the basis of single case studies. It is necessary to include a larger group of countries.

2. The method and the data

The connection between innovations and social security provisions will be analyzed in the following on the basis of internationally comparative data. On the basis of the data[7] collected by the Organization for Economic Co-operation and Development (OECD), this task could simply be solved by bivariate analyses – for example by a regression or a scatter diagram (cf. Figure 1). It turns out that the relationship between social security and research and development expenditure is with a correlation coefficient of $r^2 = 0.22$ very strong. This could be taken as a confirmation of the compensation hypothesis. However, such an interpretation would not take into account that the strong correlation is perhaps only the result of a third variable not been taken into account – for example the result of the economic prosperity or the integration into the world markets: Richer countries, who are more integrated in the world market invest more in research and social security. Due to the small number of developed countries, the control of such intervening variables is normally not possible, because the number of advanced industrial countries is too low: The required data will hardly be available for all 30 OECD countries.

7 This data can be downloaded from the various databases of the OECD available in the Internet (http://195.145.59.167) if the corresponding access authorization is available. We used above all the data bases “National Accounts and Historical Statistics” & “Labour Market and Social Issues”).

Figure 1: Public social expenditure and gross domestic expenditure for research and development (in percentage of gross domestic product, 24 OECD countries, 1999)



Sources: See Table 3.

Nevertheless, multivariate analyses can be carried out, if the necessary data are available for several years. If for example data for 20 countries are available for 20 years (in our case: for two decades, the 80s and 90s[8]), then the number of observations can be increased to a maximum of 400. Classic linear regressions could be carried out through this "pooling" of data, if the observations for one variable for one country at different times were independent of each other. However, this assumption (technically speaking: the assumption of no unobserved heterogeneity) is extremely implausible; it implies, for example, that there is no connection between the income inequalities in a country in the years 1980 and 1981. This assumption can be checked with the Breusch-Pagan Test (Schwarze 2003, Breusch/Pagan

8 In the following we use data for the following 20 countries for the 80s and 90s: Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Greece, Ireland, Italy, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

The 80s and 90s were chosen because the years 1979/1980 were a particular turning-point in most industrial countries: The extraordinary phase of prosperity of the post-war period had definitely come to an end. Since then the number of unemployed had risen continuously to levels previously unknown. The second major rise in the price of oil signalled the end of the previous period of cheap fuel and with the necessity to recycle petrodollars, created the conditions for the liberalization of the financial markets (Eurodollar markets). Since the beginning of the Reagan and Thatcher eras the national collective bargaining systems had come under considerable pressure to change. The global networking of the economy permanently exceeded levels achieved prior to the first world war (Hirst/Thompson 1996) and the Taylorist, bureaucratically-organised mass production of the post-war period was threatened increasingly by new flexible forms of production and organisation.

1980). Normally, this assumption will be rejected. It is not only implausible, but also statistically refutable. In this case, different panel regressions can be used - above all models of fixed or random effects.

Models of fixed and random effects differ regarding the assumptions concerning the error terms: Models with fixed effects assume country-specific constant error terms over a period of time; in models with random effects, the country-specific effects are considered as random variables. Whether one or the other assumption applies can be checked with the Hausman Test: The zero hypothesis of the Hausman Test is: The country-specific errors and the explanatory variables are not correlated. If this hypothesis cannot be rejected, because the differences between estimated coefficients of the random-effects model and the fixed-effects model are not systematically different from zero, a model with fixed effects as well as a model with random effects can be used. If the zero hypothesis is rejected, then a model with fixed effects is preferred (Greene 2000, Chapter 14, Baltagi 2001). An advantage of using exclusively the model with fixed effects is that the estimations are unbiased even if the fixed effects and the explanatory variables are correlated; a disadvantage is that influences of time-constant variables (for example the culture of a specific country) cannot be identified, because it cannot be distinguished from the fixed error terms.

After the Breusch-Pagan and the Hausman tests, a third test must be carried out to determine whether the error parameters of the variables are time-dependent. A conventional procedure for this is the application of a modified Durbin-Watson Test (cf. Baltagi 2001: 95). If the corresponding value clearly deviates from 2, this can be interpreted as a correlation of the residuals over time. The rho value also shown in the following tables indicates the strength of these auto correlations (zero: no auto correlation). The squared correlation coefficient (r^2) indicates the amount of variance explained by the entire model (including the 19 dummy variables for the years not listed in the following tables). With regard to the above-named tests, we will use in tables 3 - 5 fixed-effects models with first-order autoregressive disturbance terms (AR1). The estimates of these models are carried out using the procedure *xtregar* of the programme STATA 8.

The median values of the variables used in the following tables are portrayed in Table 2.

Table 2: Innovations and social security. Mean values and standard deviations (20 OECD-countries; 1980-1999)

	Aus	Austria	Bel	Can	DK	Fin	Fra	Ger	Gre	Irl	Ital	NL	Nor	NZ	Port	Spain	Swed	Swiss	UK	USA
Gross domestic product - per head, at the price levels and PPPs of 1995	19.595	19.546	19.955	21.814	21.163	18.424	18.793	19.204	12.491	15.082	18.317	19.393	20.776	16.274	11.977	13.626	19.663	25.132	17.024	25.502
Total trade (exports and imports/GDP)	35.8	76.6	135	60.0	67.6	58.7	44.2	53.3	46.6	121	43.6	108	73.6	58.1	66.3	40.7	66.3	68.6	52.9	20.6
Public social expenditure (% GDP)	14.7	25.5	25.6	17.6	29.9	25.8	26.4	23.4	19.0	18.8	22.8	27.2	23.7	20.2	14.7	18.9	31.7	20.8	22.6	14.0
Social security transfers (% GDP)	7.8	18.4	17.2	11.7	17.8	16.7	17.6	17.1	14.3	13.5	15.7	23.3	14.3	0.0	11.5	15.4	19.6	12.2	13.9	11.8
Expenditure for public services (% GDP)	6.9	7.1	8.4	6.0	12.1	9.1	8.8	6.3	4.7	5.3	7.1	3.9	9.4	20.2	3.2	3.6	12.0	8.6	8.7	2.3
Family cash benefits (% GDP)	1.5	2.3	2.4	0.7	1.3	1.8	2.1	1.4	0.7	1.5	0.7	1.3	1.8	2.3	0.7	0.3	1.9	1.1	1.8	0.3
Family services (% GDP)	0.2	0.8	0.1	0.1	1.9	1.3	0.6	0.6	0.4	0.1	0.2	0.4	0.9	0.1	0.2	0.1	2.2	0.1	0.5	0.3
Active labour market programmes (% GDP)	0.5	0.4	1.3	0.5	1.3	1.2	0.9	1.0	0.3	1.4	0.7	1.0	0.8	0.8	0.6	0.6	2.0	0.3	0.6	0.2
Health (% GDP)	5.2	5.4	6.3	6.4	7.3	5.8	6.7	6.8	4.8	5.4	5.7	5.9	6.4	6.0	4.1	5.0	7.6	6.0	5.3	4.9
Expenditure from public and private sources for education (% GDP)	5.1	5.8	5.3	6.4	6.7	5.7	5.7	4.7	2.9	5.6	5.0	5.9	6.6	5.3	4.5	5.0	7.0	5.2	4.9	5.2
Gross Domestic Expenditure on R&D (% GDP) (GERD)	1.3	1.4	1.7	1.5	1.5	2.0	2.2	2.5	0.4	1.0	1.1	2.0	1.5	0.9	0.7	0.7	2.9	2.6	2.1	2.6
Expenditure on R&D in the Higher Education Sector (% GDP)	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.1	0.2	0.2	0.5	0.4	0.2	0.2	0.2	0.8	0.5	0.3	0.4
Industry-financed GERD (% GDP)	0.5	0.7	1.1	0.6	0.8	1.1	1.0	1.5	0.1	0.5	0.5	1.0	0.7	0.3	0.3	0.3	1.8	1.9	1.0	1.4
Government-financed GERD (% GDP)	0.7	0.6	0.5	0.7	0.6	0.7	1.0	0.9	0.2	0.3	0.5	0.9	0.7	0.6	0.4	0.3	1.0	0.6	0.8	1.1
Number of patent applications to the EPO (per million inhabitants)	25.1	80.2	62.6	22.9	71.3	95.2	78.4	164	2.3	20.3	35.8	102	40.0	15.6	1.2	7.2	136	246	62.8	63.9
Number of patents granted by the USPTO (per million inhabitants)	31.9	50.4	44.5	77.1	55.5	86.7	54.1	116	1.3	19.5	22.7	66.1	36.8	21.5	0.6	4.4	120	187	51.9	225
Number of "triadic" patent families (per million inhabitants)	10.7	24.2	25.3	10.8	25.8	36.5	30.4	61.4	0.4	6.8	10.6	43.5	13.9	5.4	0.3	1.6	62.2	113	24.9	40.6
High technology industries(1)	0.0	2.0	1.9	1.6	1.7	2.1	2.5	2.7	0.6		2.1	1.3	0.9		1.0	1.2	2.8		3.1	3.7
Medium high technology industries(1)	3.7	6.2	7.7	5.6	5.1	6.6	7.5	12.9	2.3		7.6	5.1	3.3		4.3	6.3	7.4		7.5	5.9
Knowledge-based Services(1)	13.6	13.7	6.3	14.1	12.9	10.3	18.0	16.6	10.4		10.8	13.2	11.8	12.2	7.9	12.0	12.6		12.5	16.6

(1) The proportion of real net output of high-technology industries (aircraft and spacecraft, pharmaceuticals, office, accounting and computing machinery, radio, television and communications equipment, medical, precision and optical instruments), of Medium high technology industries (electrical machinery and apparatus, motor vehicles, trailers and semi-trailers, chemicals excluding pharmaceuticals, railroad equipment and transport equipment, machinery and equipment) and from market-related knowledge-based services (post and telecommunications, finance and insurance, business services) can be calculated on the basis of the OECD STAN database (cf. also OECD 2003).

3. Innovations and social security. The empirical results

In order to analyse the relationship between social security and innovations, two groups of dependent variables have to be distinguished: On the one hand, the indicators measuring the input of innovation processes, for example the expenditures for research, development and education, on the other hand output indicators, for example the number of patents or the share of advanced technologies. In the following, the connection between social security systems and innovations is discussed on the basis of three different groups of dependent variables: First, we will discuss the relationship between social security and innovation expenditure, then the connection between social security and patents and finally the connection between

public social security expenditure and the relative weight of knowledge-based industries and services.

3.1 Social security an innovation expenditures

Research and development expenditure in percentage of the gross domestic product is a central indicator for the input to innovation processes. However, a weakness of this indicator is that it focuses only on systematic innovation activities especially in larger businesses. Therefore, the inclusion of additional indicators, which measure the role of technical knowledge based on investments in machinery and equipment, software or higher education would be highly desirable. The OECD (2003) has proposed in a recent study a more comprehensive concept of innovation expenditure taking into account all these expenditures. It has been estimated that in the year 2000 in the 30 OECD countries, 2.3 % of the gross domestic product (2000) was spent on research and development, 1,3 % on software, 1.3 % on higher education and 8.4 % on machinery and equipment. However, the last three types of expenditure can only be estimated for some recent years.

Therefore, in the following we will use other input indicators: As "knowledge investments" we will take the expenditure for research and development and for education (subtracting the share of research and development expenditure in higher education, since this expenditure is included in both positions). On the one hand, these two indicators overestimate the investment in knowledge, since the expenditure for primary school education can hardly be counted as innovation expenditure. However, since the educational expenditure and the expenditure for higher education in the second half of the 90s are closely correlated ($r = 0.63$), the changes in educational expenditure can be taken as indicators for the size of innovation-relevant investments in human capital. On the other hand, the innovation expenditure is underestimated since the investments in software and into new machinery and equipment are blanked out. The OECD (2003: 74) submitted estimations of the investment in software for the last years. However, these data are not available for all the eighties and nineties. In the following, we will therefore take the educational and research expenditure as input indicators.

In Table 3, different models are reported, in which the connection between innovation expenditure and public social security expenditure is captured in different ways. In each case, the purchase-power-adjusted gross domestic product (GDP), the integration into the world market (the sum of the import and export quotas), and the dummy variables for the different years (with the exception of the reference year 1980) are included as control variables. The coefficients of the constant and these dummy variables are not reported in the following tables.

In the first column of table 3, a model is introduced, which – with the exception of the additional control variables - essentially corresponds to the model portrayed in Figure 1. The results are surprising: In contrast to figure 1, there is no significant correlation between research expenditure and social security expenditure. When the economic performance and the integration into the world market taken into consideration, there is no connection between the two variables. This indicates the previously indicated limitations of bivariate analyses. In international comparisons, bivariate analyses can be used only with the utmost caution.

Table 3: The relationship between educational and research expenditure and social expenditure (20 OECD countries, 1980-1999)

	R&D expenditures	**Government-financed R&D expenditures**	**Public and private expenditures for education**	**Public and private expenditures for education and R&D**	**Public-financed education and R&D expenditures**	**Public expenditures for education and R&D**	**Public expenditures for education and R&D**	**Public expenditures for education and R&D**
GDP (per head, PPP, 1995)	-0.01	-0.00	-0.06	-0.07	-0.19	-0.18	-0.24	-0.25
	(0.67)	(0.09)	(1.14)	(1.26)	(3.31)***	(3.08)***	(4.55)***	(4.51)***
Total trade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.69)	(0.64)	(0.50)	(0.73)	(0.43)	(0.42)	(0.52)	(0.13)
Public social expenditures	-0.00	0.01	0.04	0.03	0.08			
	(0.49)	(3.11)***	(2.00)**	(1.48)	(3.15)***			
Social security transfers						0.10		
						(3.19)***		
Public social services						0.07		
						(2.58)**		
Family services and cash benefits							0.07	
							(0.50)	
Active labour market programs							0.22	
							(1.17)	
Health expenditures							0.18	
							(2.00)**	
Taxes on income, profits and capital gains								-0.01
								(0.21)
Social security contributions								0.03
								(0.71)
Taxes on goods and services								-0.01
								(0.22)
Breusch-Pagan Test	1940***	1743***	1255***	1218***	1533***	1245***	949***	1221***
Hausman-Test	44.34	29.79	6.22	13.44	36.90	92.59	69.34	67.07
DF	22***	22	22	22	22*	23***	24***	24***
Modified Durbin-Watson-Test	0.21	0.22	0.38	0.38	0.57	0.57	0.58	0.48
Rho_ar	0.91	0.89	0.84	0.83	0.73	0.73	0.74	0.77
R^2	0.09	0.10	0.24	0.23	0.24	0.24	0.23	0.22

Absolute value of t statistics in parentheses; balanced fixed-effects model when the disturbance term is first-order autoregressive; data for 20 OECD countries from 1980-1999. Time dummies and constants included but not portrayed in the table. * significant at 10%; ** significant at 5%; *** significant at 1%
Breusch-Pagan Test on the existence of country-specific effects (chi-square distributed with a degree of freedom). Hausman-Test on failure specifications using a model with random effects (chi-square distributed; Number of degrees of freedom shown in the table)
Sources: OECD: Statistical Compendium and own calculations.

However, only 29 % of the research and development expenditure in OECD countries is financed by governments (OECD 2003: 21). 64 % (2000) of R & D expenditure is carried

by the private economy. If only the government-financed R & D expenditure (column 2) are included, a significant connection emerges between R&D and social security expenditure. The connection between public social security expenditure and public and private educational expenditure also is significant (Column 3): An active state invests in education as well as in research and in the social security of its citizens.

If the public and private educational and research expenditure is added and the overlapping expenditure for research in higher education is deducted (Column 4), the correlation between knowledge investments and social security expenditure is no longer significant. If public and the private research and educational expenditure is taken as an indicator for the input of innovation processes, neither the efficiency nor the compensation hypothesis can be confirmed.

However, this is not valid if only public educational and research expenditure (Column 5) is included: The correlation between public social security and educational and research expenditure is highly significant. The compensation hypothesis therefore applies if it is understood as a statement about political actors: States, that invest a great deal in social security, also invest a great deal in education and research. A general correlation between innovation expenditure and social security expenditure - as predicted by the compensation hypothesis – however cannot be proved.[9]

In the last three columns of Table 3, the connection between social security expenditure and public educational and research expenditure is examined more closely. At first, the public social security expenditure is divided into transfer payments and into expenditure for the public provision of services (column 6). Both indicators are significantly correlated with research and educational expenditure. A state, which invests in research and education, does not have any preference for transfer payments or for a developed public service.

In the seventh column, the hypothesis is tested that "future-oriented" social expenditure (expenditure for families, for active labour market policies and for health services) in comparison to ex post measures (unemployment benefit, pensions...) are more closely associated with research and educational expenditure. After the inclusion of three different "ex ante" types of social expenditure it can be seen, that only the expenditure of publicly-financed health services is correlated significantly with the amount of the research and educational expenditure. This indicates the importance of "life sciences", which will be one of the future growth markets in view of the older population of most OECD-countries.

In the last column, the hypothesis is examined that the relative weight of social security contributions and of taxes on income and goods and services influences the state commitment to education and research. It could be supposed that a high share of social security contributions limits the possibilities of the state to finance research and education investments. This hypothesis cannot be confirmed.

In conclusion: Neither the negative correlation between social security and innovation expenditure predicted by the efficiency thesis nor the positive correlation predicted by the compensation thesis can be adequately proven. However, a positive correlation between public social security and educational and research expenditure can be proved. This connection cannot be interpreted - in the sense of the compensation hypothesis - as expression

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9 This diagnosis may however also be a consequence of insufficient data. Whilst the compensation hypothesis applies to all social security expenditure, only the public spending on social security was included in the analysis, as private social security expenditure is only available for a few OECD countries over the period of a few years (Adema 1999).

of functional requirements, but it reflects the fact, that welfare states are engaged in education and research as well.

3.2 Social security and international patents

In the next stage, the relationship between social security expenditure and the results of innovation processes will be analyzed. We will consider the patent activities of the respective national economies. These patent activities can be detected by using three different patent categories: Firstly, by the number of applications for patents (per million residents) to the European patent office (EPO); secondly, by the number of the patents approved by the United States Patent and Trademark Office (USPTO), and finally through the number of the patents approved in Japan, the European Union and the USA ("triadic patents").

Table 4: The relationship between patent applications and social security expenditure (20 OECD countries, 1980-1999)

	Triadic patents	**US patents**	**EPO patents**	**Triadic patent families**	**US patents**	**EPO patents**	**Triadic patent families**	**US patents**	**EPO patents**
GDP (per head, PPP, 1995)	-1.60	-2.11	-3.09	-1.55	-2.04	-2.93	-1.50	-1.92	-2.84
	(3.2)***	(2.19)**	(2.47)**	(3.1)***	(2.11)**	(2.35)**	(3.1)***	(2.00)**	(2.30)**
Total trade	0.03	0.01	-0.02	0.02	0.00	-0.03	0.03	0.01	-0.02
	(0.60)	(0.07)	(0.21)	(0.54)	(0.03)	(0.31)	(0.60)	(0.11)	(0.21)
Public social expenditures	-0.28	-0.34	-1.12	-0.30	-0.37	-1.18	-0.24	-0.15	-0.82
	(1.42)	(0.90)	(2.26)**	(1.53)	(0.97)	(2.40)**	(1.17)	(0.38)	(1.60)
Expenditures for education and R&D				0.81	1.09	2.59			
				(1.78)*	(1.26)	(2.27)**			
Industry-financed R&D (GERD)							4.08	7.22	19.51
							(1.82)*	(1.67)*	(3.48)***
Government-financed R&D							-2.64	-14.38	-12.54
							(0.72)	(2.06)**	(1.38)
Expenditure for education (public/private)							0.68	0.84	1.71
							(1.38)	(0.90)	(1.40)
Observations	380	380	380	380	380	380	380	380	380
Breusch-Pagan Test	2704***	2073***	2439***	2723***	2208***	2412***	1635***	1127***	1548***
Hausman-Test	29.28	24.85	18.39	19.83	24.59	16.91	33.38	34.06	19.70
DF	22	22	22	23	23	23	25	25	25
Modified Durbin-Watson-Test	0.16	0.11	0.14	0.18	0.15	0.14	0.37	0.29	0.26
Rho_ar	0.92	0.95	0.93	0.92	0.95	0.93	0.90	0.94	0.92
R^2	0.25	0.29	0.37	0.26	0.29	0.38	0.27	0.31	0.41

Sources: See Table 3.

The number of the European patents is negatively correlated with the proportion of public social security expenditure, (Table 4, Column 3). However, this is not true for triadic and US patents (columns 1 and 2). Contrary to the European experience, in the USA and the

American-European-Japanese triad, high social security expenditure does not have any negative effects on the patent applications. Even if, additionally, the amount of the educational and research investments is included, the correlation between social security expenditure and European patent activities remains significant (column 6). Such a relationship cannot be proved with the triad and US patents (columns 4 and 5). This points to a European particularity – a negative impact of welfare state activities on patent activities.

In the next stage, the educational and research expenditure is divided into three components (columns 7-9): Into public and private educational expenditure, into industry-financed R & D expenditure and into government-financed R & D expenditure. The R&D expenditure of businesses do has in all cases a clear positive influence on the patent intensity in the triad, in the USA and in Europe. Public research however, is negatively correlated with patent intensity. In the USA, the corresponding coefficient is even significant at the 5 % level (Column 8). The influence of social security expenditure on the patent level is no more significant.

At first sight these results are calming: On the basis of a central output indicator, the patent applications, the expected negative effects of the efficiency hypothesis on the innovativeness of the respective national economies could not be confirmed. However, this is not applicable to the patent registrations with the European Patent Office. If it is assumed that there is a "home bias", and therefore a propensity to apply for patents in one's own economic area, then this can be interpreted as a minor innovativeness of the relatively strongly developed European welfare states.

Furthermore, if the fact, that public research and educational investments do not have any positive effect on the patent intensity of a country is taken into consideration, then the positive correlation between social security and educational and research expenditure described in section 3.1 can no longer be evaluated as a positive evidence. Only industrial research and development expenditure seems to have an immediate and positive influence on the patent activities of a country. Altogether, at least for Europe this evidence seems to confirm the negative relationship between social security and innovations postulated by the efficiency hypothesis.

3.3 Social security and the share of knowledge-based industries and services

A further indicator of the innovativeness of a national economy is the relative share of knowledge-based industries and service industries as a percentage of the respective national GDP. Industries characterised by particularly high expenditure for research and development are regarded as knowledge-based (see footnote to Table 2). The relative weight of high-tech- and high-and medium-technology industries and knowledge-based services can be calculated on the basis of the OECD STAN database.

The connection between social, educational, and research expenditure and the branch structure of the respective countries is examined in Table 5. The first column shows, that industry-financed research and development activities are positively correlated with the relative weight of leading-edge technology industries (Column 1). This is not surprising, since these industries invest at least 18 % of their value added in research and development (OECD 2003: 156). Public research and educational expenditure however does not have any recognizable effect on the share of the value-added of knowledge-based industries.

Social security expenditure is also not significantly correlated with the share of high-technology industries. This is a surprising result, since other studies describe a lower degree of economic coordination and social embedding, for example in the USA, as a prerequisite for the strong position of the American high-tech industries (Hall/Soskice 2001). The panel

regression introduced here cannot confirm this supposition: Countries with a developed system of social security (for example Germany, Sweden, Finland) are also characterized by a considerable share of leading-edge technologies. The efficiency hypothesis - just as the compensation hypothesis - cannot be confirmed for this group of output indicators.

However, social security expenditure and the relative share of medium high-technology industries (for example vehicle and mechanical engineering), are negatively correlated (Column 2). This could be assessed as confirmation of the efficiency hypothesis. The positive correlation with the relative openness of the countries suggests another interpretation: The international competition, especially in industries with higher-quality technologies, is particularly intensive. The lower share of social security expenditure, particularly in those countries that specialize in medium high technologies, could also be explained by the fact, that the intensive international competition, especially in higher-quality technologies, restricts the scope of welfare state activities (cf. Alber/Standing 2000). This effect is not seen, however, in high-technology industries (Column 1), since there is less pressure of competition in these industries.

There is no significant relationship between the share of knowledge-based services and the amount of expenditure on social security, research, and education (Column 4).

Table 5: The relationship between knowledge-based industries and social security expenditure (20 OECD countries, 1980-1999)

	High technology industries (VA)	**Medium high technology industries**	**Knowledge-based industries (VA)**	**Knowledge-based services (VA)**
GDP (per head, PPP, 1995)	-0.02	0.08	0.07	-0.14
	(0.52)	(1.44)	(0.94)	(0.60)
Total trade	-0.00	0.02	0.02	-0.02
	(0.06)	(4.46)***	(3.33)***	(0.67)
Public social expenditures	-0.02	-0.06	-0.07	0.09
	(0.96)	(2.73)***	(2.54)**	(0.93)
Industry-financed R&D (GERD)	0.80	-0.10	0.56	0.93
	(4.49)***	(0.43)	(1.82)*	(0.86)
Government-financed R&D	-0.11	0.00	-0.24	-1.56
	(0.42)	(0.00)	(0.52)	(0.98)
Expenditure for education (public/private)	-0.00	-0.06	-0.06	0.15
	(0.10)	(1.33)	(0.92)	(0.72)
Observations	323	323	323	342
Breusch-Pagan Test	1723***	2196***	2065***	196***
Hausman-Test	4.92	112**	57***	56***
DF	25	25	25	25
Modified Durbin-Watson-Test	0.43	0.33	0.33	0.27
Rho_ar	0.83	0.87	0.89	0.88
R^2	0.15	0.34	0.29	0.12

Sources: See Table 3.

It can be concluded, that higher social security expenditure goes hand in hand with a lower share of medium-high technology industries. Since this effect cannot be observed in the case of high-technologies, this result cannot be considered as a confirmation of the efficiency hypothesis. More likely, this result can be explained by the stronger competition in the field of medium-high technologies: Nations with a higher share of advanced technologies are confronted with the limits of growth of welfare state expenditures in an increasingly globalized economy.

4. Summary

In this article, the relationship, already put forward by Schumpeter, between social security and innovations was pursued on the basis of internationally comparative data for 20 developed industrial countries. At first, two different hypotheses were introduced: The efficiency hypothesis emphasises that the inclination to take economic risks is hampered by higher standards of social security; there are less incentives for innovation. The compensation hypothesis however, presumes that higher risks conditional to innovation require higher standards of social security. Without a political compensation for innovation losers, the resistance to innovations could become so great, that innovations would no longer be implemented in developed democratic societies.

These two hypotheses were checked on the basis of three different innovation indicators with the assistance of panel data for 20 countries over two decades: First of all, the amount of research and development expenditure and the amount of the educational expenditure were included as indicators of the input of innovation processes, then the patent quotas in Europe, in the USA and in the triad added and finally the share of value added in knowledge-intensive industries and service sectors. Here too, as with every empirical analysis, the limitations of the data used must also be emphasised: The input for innovations is only partially taken into account, since, amongst others, the investments in software, in new machinery and in highly-qualified employees are not available for the 80s and 90s; with social security expenditure, only public expenditure was taken into account and not private, family or entrepreneurial expenditure. Also, no non-linear connections between the variables were modelled.

It could be demonstrated that the compensation hypothesis predicts correctly the connection between public social security and research expenditure: States, which invest in research and development, also invest strongly into social security. However, in both groups of output indicators used, the compensation hypothesis could not be confirmed. A higher share of patents and knowledge-intensive industries is not positively correlated with higher social security expenditure. Given the positive correlations between social security, educational, and research expenditure, this result comes as a surprise. This surprising result can be explained by the fact that higher governmental research and development expenditure does not lead to significantly higher patent successes or to a significantly higher value added of knowledge-intensive industries. Only business expenditure on research and development has a positive impact on the patent activities of a country and the share of knowledge-intensive industries. In addition, an active state cannot contribute directly to innovations through the support of research and education.

The negative relationship between social security expenditure and the applications to the European patent office can be considered as a partial confirmation of the efficiency hypothesis. This relationship was interpreted as an indication of a lesser propensity for innovation in the relatively strongly-developed European welfare states. The negative

correlation between social security expenditure and the share of medium-high technology industries refers, however, rather to the higher competition in the international markets for these technologies.

In conclusion: Neither the negative relationship predicted by the efficiency hypothesis nor the positive one by the compensation hypothesis between social security and innovations can be confirmed in all circumstances. Neither it can be concluded (as a consequence of the efficiency hypothesis), that the welfare state, which is the result of over 100 years of conflicts, negotiations, compromises and reforms, has become functionless in a globalized knowledge society and will gradually vanish due to international competition. However, there is also little in support of the conclusion (which would be the implication of the compensation hypothesis), that the shift from territorially-based strategies of social closure to innovation-based, temporary competitive advantages in innovations will be possible without a fundamental redesign of the current, national systems of social security. The importance of qualification and innovation-centred state policies will increase but the state cannot hope to increase directly the innovativeness of the national economy. There is therefore no reason for political fatalism: Social state security in a global knowledge economy is not a locational disadvantage per se, nor is it an advantage, per se. The fate of social security probably depends on how successfully the different countries manage to walk the tightrope between lower innovation incentives and the higher preparedness to take risks.

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