Innovation and Competitiveness: A Field of Sloppy Thinking

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Setting the Stage

If they are to remain competitive and maintain performance at a high level, economies need to be innovative. To promote innovation they need to spend on research and development (R&D). The inference is, therefore, that if they also want to *enhance* competitiveness, countries have to increase R&D spending. This supposed need to increase R&D efforts, coupled with the enormous importance of competitiveness, explains why there is always much ado in the media when new international rankings on R&D spending are announced. Furthermore, government- and EU-sponsored reports, such as the Sapir Report (2003: 34), often mention these rankings and – together with politicians and interest groups – regularly call on the relevant authorities (governments and companies) to spring into action and to raise their R&D spending.

With R&D, the emphasis is generally on input figures, despite the fact that, generally speaking, the relationship between input and output is not clear-cut. Nevertheless, the ease with which the input–output equation is formulated in the case of innovation is remarkable. In other fields, matters are otherwise. Scandinavian or US spending on R&D, for example, is presented as a positive example, but no one does the same with US health care spending, which is much higher than that of most other comparable countries: it is well known – and it has been a major issue in US presidential elections since the 1990s – that the US health care system excludes millions of people and does not prevent a relatively high level of infant mortality (cf. OECD 2007a: 9-12).

Is there any reason to assume that this is an exception and that »output matches input« is the rule? Does the assumed correlation between R&D spending and innovation, and subsequently between innovation, competitiveness, and economic performance, really exist? The answer is that the relations between these parameters are much more complex. There is some – although no more than that – correspondence between spending and innovation. While some big spenders are very competitive, others are less so, while some low spenders appear to be quite competitive. Sometimes, particularly competitive economies are also particularly innovative, but this is not always the case; sometimes they rely on specialization. In general, it appears to be problematic to establish a close relationship between spending, innovation and competitiveness or, more generally, performance.

Another link often discussed in this connection is that between institutional structure and innovation. The theory of varieties of capitalism (Hall and Soskice 2001) and liberal think tanks, such as the World Economic Forum, also suppose that the more liberal an economy is, the more innovative – or at least the more radically innovative – it is. Reading prominent economists such as Alesina, Eichengreen, Porter, and Phelps on the subject of continental Western Europe one gets the impression of large-scale innovation, but also of an economic performance gap between that region and the United States: the latter is doing particularly well, the former very badly. With regard to France and Germany, Michael Porter (in Snowdon and Stonehouse 2006: 13), who is associated with the WEF, even talks of »a mess.« Apart from a few positive words (with reservations) about Scandinavia (ibid.; Alesina and Giavazzi 2006: 9), they declare in general terms that »Europe« performed well as long as it could catch up by imitating American inventions, but that it has run into serious trouble since it has itself been required to be inventive (ibid.: 8; Eichengreen 2006: 2 and 5). In Phelps's view (2003, quoted in Gordon 2004: 13f), continental Europe performs poorly because venture capital and equity finance are underdeveloped and because corporatist institutions – »the need to consult with workers« – hamper innovation and competition.

These are remarkable claims in studies that use as their empirical basis an imaginary »continental Europe« (in the case of Phelps) or are largely restricted to Italy (in the case of Alesina and Giavazzi), and France, Germany, and Italy (in the case of Eichengreen), respectively. Nonetheless, Alesina and Giavazzi (2006: 11) go so far as to say that Europe is a »frog in water whose temperature is slowly rising.« There is a lot wrong with European political economies and much has to be reformed, but ignoring the sometimes huge differences between individual countries is a scientific sin. An uncritical attitude towards the United States, which characterizes the quoted studies to an amazing degree, is another.

There is no evidence to support the claim that liberal economies are superior in terms of innovation. No doubt, the US economy is innovative, but some highly liberal economies are innovation laggards, while some considerably less liberal economies, in Europe and East Asia, appear to be strong innovators. I do not want to suggest, however, that R&D spending, let alone innovation, is not important for competitiveness and that it would be justifiable to make less effort. It is only – as so often – that these matters are more complicated than they appear in the public debate. And factors other than innovation are also important for growth and competitiveness, even for the developed economies of the West and East Asia, which largely operate in technologically advanced markets. National competitiveness will be understood here in terms of a country's capacity to host and facilitate a relatively large number of innovative companies and to export goods and services primarily because of their quality and product/price relationship.

In what follows, I will illustrate the lack of clear patterns in the relations between R&D spending and innovation, as well as between innovation and economic growth, productivity, competitiveness and institutional structure. Precision is not possible in this undertaking. Innovation and competitiveness are somewhat vague concepts. Data on innovation would have to be much more detailed: is innovation with regard to razors of the same order as innovation with regard to efficient and environmentally reliable batteries for hybrid cars? Furthermore, national figures on R&D conceal the reality of multinational companies that spread their research activities and use their patents in all the countries they operate in.

Input and Output: R&D Spending and Economic Performance

The absence of a strong pattern in the relationship between R&D input and economic output would appear to be confirmed by Table 1, in which GDP per capita (overall GDP, not adjusted for population growth, in Australia, Canada, New Zealand, Norway, and Switzerland) and productivity per hour in the period from the mid-1990s to the mid-2000s are compared to R&D spending. In the case of GDP and productivity growth, the years before and after the bursting of the dot-com bubble in 2000/2001 are shown separately; in the case of R&D spending, data for 1996 and 2005 are provided. Spending in 2005 did not influence economic activity in that or the following year, but it does indicate the development of R&D spending over the preceding decade. In most countries, it has

Table 1

Rough Indication of Correspondences between GDP and Productivity (GDP per Hour) and R&D Spending (Grades based on averages of all years covered)

	Real GDP per capita (average annual change)			*Productivity (average annual change)*			*R&D spending*			*Correspondence to R&D spending*	
	97–01	*02–06*	*Grade*	*95–00*	*01–06*	*Grade*	*1996*	*2005*	*Grade*	*GDP*	*Productivity*
Australia	3.8*	2.5	H	2.5	1.5	H	1.66	1.76	L		
Austria	2.4	2.1	M	2.1	1.0	M	1.60	2.42	M	√	√
Belgium	2.4	1.9	M	1.9	0.9	L	1.80	1.82	L		√
Canada	4.2*	2.3	H	2.3	1.0	M	1.68	1.98	L		
Denmark	2.1	1.1	L	1.1	1.0	L	1.85	2.45	M		
Finland	4.3	2.7	H	2.7	2.2	H	2.54	3.48	H	√	√
France	2.4	2.1	M	2.1	1.4	M	2.30	2.13	M	√	√
Germany	1.9	2.0	L	2.0	1.4	M	2.26	2.46	M		√
Ireland	7.7	5.4	H	5.4	2.8	H	1.32	1.26	L		
Italy	2.1	0.9	L	0.9	0.2	L	1.01	1.10	L	√	√
Japan	0.2	2.1	L	2.1	2.1	H	2.77	3.33	H		√
Netherlands	3.1	1.7	M	1.7	0.7	L	2.01	1.78	L		√
New Zealand	2.9*	1.4	M	1.4	0.9	L	0.96#	1.15	L		√

	Real GDP per capita (average annual change)			*Productivity (average annual change)*			*R&D spending*			*Correspondence to R&D spending*	
	97–01	*02–06*	*Grade*	*95–00*	*01–06*	*Grade*	*1996*	*2005*	*Grade*	*GDP*	*Productivity*
Norway	3.1*	2.3	H	2.3	2.2	H	1.70#	1.52	L		
Spain	3.7	2.2	H	0.2	0.9	L	0.83	1.12	L		√
Sweden	3.1	2.4	H	2.4	2.9	H	3.35#	3.89	H	√	√
Switzerland	2.2*	1.6	L	1.6	1.1	L	2.73	2.93	H		
UK	2.8	2.3	H	2.3	2.0	H	1.88	1.78	L		
US	2.4	2.2	M	2.2	2.1	H	2.55	2.62	H		√

* GDP; # 1995;

Valuation: GDP per capita: average of < 2.0 = L, 2.0–2.4 = M, > 2.4 = H; productivity: average of < 1.5 = L; 1.5–1.9 = M; > 2.0 = H; R&D spending: average of < 2 = L; 2.0–2.49 = M; > 2.5 = H.

Sources: European Commission 2008: 139ff; OECD 2003: 164; OECD 2007a: 38f, 2007c; 2008: 239 and 250.

remained at roughly the same level, but in some – Austria, Canada, and the Scandinavian countries – it has risen considerably. A remarkable case is Germany, which, at 2.68 percent of GDP, was among the front-runners in 1985, but whose R&D spending has since declined.

Table 1 shows that levels of growth per capita and R&D correspond in only five of the 19 countries, while those of productivity and R&D correspond in 11 countries. We have to recognize, of course, that correspondence is not the same as causality and so we must proceed with caution. Another reason for caution is the fact that the comparisons in Table 1 are crude, making no distinction between, for example, low and very low. The United Kingdom's R&D spending in 1995 and 2006, on average, was low, but not much lower than Austria's (ranked M) and much higher than Italy's, which is also classified L.

The basic message, however, is that, where there is no correspondence at all – or, when more levels than L, M and H could be differentiated, only a weak one – then no or only a weak causal relationship exists between R&D and GDP growth and, more importantly, productivity growth. Clear examples of this are provided by, on the one hand, Australia, Britain, Ireland, and Norway, where high productivity increases took place in combination with low R&D spending (although in the case of Ireland the spending of US multinationals has been very important, and Norway is a special case because the ups and downs of the oil price strongly determine the development of its productivity) and, on the other hand, Switzerland and Denmark, where medium to high R&D spending did not bring about a corresponding rise in productivity. Generally, GDP per capita and per hour fell in the second period presented in the table, despite stable or even increasing R&D efforts.

By contrast, the correspondence between the occurrence or absence of a house-price bubble and productivity levels is much more straightforward. The years since the middle of the 1990s have been characterized by house-price bubbles in many Western countries. Comparing the periods 1985–94 and 1995–2004, it is in Western countries – of those mentioned in Table 1, Australia, Denmark, Finland, Ireland, the Netherlands, Norway, Sweden, the United Kingdom, and the United States – that productivity growth has accelerated, whereas in countries with no house-price bubble – Belgium, Germany, Italy, and New Zealand – productivity growth deteriorated. The sole exceptions to this pattern are Austria – no bubble, but improved productivity figures – and France (a bubble in the 2000s, but deteriorating productivity). The »bubble pattern« might tell us that, in recent years, accidental factors have been more important for economic progress than institutional structures, and policies on R&D spending – or at least its public component – reflect this.[1]

Going back to the weak correspondence between input and output in the case of spending and performance one can identify another example in education spending and literacy/numeracy performance, as presented by the PISA tests, which receive as much or even more attention than R&D figures. Particularly striking are the cases of Denmark and the United States. In these two countries, the percentage of GDP spent on education is higher than in any of the other economically advanced countries (cf. Table 3), but the performance of Danish and US high school pupils in the PISA tests is mediocre. The situation in Japan and the Netherlands is the reverse (see Table 2 – the sample of countries in this table is restricted to those for which comparative data on adult literacy are available). A similar difference holds true for Norway and Sweden versus Ireland: the former do not perform worse than the latter, but this is achieved at a much higher price. In Finland and Italy, by contrast, expenditure and performance roughly correspond.

PISA tests have been criticized for departing from normative ideas about school performance, favoring certain types of education and learning, and for deficiencies in methodology and sampling (see the contributions in Hopmann, Brinek, and Retzl 2007) and should therefore be used with caution. However, taking adult literacy and numeracy in 1994–98 and 2003, the relations between expenditure and performance are in part (in the Danish, Dutch, and US cases) as weak as with regard to the PISA tests, although high-spending Norway and Sweden have better scores in this instance.

1. The relation between productivity growth and the existence of »house-price bubbles« is as follows (1995–2004 in comparison with 1985–1994): Improving productivity growth was present in Austria, Australia, Denmark, Finland, Ireland, Norway, the Netherlands, Sweden, United Kingdom, and United States. All these countries, except for Australia, experienced a »bubble«. Deteriorating productivity growth was present in Belgium, Switzerland, Germany, France, Italy, and New Zealand. Among these countries only France (in the 2000s, with no fiscal arrangements) experienced a »bubble« (cf. Becker 2009: 132).

Table 2

Efficiency of Education Spending: Performance of 14–15-Year-Olds in 2003; Adult Literacy (Prose and Document Reading Plus Math) in 1994–98/2003

	Expenditure (% GDP)	*Reading*	*Math*	*Science*	*Adult literacy and numeracy*
High expenditure – relatively mediocre performance					
USA	7.46	495	483	491	Low/medium[1]
Denmark	7.01	492	514	475	Medium[3]
Norway	6.56	500	495	484	High[2]
Sweden	6.74	514	509	506	High[3]
Low expenditure – relatively high performance					
Japan[1]	4.77	498[4]	534	548	
Netherlands	4.99	513	538	524	Medium/high[3]
Ireland	4.44	516	503	505	Low[3]
Matching relationship					
Finland	6.13	544	544	548	Medium[3]
Italy	5.05	476	466	486	Low[2]

Notes: [1] 1994–98 and 2003; [2] 2003; [3] 1994–98; [4] The Japanese alphabet is much more difficult than the Latin one. Understandably, the first Japanese score is relatively low.

Sources: OECD 2007a: 52f; HRSDC 2003, IES 2005; Pontusson 2005: 136.

Patents and Input Efficiency

A final example of the rather weak input–output correspondence in the area under discussion is the relationship between R&D spending and the number of patents, as well as the scores for overall innovation and competitiveness rankings (see Table 3). The top spenders are the top inventors, to be sure, but at one level lower it is difficult to discover any pattern. Australia, Belgium, Canada, and the United Kingdom did not spend less than the Netherlands, but their innovative performance is much lower; while France and – albeit only recently – Austria spent more but without performing any better. The competitiveness data of the World Economic Forum (WEF) have to be taken with a grain of salt, however, because they are partly based on interviews and so have a subjective dimension. With regard to the figures on employment in mid- and high-tech manufacturing it is necessary to be aware of the generally higher percentages for employment in manufacturing in Germany (with by far the highest score) and Austria. I shall look briefly at the »Summary Innovation Index« produced for the European Commission below. With the exception of Denmark and Sweden, it does not differ much from the WEF's Innovation Index.

The data presented in Table 3 give the impression that Germany (no longer a top spender), Japan, Switzerland, Scandinavia (with the exception of Norway), and the United States are far ahead of the rest of the pack. The differences are particularly pronounced with regard to TPF patents (TPF or Triadic Patent Families, patents registered at all of the three main patent offices – the EU, Japan, and the United States[2]), where the number of Japanese patents per one million inhabitants is 10 times that of Italian patents and 25 times that of Spanish patents. Overall, Japan and Switzerland are the most inventive in this respect, followed by Germany, the Netherlands (only low-ranked in terms of R&D spending), and Sweden. Patents may be an indicator of the efficiency with which research money is used. How robust are the data in Table 3, however? Is the habit of registering inventions as patents in the three major patent offices the same in all countries (Crouch (2005: 30) questions it, for example)? Again, does every patent have the same value; is, for example, an improvement in a washing powder or the invention of a new flavor of coffee (some years ago, Starbucks was named the most inventive company in the US) just as important in terms of overall innovation as the invention of an energy-saving engine or new computer software? Answering these questions would require much additional research, but even if it were carried out, normative judgments would still be required about the importance of specific patents.

The OECD also presents separate figures on ICT patents, often supposed to be more important than those in the coffee or soup industries. These figures (Khan and Dernis 2006: 29) confirm the picture we have already established: the United States, Japan (both about 10,000 TPFs), and Germany (5,500) have by far the most patents, while Switzerland

2. A significant number of studies take only the US Patent Office as their empirical basis (a recent example is Akkermans, Castaldi and Los 2009). Such studies are, of course, strongly biased in favor of the United States.

Table 3

Indicators of Competitiveness and Innovative Capacity

	Spending on educational institutions	*R&D spending as a % of GDP, 2005*	*Employment in M&HT (%), 2003*	*Summary Innovation Index, 2007*	*TPF per 1 million inhabitants in 2005*	*GCI 2007*	*BCI 2007 (Rank)*	*Innovation Index 2007*
Australia	5.77	1.76*	–	0.36 (20)	20.2	5.17 (19)	18	4.41 (22)
Austria	5.49	2.42	5.2	0.48 (14)	36.5	5.23 (15)	8	4.76 (15)
Belgium	6.13	1.82	5.2	0.47 (16)	31.8	5.10 (20)	15	4.74 (16)
Canada	5.93	1.98	3.9	0.44 (18)	25.4	5.34 (13)	14	5.08 (12)
Denmark	7.01	2.45	5.6	0.61 (5)	40.5	5.55 (3)	5	5.11 (11)
Finland	6.13	3.48	7.0	0.64 (3)	50.3	5.49 (6)	3	5.67 (3)
France	6.31	2.13	5.4*	0.47 (16)	39.3	5.18 (18)	17	4.69 (17)
Germany	5.28	2.46	9.8*	0.59 (7)	76.0	5.51 (5)	2	5.46 (7)
Ireland	4.44	1.26	7.0*	0.49 (13)	14.2	5.03 (22)	24	4.54 (19)
Italy	5.05	1.10	6.5	0.33 (24)	12.2	4.36 (46)	42	3.45 (47)
Japan	4.77	3.33	7.3	0.60 (6)	119.3	5.43 (8)	10	5.64 (4)
Netherlands	4.99	1.78	4.0	0.48 (14)	72.6	5.40 (10)	7	4.88 (13)
New Zealand	6.84	1.15	–	–	15.7	4.98 (24)	22	4.09 (25)
Norway	6.56	1.52	–	0.36 (20)	24.1	5.20 (16)	13	4.60 (18)

	Spending on educational institutions	*R&D spending as a % of GDP, 2005*	*Employment in M&HT (%), 2003*	*Summary Innovation Index, 2007*	*TPF per 1 million inhabitants in 2005*	*GCI 2007*	*BCI 2007 (Rank)*	*Innovation Index 2007*
Spain	4.71	1.12	5.0*	0.31 (26)	4.6	4.66 (29)	27	3.58 (39)
Sweden	6.74	3.89	7.2	0.73 (1)	72.3	5.54 (4)	4	5.53 (6)
Switzerland	6.54	2.93*	–	0.67 (2)	106.7	5.62 (2)	6	5.74 (2)
United Kingdom	6.09	1.78	4.8	0.57 (8)	26.4	5.41 (9)	11	4.79 (14)
United States	7.46	2.62	3.8	0.55 (9)	55.2	5.67 (1)	1	5.77 (1)

Note: * Previous year.

Sources: OECD 2007a: 50f and 38f for columns 1 and 2; Begg, Draxler, and Mortensen 2007: 111 for *Employment in Medium and High Tech Manufacturing;* % of total employment); TII *(Summary Innovation Index):* Pro Inno Europe 2007, Figure 1; TPF (Triadic Patent Families): OECD 2007b; BCI *(Business Competitiveness Index)* 2007, GCI (*Global Competitiveness Index*) 2007 and *Innovation Index* 2007: WEF 2007/08.

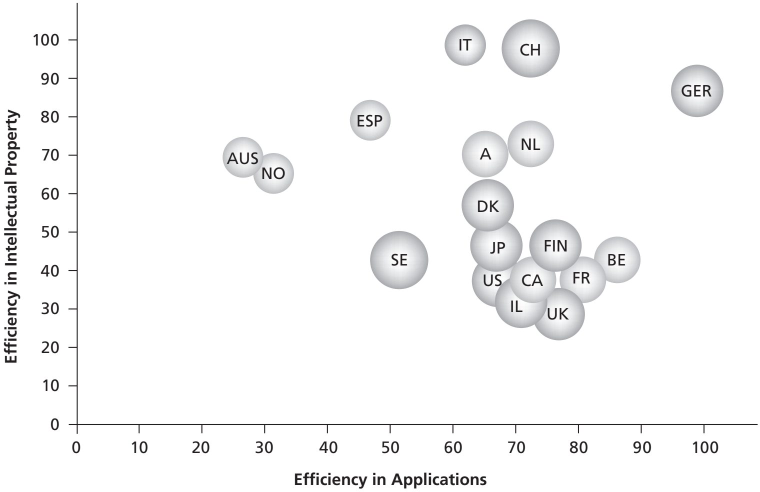
and the small corporatist Benelux and Scandinavian countries perform, at least relatively, as well as the three big countries. From the same authors (p. 24) we also learn that Germany and Switzerland have the highest patent-to-researcher ratios, with the Netherlands and Japan as runners-up and the »usual suspects« – Scandinavia and the United States – following. The patenting performance of the other largely liberal political economies is not worth mentioning and the same can be said about Italy and Spain. Apart from Western countries and Japan, only South Korea has a significant share (6 percent in 2005) in the total number of TPFs (United States: 31 percent; Japan: 28.8 percent; EU: 28.4 percent; Germany: 11.9 percent; France: 4.7; United Kingdom: 3.0 – OECD 2007b), while China (0.8 percent) and India (0.2 percent) have not yet become important innovators.

An alternative attempt to come to terms with the input-output relationship is the European Commission's *European Innovation Scoreboard* (EIS; Pro Inno 2007), in which five dimensions are distinguished. On the input side, these are »innovation drivers« (the structural conditions required for innovation potential), »knowledge creation« (R&D investment), and »innovation and entrepreneurship« (efforts towards innovation at the enterprise level). The output dimensions are »applications« (performance in terms of labor and business activities and their value added in innovative sectors) and »intellectual property« (results in terms of successful know-how). Based on these criteria, the EIS identifies four country groups, of which three are relevant for the countries under discussion in this article:

- *Innovation leaders:* Denmark, Finland, Germany, Japan, Sweden, Switzerland, (perhaps surprisingly) the United Kingdom, and the United States.
- *Innovation followers:* Austria, Belgium, Canada, France, Ireland, and the Netherlands.
- *Moderate innovators:* Australia, Italy, Norway, and Spain.

Sweden appears to be the most innovative country in this ranking (see Table 3), most of all because of its innovation inputs. In terms of transforming innovation inputs into outputs, however, Sweden is less efficient. Among other countries this also holds true for the United States. This is demonstrated in Figure 1, in which the total innovation scores of the various countries (expressed by size of circle) are related to the separate output criteria.

Figure 1:
Efficiency of Innovation Inputs: Application and Intellectual Property Outputs according to the European Innovation Scoreboard*



Note: * The size of the bubble gives the value of the 2007 Summary Innovation Index (SII) as presented in Table 3.

Source: The figure is a modified version of Figure 10 in Pro Inno Europe (2007).

While the high positions of Germany and Switzerland are no surprise when it comes to output in terms of applications and the use of know-how, the radical repositioning of many other countries perhaps is. This again points to the relatively weak correspondence between input and output (which is confirmed by an OECD study on the relationship between R&D investment and the development of productivity, understood as the efficiency of production processes; Khan and Luintel 2006: 7). Taking all criteria into account, Italy is only a moderate innovator (and also scores very low in the PISA rankings), while Austria, Belgium, and the Netherlands are followers. In this context, however, they appear as relatively efficient innovators. The reverse is true not only for Sweden, but also for the United Kingdom, the United States, and, surprisingly, even Japan. According to the EIS, these countries are only averagely efficient innovators.

Does this mean that Sweden, Japan, and the United States are less innovative than Italy or Belgium? It does not, and not only because the EIS is debatable. First, the output scores are relative expressions of the countries' inputs (measuring how efficiently this input is used, independently of absolute size), but not a measure of total output (innovation); second, the input-output relations in the figure once again illustrate how difficult it is to determine countries' innovative capacity; and third, the efficient use of inputs is an art in itself. Moreover, the high efficiency scores of Austria, Belgium, the Netherlands, and Italy (as well as of Germany and Switzerland) perhaps indicate the prevalence of small and medium-sized firms in these countries, which might be innovative as a result of initiatives on the shop-floor, without specialized research departments covered by comparative R&D statistics. If this is true, small company-dominated Denmark would be the exception to the rule.

Comparative Institutional Advantages: Does Liberalization Facilitate Radical Innovation?

There is, therefore, a great deal of evidence to indicate that the correspondence between input and output is not particularly strong. The most striking overall results seem to be (again, one must be cautious because of the imprecision of the data) that the corporatist countries – characterized by some degree of macroeconomic cooperation between labor and capital – perform considerably better than the distinctly liberal countries, with their low labor and product market protection and rather residual welfare systems. Furthermore, the most liberal economy of all, the United States, is, contrary to its image, relatively speaking not the most innovative economy, at least according to the scoreboards of the OECD and the European Commission (EIS – however, in the rankings of the World Economic Forum, the United States was number one in 2007[3]).

3. Herbert Kitschelt (2006: 70) also puts the United States ahead, while the United Kingdom also fares very well in his account, which is partly based on the trade in patent licenses, in which these countries have a surplus, while Germany and the Scandinavian countries have deficits. The basis of the figures Kitschelt presents is not strong, however. As Dernis and Khan (2004: 30) put it: »Comprehensive data on patent licensing and resulting royalties are not generally available. Most patent licensing is based on private contracts and confidential agreements, and accounting guidelines and corporate disclosure rules do not require firms to break out

Also, it is not justified to classify the economies which most closely approximate the ideal type of liberalized economy in general, and the United States in particular, as radically innovative, as is supposed by American neoclassical economists, as well as in the theory of varieties of capitalism. These approaches give too much weight to recent developments in the United States, exclude the history of capitalist innovation (cf. Zachery Taylor 2004 and Crouch 2005: 30ff), and distinguish absolutely between radical and incremental innovation, which is more properly described as a continuum. It would have been a very radical innovation indeed if Leonardo Da Vinci had invented a flying machine that really flew, but it took another 400 years before this happened. Moreover, one must distinguish between an innovation as such and its effects on society. Some – electricity, cars, television, computers and the internet, to mention the most striking – have brought about radical changes in our way of life, while the innovation processes which led up to them were incremental and several countries were involved.

Take ICT, perhaps the biggest field of innovation in recent decades. The United States has led the way in terms of development, and most major companies in this field are American. Computers, microchips, and the internet were not sudden inventions of the period from the 1970s to the 1990s, however. After its early beginnings (ideas for calculation machines go back to the seventeenth century), the modern history of the computer started in the 1940s in Germany (the *Zuse 3* was the first »computer«), the United Kingdom, and the United States. A similar story can be told about the integrated circuit, from which the microchip emerged (cf. Hoddeson and Riordan 1998). A Siemens engineer registered the first patent in 1949, the next important innovation was by a British scientist in 1952, and thereafter, in 1958 and 1959, it was the turn of US firms (Texas Instruments and Fairchild). Apart from a few years in the 1980s, the United States has maintained its lead in this technological field. This development was not the result of capitalist competition in free markets, however, but due to concerted government action. The state, particularly military investment, has been crucial for the electronics and, later, the ICT industries throughout the post-war period (Lazonick 2007: 39, 51f; cf. Crouch 2006: 326). This was also true of the internet, the first predecessor of which was launched as early as 1969 (APRANET). Moreover, the

IPR-related revenues from other sources of income. Estimates are therefore based on firm-level surveys.«

growth of the internet was possible only because of the increasing presence of so many PCs and laptops in millions of homes and offices since the 1980s (Lazonick 2007: 52).

It does not seem, therefore, that liberal political economies have any institutional advantage in terms of radical innovation. Radical innovation, indeed, is a problematic concept and the innovative character of the US economy (like those of Germany and Switzerland) has to be explained in terms of specific national factors, as does the lack of innovation in liberal countries such as Australia, Canada, and New Zealand. However, a number of very innovative corporatist countries, notably in Scandinavia, combine competitiveness with high scores on social indicators, begging the question of whether or not their innovative capacity is related to their corporatism. Is there an institutional competitive advantage in corporatism?

The obvious institutional advantage enjoyed by corporatist countries is the making of pacts between capital and labor. Does this enhance innovation and, as a consequence, competitiveness? In any case, the issue of innovation and competitiveness has been on the corporatist agenda, above all in Finland (cf. Kettunen 2004) and Sweden (cf. Elvander 2002: 201). In these countries – especially the former[4] – it has become clear that the expensive welfare state can be borne only by a highly productive market sector. In Finland – sometimes referred to as »Nokia-land« – in the 1990s the state, as well as capital and labor, put a strong emphasis on innovation. The establishment of the corporatist Science and Technology Policy Council (STPC) in 1987 was crucial in this regard, although the concerted move towards high tech and innovation took place only under pressure from the economic crisis a few years later. Important activities launched by the STPC include the creation of an IT infrastructure, changes in the education system, and the opening up of possibilities for international venture capital investment in Finland (Moen und Lilja 2005: 368ff).

The spectacular rise of Nokia from an unknown TV and tire producer to the global number one in mobile telephony has to be understood in

4. Denmark relies more on small businesses and depends rather on informal innovation occurring in the course of the work process. An important aspect of this is the importance attached to regular further education and training, building on a high general level of education. In comparative perspective Denmark – and to a lesser degree also Finland and Sweden – has a significant edge in this respect (Gallie 2007: 92).

this context. We should not overestimate the influence of »wise« policies, however. Particularly important in the case of Nokia appears to have been the lucky circumstance that the European Commission chose GSM as the standard for mobile telephones. Again, in the context of the stock market euphoria of the second half of the 1990s with regard to high tech shares – another lucky accident – the country became very attractive for foreign capital.

If we take instead strongly corporatist Austria, the Netherlands and, to a lesser extent, Belgium, we find ourselves confronted with political economies that do not appear in the upper echelons of innovation and it would not make much sense to ask about the comparative institutional advantages of corporatism in this respect. One would rather have to ask how it is possible to become rich (all three) and to enjoy relatively high GDP growth and employment (Austria and the Netherlands) without being particularly innovative in the terms discussed here.

What can generally be said, therefore, about the comparative institutional advantages of corporatism? Does it enhance innovation? The comparative experience does not support an unequivocal »yes.« Does corporatism have something to add to market incentives to increase productivity and to state action to create favorable conditions? Traditional pro-corporatist arguments, from an enterprise point of view, include trade union accountability and the long-term perspective which corporatist agreements make possible. Innovation can be included in collective agreements and exchanged for the promise of a better future. The big plus of corporatism is its macro-orientation, which is shared by capital and labor. This does not automatically improve a country's innovative capacity and competitiveness, but it does facilitate it. This facilitation is what corporatism has to offer here, apart from a high degree of social peace and social security. Otherwise, countries' innovative capacities seem to depend on specific national conditions.

Competitiveness

Moving on from innovation to the broader issue of competitiveness does not bring us onto firmer ground. Innovation is a pivotal ingredient in the current and future competitiveness of highly advanced economies, but location, specialization, and infrastructure can be just as important. If domestic innovation was the only factor determining competitiveness it would be very difficult to explain why countries such as Ireland, Spain, or Greece have grown as strongly as they have in the context of global competition. But how is competitiveness to be measured? Growth in productivity per hour and unit labor costs are important but imprecise indicators because their development also depends on economic output and, possibly, rising or falling prices. Moreover, productivity growth may be based on imported innovations.[5] Current account balances (which would make a deficit country, such as the United States, a bad competitor, while Norway, with its surplus, would be a top competitor) are also a vague indicator and a country's share in world exports is not viable because it privileges small countries. It would not be inaccurate, therefore, to indicate competitiveness in terms of a country's innovation capacity, as well as the average broad competitiveness scores in Table 3.

An additional indicator, and one which is even more difficult to quantify, is a country's comparative economic (dis)advantages in financial services and middle and high tech goods, such as ICT, transport equipment, non-electrical machinery, and electronic components.[6] The countries doing relatively well in these fields include Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Sweden, and Switzerland, as well as the United Kingdom and the United States in financial services (see Becker 2009: 162f; if it did not offshore so much of its manufacturing, the US could also have high scores in middle and high-tech goods). Denmark in transport and Austria in tourism also have conspicuous advantages, but these do not belong to the high or medium-high tech sectors. Any clear correspondence between comparative advantages and innovative capacity is barely visible. Countries with a low innovative capacity, such as Ireland and Italy, appear to have stronger comparative advantages than competitors which are considerably more innovative.[7]

5. »So what?« one might say. Import-based productivity growth is still productivity growth and companies have to pay for it – if it is not the intra-company trade of multinationals. This looks like a defendable position, but it is short-sighted. First, imported innovation regularly implies a delay in application; second, even imported innovation requires an up-to-date environment in terms of technology, skilled people, and infrastructure; and third, in the long term, a country's export position could deteriorate and, as a result, productivity growth relying on imported innovation could become too expensive.
6. For even more detailed information, see Tables 2a and 2b in Havik and McMorrow (2006: 54f).
7. In the case of Ireland one could explain this by the dominant influence of US companies and the US innovative capacity in that country (a share of 40 percent foreign-

Only Australia and Norway appear not to be competitive in the sectors mentioned. They rely on their minerals and oil, respectively. It is not clear, however, by what method strengths and weaknesses should be determined quantitatively. On the whole, the conceptualization and measurement of competitiveness is still underdeveloped. There is too much attention to input factors, while factors such as economic specialization, export share, and the (large-scale) application of inventions have not yet been taken into account satisfactorily.

The real story of this article is not competitiveness, but innovation and the relationship between input – particularly R&D spending – and output measured in patents and, subsequently, the application of inventions. It appears that spending is very important, but that no direct link can be detected between spending and innovative capacity. To transform input into the first stage of output – patents – is more difficult in some countries than in others. Furthermore, the latter are not by definition those that spend most on R&D. Similar transformation problems exist between the first and the second stage of output: application. The only countries which, according to the data presented by the European Commission and the OECD, perform well in both transformation processes are Germany and Switzerland, and Germany is not one of the top R&D spenders.

More specific research will have to find out why Germany, although not spending much more than France, performs considerably better in terms of patents and applications, and why it performs as well as Finland and Sweden, although it spends significantly less. Is it the long-term effects of the relatively high German spending in the 1980s? Or is it related to the apprenticeship system, which provides a large number of mid-level qualified people who are better equipped to participate in the application of inventions on the shop-floor than unskilled and semi-skilled workers, who are more numerous in the French economy? Detailed research will also have to explain why the United States is the only predominantly liberal country at the top of the innovation league, although its performance is not as outstanding as is often suggested.

Does the relative decoupling of R&D spending and tangible innovation imply that spending can be reduced or frozen at a given level? No, it

owned Irish patents might indicate this influence; cf. Khan and Dernis 2006: Figure 32). This explanation does not hold for Italy, however, which in some sense is a »miracle«. Most of its innovation scores are extremely low for a rich country, but Italy is still competitive – although its position has been deteriorating in recent years.

does not. Economic fitness and innovative capacity have become increasingly important in the global market and without R&D there is no innovation at all. And the higher the former is, the higher is the *potential* of the latter. R&D, like PISA results or the number of academics, has to be put into context, however; the context, in other words, that renders spending effective, makes outputs match inputs, and explains national (or regional) peculiarities. Policy-makers have to take this context into account and, when necessary, to work to improve it. At the national level – and in Europe at the EU level – this is as important as spending, particularly since we have to acknowledge that the global economy is dominated by multinational companies and national R&D might lose relevance.

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