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Letter to the editor

A critique of Staffan Jacobsson's paper "Universities and industrial transformation"

Thomas Andersson and Magnus Henrekson

IN A RECENT ARTICLE, Staffan Jacobsson (2002) presents his views on the level of knowledge as it applies to universities, and their role in innovation and in industrial development, with particular emphasis on Sweden. He discusses the possibilities for increasing the social benefits from resources invested in the university sector through various policy measures.

The report covers a vast area in a selective manner, and it is beyond the scope of this brief note to give a comprehensive review of the paper. We limit our commentary to critical aspects relating to the current discussion on innovation policies in Sweden, which we believe to be generally important for the main thrust of his paper. We particularly focus attention on the following two central assertions in Jacobsson's paper:

- Sweden does not face a situation where high rates of R&D spending, patenting and scientific publication coexist with a low level of 'real' output from research and innovation sectors in terms of commercial and industrial development and economic performance.
- The link between input and output is so complex that, given the current level of knowledge, it is not possible to draw *any* conclusions about what type of innovation policy may generate high societal returns; "good science is useful science", period.

In the following two sections, we will assess the validity of these two assertions.

The notion of a Swedish paradox

The final report of the government-commissioned Expert Group on Innovation Policy (Andersson *et al*, 2002),[1] as well as a number of similar studies (for instance, Edquist and Lundwall, 1993; Goldfarb and Henrekson, 2003; Boekholt *et al*., 2002; Gustavsson and Kokko, 2003) have documented that, based on existing cross-country comparisons, Sweden tends to fare well in terms of R&D, scientific publication rates and patenting, whereas corresponding strengths with regard to commercialisation of new technology, fast-growing smaller firms and aggregate growth are largely lacking. This has popularly been referred to as the "Swedish paradox".

In effect, Jacobsson questions the existence of such a paradox, although his wording is somewhat cautious: "the perception of Sweden as an industrially under-utilised 'academic power-house' is somewhat exaggerated" (page 351). In one sense, this is not an issue, since nobody really believes in a 'paradox'; what matters is the contrast between strengths in input and weaknesses in output, which, on closer scrutiny, is transformed from a 'paradox' to a 'problem'.

That is not, however, the point made by Jacobsson. While his line of argument is not entirely clear, he advances two assertions that appear aimed at contradicting the notion of a paradox: first, Sweden is not as strong on the input side as is often maintained, especially with regard to publications in scientific journals and the level of R&D; and second, inputs and outputs are difficult to measure, which, in particular, makes comparisons between countries unreliable.

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However, Jacobsson's handling of the empirical data suffers from serious deficiencies. For example, Table 1 shows in two columns the level of R&D in science and technology as a share of GDP (gross domestic product) in academia and non-industry, respectively, for a number of countries, both as of 1995 (the year chosen by Jacobsson for comparison). The first column presents the most precise estimate of 'academic' R&D as defined by official OECD (Organisation for Economic Co-operation and Development) statistics, whereas the second includes a much broader set. No statistics are flawless, but these are the best ones available, provided by member states in a consistent manner in accordance with a manual that has been in use for many years. Jacobsson also refers to this source as a basis for his argument, but with the following astonishing formulation (page 352):

> "Unfortunately available data do not cover many countries but a comparison can be made with both Germany and Japan … the picture of the superior strength of Swedish non-business R&D largely disappears."

This is based on the observation that Sweden's position is less superior, relative to Germany and Japan, in the crude measure of non-industry R&D compared to the more relevant measure of 'academic' R&D.[2] The fact remains that Sweden displays a high level in particular with regard to R&D in academia, and a fairly high level in non-industry based R&D as well as shown in Table 1.

Furthermore, in his Table 2 (page 352), Jacobsson states that output in the form of number of published articles in engineering is not higher in Sweden than in many other countries and, in addition, the proportion is lower (and higher) in sub-categories such as information and communications technology. It is actually unlikely that the country leading in the aggregate is also in the lead in all or virtually all subcategories. Jacobsson works really hard to show that Sweden comes out unfavourably in terms of performance in the areas he selects, raising every possible argument that data for Sweden are biased upwards (not working equally hard to show possible downward biases for other countries).

However, with reference to his tables and the extended version that we present, there is scope for a more positive view, where Sweden ends up in the top group of countries within most categories.[3] The fact is that several countries perform *equally well* as Sweden. This does not in any way change the impression that Sweden in several ways underperforms in areas related to the commercialisation of new products, entrepreneurship,[4] creation of new and high-growth firms, the level of consumer prices and long-term GDP growth. We do not claim that a change with regard to research is the key to success, but rather that a strong position in research is not a sufficient condition for generating strong economic performance. An appropriate policy response requires that attention be directed to shortcomings in a number of relevant areas.

A successful examination of the Swedish paradox and the formulation of policy conclusions require a certain understanding of the circumstances under which research and education contribute to higher prosperity in society at large. This observation brings us to Jacobsson's second central assertion.

Table 1. R&D in science and technology per GDP in academia and outside industry in selected countries, 1995

Country	R&D/GDP in academia	R&D/GDP outside industry
Iceland	0.0037	0.0093
Japan	**0.0039**	**0.0079**
Sweden	**0.0061**	**0.0072**
Australia[a]	0.0031	0.0072
Denmark	0.0034	0.0064
Germany	**0.0033**	**0.0064**
Norway	0.0030	0.0052
Canada	0.0026	0.0050
Austria[b]	0.0039	0.0048
Poland	0.0017	0.0041
Portugal	0.0014	0.0039
Spain	0.0021	0.0037
Czech Republic	0.0008	0.0032
Ireland[c]	0.0021	0.0031
Hungary	0.0015	0.0029
Mexico	0.0010	0.0020
Finland	0.0030	na
Switzerland[a]	0.0055	na
Turkey	0.0021	na
United States[c]	0.0037	na

Notes: [a] 1996
[b] 1993
[c] 1994
na = not available
R&D in academia is just another name for OECD's expenditure on R&D in the higher-education sector (HERD), and R&D outside industry is the sum of HERD, Government intramural R&D expenditure (GOVERD) and private non-profit institution expenditure on R&D

Source: OECD (2000a; 2000b)

What is an efficient innovation policy?

Lately the factors contributing to economic performance have gone through considerable change as a result of, for instance, the breakthroughs in ICT (information and communication technology) and biotechnology, the ongoing integration of product and factor markets on a global basis, the challenges related to demographic change, and the demand for growth that is sustainable *vis-à-vis* the environment and societal values. Today, both companies and governments world-wide are considering and reconsidering their growth strategies in light of these trends and circumstances. Even if traditional factors of production remain important, innovation capacity is assuming an increasingly central position. That capacity in turn hinges on intangible ('soft') assets

(R&D, know-how, goodwill or organisational capital) and a number of underlying circumstances (institutional frameworks, rules of the game, incentives and attitudes) that are influenced by multiple factors.

Like many other analysts, we argue that innovative output is crucially dependent on the interplay, through competition as well as co-operation, among different actors. It is the combined effect of their partly complementary and partly contradictory efforts that counts, and the innovation process is the result of a dynamic process that increasingly straddles traditional sectors and geographic boundaries. This underlines the importance of a systemic perspective.

Jacobsson, however, adopts a more nihilistic point of view. Leaning on, *inter alia*, Salter and Martin's (2001) conclusion that there is no simple model to explain how economic benefits can be generated from investments in basic research and that the economic value of specific investments cannot be assessed *ex ante,* he argues that we, in view of the current level of knowledge, must accept the adage that "good science is useful science". Thus, it is not possible to have a well-founded view about the design of an effective science and innovation policy.

At the same time, Jacobsson chooses to quote Pavitt (1998, page 797):

> "… the main practical benefits of academic research are not easily transmissible information, ideas and discoveries available on equal terms to anyone in the world. Instead, there are various elements of problem-solving capacity involving the transmission of often tacit (i.e., non-codifiable) knowledge through personal mobility and face-to-face contacts. The benefits therefore tend to be geographically and linguistically localised."

This quote captures the essence of the issue: innovation depends on a myriad of actors, each with their own agenda, decentralised knowledge that to a large extent is non-codifiable and the local environment working well in all its complexity. Under such conditions, no 'central planner' can hope to achieve the required overview to 'manage' all relevant activities in a rational manner. Jacobsson acknowledges this, writing that (page 362):

> "In a situation of ignorance about future applications of technology and its value, there is no reason to believe that choice can be 'rational'. In an uncertain and complex world, the main justification for academic research would not lie in the production of information in the shape of a public good, but instead lie in building capabilities."

Under such circumstances, the main role of policy-makers will be to provide adequate rules of the game (Baumol, 1990).[5] In our context, this means that policy-makers should aim to establish appropriate institutions and reward structures that foster investments and efforts conducive to innovation by all relevant actors.

Two examples may be used to illustrate the point. It has been well established that successful transfer of knowledge from universities to the commercial sector often requires the active participation of the researchers in question (Jensen and Thursby, 2001). Then it is hardly purposeful that universities look unfavourably on, and even actively discourage, such participation. If the need for knowledge is rapidly increasing and universities have little incentive to adjust their programmes to changing needs, there is great risk that the efficiency of the university system is reduced.[6]

The point is not that the government should try to micromanage decisions in these areas. It needs to be understood, however, that governments exert an influence on incentives in these areas through a number of, often unforeseen, channels. In our view, incentives to contribute sufficiently and convincingly to the innovation and commercialisation process among those directly involved (researchers, universities, institutions, companies, commercial knowledge and financial brokers and so on) have been too weak in Sweden, partly because of prevailing Government policies. In Andersson *et al* (2002) ample evidence for this proposition is provided. To compensate for the lack of incentives by the actors directly involved in innovation, the Government has established a great many 'bridging institutions'.

The strategy adopted by the Swedish Government has had strong elements of a top-down model in which the Government, through supporting measures, is directly involved in the transfer of knowledge with a commercial potential from the universities to the private sector. Considering that such transfers to a great extent are dependent on the availability and dedication of individual researchers, more favourable conditions are called for. This includes more appropriate legal structures (including the tax code) encouraging the spontaneous evolution of effective incentive structures for the actors involved.

Innovation depends on a myriad of actors, each with their own agenda, decentralised knowledge that to a large extent is non-codifiable and the local environment working well in all its complexity: no 'central planner' can hope to 'manage' all relevant activities rationally

Conclusion

Like Jacobsson, we have underscored the presence of difficulties in measuring and comparing country data. These difficulties need to be taken seriously, meaning that both policy-makers and researchers must be careful not to draw too far-reaching conclusions. Yet where does this lead us? We have argued that policy-makers must seek to establish greater room for manoeuvre for university researchers and for people wishing to start companies. Increased competition must be allowed between different types of research institutes and educational institutions, and important reward structures (for instance, through the distribution of public support to universities) need to be designed so that improved performance in R&D and teaching is encouraged.

Jacobsson sets out to scrutinise methodological problems behind R&D and publication data and succeeds in some ways, but unfortunately he is using the data he asserts to be inadequate to try to prove that Sweden is not facing the problems identified by numerous analysts. To some extent he is caught in the trap that he claims others have fallen into.

Is it then possible, in light of current knowledge, to design an effective innovation policy? In our view, it is important that policy-makers are mandated to try to correct conditions that distort or impede the emergence of purposeful structures and institutions conducive to innovation. Jacobsson, by contrast, meekly hopes that we can learn from additional research about how innovation systems within defined areas function in order to understand (page 361):

> "… the interaction of universities with industry through all kinds of mechanisms in these fields (including an analysis of obstacles to the proper functioning of each mechanism), … the determinants of these patterns, be they in the form of virtuous circles, including both governance structure of the universities, the nature of science policy, the existence and behaviour of external actors funding research and the nature of the remaining components of the surrounding technological system."

There is nothing novel in observing that our knowledge of the world is imperfect. The issue is rather how we use the knowledge we do have. Jacobsson ends up arguing that our lack of complete understanding is a reason for leaving policy-makers and/or scientists alone. In practice, this means relying on 'top-down' policies, since leaving them alone increases the risk of getting a university system lacking in quality and relevance, when insider 'entrepreneurs' are given more room.[7] However, both research and post-war economic history teach us that, given the incredible complexity of the real world, it is futile to expect that it is possible to gain sufficient knowledge for decision-makers at the national level to succeed in managing and co-ordinating from above.

Notes

1. The Swedish Government has expressed that a strengthened capacity to commercialise research and knowledge is crucial for raising economic growth. In the declaration of the newly elected Government in Autumn 2002 it was stated that "A new innovation strategy [will] be prepared". In January 2002, the Ministry of Industry and Trade and the Ministry of Education jointly launched a project entitled "Cooperation for a Strengthened Innovation Climate 2002". The goal was to attain a national focus on improving the environment for innovation and competitive advantage. The Government of Sweden commissioned the authors of this note and Ola Asplund, head of research at The Metal Workers' Union, to form the Innovation Policy Expert Group (IPE). During a number of meetings in the Spring and early Summer of 2002, we presented our analysis to key representatives from the Government, industry, trade unions, researchers, and authorities concerned. Our final report was published in November 2002 by the Swedish Agency for Innovation Systems (VINNOVA).
2. It is remarkable that Jacobsson has failed to uncover data for more than three countries. In addition, there are factors that may lead to underestimation or overestimation of the data used. In fact, both numbers given for Sweden in his Table 1 are likely to be underestimated because capital expenses for R&D in academia were not included in the calculations for the year Jacobsson chose for his analysis (1995). At the same time, the numbers for Japan are based on overestimated figures. OECD have adjusted HERD and GERD by about 25% and 15% respectively, which gives an indication of the extent of the miscalculation with regard to Japan (see OECD (2000a) for further country specific measurement problems connected to Jacobsson's Table 1).
3. Recall that total R&D/GDP for Sweden, at 4.5% was by far the highest among all countries in 1999. This should be compared to the OECD average at less than 2% (OECD, MSTI database, May 2001). Finland ranked second with 3.3%.
4. According to the most recent Global Entrepreneurship Monitor report, Sweden ranks 31st among 37 assessed countries in terms of the level of entrepreneurial activity (see Reynolds *et al*, 2002).
5. Both Silicon Valley and the often cited Italian districts show that clusters emerge from below in unforeseeable ways. For example, Lazerson and Lorenzoni (1999, page 257) draw the following conclusion from their comprehensive study of the Italian industrial districts: "… it should be remembered that no industrial district has ever emerged from a set of industrial policy initiatives promoted by either private or public organizations". What policy can do, however, is to boost the probability that viable clusters emerge.
6. Jacobsson has himself shown (Jacobsson *et al*, 2001) that the Swedish university system was very slow to adapt to the rapid growth in demand for university programmes in electronics and computer science. In this regard, European university systems differ greatly from that in the USA. Rosenberg (2000) has shown how quickly completely new fields as well as important breakthroughs in established areas have entered the curricula at leading American universities. US universities can be seen as endogenous institutions that more quickly adjust to the demands of the surrounding society.
7. The reader is referred to Henrekson and Rosenberg (2001) for an analysis of incentives within different types of university systems.

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Response to the critique by Andersson and Henrekson

Staffan Jacobsson

Note: this is a response to an earlier version of the critique. The reiteration was stopped here because it was becoming time-consuming and perhaps not greatly improving the quality of this contribution to the debate.

I AM GLAD THAT MY PAPER was read by these two prominent Swedish academics and that they took the time to formulate some points of critique and raise issues for further discussion. Only through dialogue can we improve our understanding. This may be clearly seen in their Critique, which contains a great deal of misunderstanding, or misreading, of my paper.

They centre their discussion on two statements, which they suggest are central to my paper. In brief, these are that: there is no ‘Swedish paradox’; and it is not possible to draw *any* conclusions about what type of innovation policy may generate high societal returns. I will respond to these two in turn.

There is no ‘Swedish paradox’

My paper did *not* refer to the broader Swedish paradox (which also includes R&D in the business sector) but to a more restricted one. My focus was on R&D, which is conducted in what is normally referred to as the academic sector, and how the strength of that R&D is measured. Nor did I seek to “prove that Sweden is not facing the problems identified by numerous analysts”. My conclusion was therefore *not* that ‘there is no paradox’. I was surprised, and a bit troubled, by this misunderstanding of my arguments.

My most important point was that we face a set of methodological problems in measuring the strength of ‘academic’ R&D. In particular, I argued for the inclusion of not only R&D undertaken in the higher-education sector (the conventional way) but also that carried out by Government and private non-profit organisations. For instance, it is obvious that R&D done by the Max Plank and Fraunhofer societies in Germany should be included (but it is classified under Government and not under higher-education institutes in the statistics for Germany).

If we only look at the higher-education sector, Sweden ranks number 1 and has about double the share of the OECD (and European Union) in terms of R&D/GDP. Sweden is, indeed, an ‘outlier’ if we measure in that restricted way. However, I demonstrated that the inclusion of ‘academic’ R&D done outside the higher-education sector dramatically changes the position of Sweden *vis-à-vis* that of two major countries, Germany and Japan.

I then concluded that[1] (if I may cite myself on page 353): “… there are important methodological … problems that would appear to have exaggerated

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the relative strength of R&D undertaken in Swedish academia" and "[t]he case for focusing on poor exploitation of academic research … does not … seem as strong as may be thought at first glance". I was, therefore, concerned mainly with methodological issues and much more cautious and tentative in my conclusions regarding the 'academic paradox' than the Critique claims me to be.

In my paper, I gave data for only three countries (and I simply made a mistake in writing the paper — there is data for other countries).[2] Further work demonstrates that, whereas Sweden is clearly an 'outlier' in terms of how 'academic' R&D is organised (with an unusual dominance of the higher-education sector), she is not an 'outlier' either in terms of the allocation of funds to 'academic' R&D, or in terms of time spent on such R&D (Jacobsson and Rickne, 2003). Looking at 15 countries in total,[3] for which data is available, and focusing on R&D in natural sciences and engineering, Sweden ranked number 4[4] with 0.72% of GDP (in 1995) whereas the average for the 15 countries was 0.54%. For ten rich OECD countries (excluding Spain, Portugal, Poland, Hungary and the Czech Republic), the figure was 0.63%. Sweden was, therefore, only marginally above the average for these countries of similar standing.

In terms of person-years spent on R&D[5] per million inhabitants, where data exists for 15 countries,[6] Sweden ranked (in 1999) number 7[7] with a figure of 1,769 and the average for the 15 countries was 1,851, that is, the Swedish figure was below the average.[8] If we compare only ten rich OECD countries (Australia, Austria, Sweden, Finland, Iceland, Denmark, Japan, Germany, Canada and Norway), Sweden actually spent much less than the average (2,176).[9]

Hence, in terms of both ways of measuring, and assuming that the data is reasonably accurate, the conclusion is no longer tentative and cautious: rather than seeing Sweden as an 'outlier' we should regard her as one country out of many rich OECD countries in terms of the allocation of resources to 'academic' R&D. This greatly contrasts with the conventional wisdom.

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Impossibility of drawing *any* conclusions

My focus in other parts of the paper was on the dangers of a science policy with an emphasis on short-term usefulness in terms of codified information coming out of research. The thrust of my argument was that it is not possible to measure the usefulness of science *ex ante*. I argued that (page 356) "[i]n a situation of ignorance, quantifying the expected benefits of academic R&D does not seem to be possible and, hence, there is no reason to believe that choice can be 'rational'". Instead I suggested that the main benefit of science is that it generates capabilities so that society can create and respond to new opportunities (page 356). It follows that the main challenge to science policy is to ensure that the universities have an appropriate capacity for responding to global scientific and technological trends.

In the Critique, this line of argument has been turned into something that I do not recognise. The text has been interpreted in a manner whereby I supposedly

- adopt a nihilistic view and argue that it is not possible to have a well-founded view on innovation policy;
- am sceptical about an innovation policy;
- argue that our lack of complete understanding is a reason for leaving policy-makers and/or scientists alone;
- in some way advocate 'central planning' (in spite of my alleged nihilistic stance on policy!).

I have three comments on this. First, these views, which the Critique ascribes to me, have no basis that I can see in the text, nor did the review process reveal interpretations of this kind.

Second, the paper dealt with science policy, not innovation policy, which is a much broader concept. In the 1990s, I wrote about innovation policy from an innovation system perspective (Carlsson and Jacobsson, 1994; 1995; 1996; 1997a; 1997b; Jacobsson, 1995). Our views were neither nihilistic in nature, nor did my co-author and I advocate central planning. Moreover, at the end of the currently discussed paper, I outlined some implications of my analysis for science policy, again no nihilism. This was clearly recognised in the review process, where it was argued that: "[t]he final section is a constructive attempt to outline a science policy based on the generation of capabilities".

Third, I find the way in which the arguments are made in this part of the Critique disturbing. For instance, it is said that I "admit" that no central planner can hope to achieve the required overview to manage all relevant activities in a rational manner. This is not an 'admittance', but the thrust of my argument! A proper reading of pages 354–357 makes this plain. All in all, this suggests to me that we should forget about this part of the Critique as quickly as possible. It worries me, though, that my paper has been read in this manner and I would be happy to discuss this matter with Andersson and Henrekson at some time.[10] We could then perhaps also come to an agreement about what we can see, and not see, in OECD statistics as regards 'academic' R&D.

Notes

1. This conclusion was also based on a discussion of methodological problems involved in interpreting bibliometric data.
2. Andersson and Henrekson claim that I present non-comparative data for the countries selected since I include "… R&D expenditure for private non-profit organisations in Japan, which is unavailable for both Sweden and Germany" (p. 3). This is ridiculous. The data for Germany is included under the heading of Government. In the Swedish case, the sums involved are very small but a figure is given in OECD (1999, Table 7). Much of the activity in this sector was reclassified in 1995 and moved to private industry and to government R&D. R&D expenditure was therefore reduced from 330 million SEK in 1993 to 93 million SEK in 1995 for all fields of science. The 330 million SEK represented 2.3% of total R&D in government, higher education, and the private non-profit sector in 1993. An omission is therefore of little importance.
3. Iceland, Japan, Australia, Sweden, Denmark, Germany, Austria, Canada, Norway, Poland, Portugal, Czech Republic, Spain, Ireland and Hungary.
4. Data was not available for Finland and Israel, which ranked above Sweden in 1999 in terms of expenditure on R&D as a percentage of GDP for all fields of science. The Swedish ranking could, thus, be lower than number 4.
5. We used time and an alternative way of measuring input to R&D to overcome some potential problems of using money as an indicator. For instance, in Sweden, PhD students at technical universities receive normal pay (with all overheads). This may not be the case in other countries where, for instance, a grant may finance the studies. Using money as an indicator may then exaggerate the size of activities in Sweden. Rolf Nilsson at the Swedish Agency for Innovation Systems (Vinnova) kindly gave the data to us.
6. Australia, Austria, Iceland, Finland, Denmark, Japan, Norway, Sweden, Germany, Slovakia, Spain, Canada, Poland, Korea and Czech Republic.
7. Data is not available for Israel, which probably ranks above Sweden (see note 4).
8. Excluding the outlier Iceland, the average for 14 countries was 1678, that is, the Swedish figure was only 5% higher.
9. If we exclude the outlier Iceland, the average of the remaining nine countries was 1943, which is 10% above the Swedish figure.
10. Another peculiarity is found in footnote 7 for which there is no basis in my paper. The authors must have mixed up my paper with somebody else's.

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