The top eight percent: development of approved and rejected applicants for a prestigious grant in Sweden

Göran Melin and Rickard Danell

FOR A YOUNG AND PROMISING researcher in his/her formative years, after the PhD exam and a subsequent post-doc period but before obtaining a permanent research position and becoming an established research leader, life is often a hard fight for financial resources (Horton, 1996; Nerad and Cerny, 1999; Dillon, 2003). The approval of a research proposal can mean the difference between a continued academic career and the end of it. Those who can attract grants have relatively good possibilities of forming a research group or developing a line of research of their own.

In many European countries, there has been an increase in the number of students who receive a PhD degree. Naturally, attention is paid to the preconditions for continuing with scientific work for the young researchers, in academia or elsewhere — what employment opportunities there are and what funding possibilities exist (Melin, 2004; Musselin, 2004; 2005).

It is important that good talents are located and provided with reasonable resources to develop their ideas and, in the long run, contribute back to society.
The functionality of funding schemes, evaluation procedures and selection processes is crucial in this context (Langfeldt, 2001). It is important that the most talented students are picked for graduate studies; it is important that the most talented PhDs are picked for post-doc positions; it is important that the most talented young researchers are provided with research money and decent working conditions — not only for them, but for the grant-giving organisations as well, no matter whether it is private or public money they distribute.

This study focuses on a group of highly talented young scientists in the natural, medical and technological areas. They all sent in applications to one of Sweden’s largest research foundations, which had announced a very prestigious funding programme with 20 research grants of a scale and scope that is unique for Swedish circumstances: each over 1 million Euro during six years. For young and relatively non-established researchers, this may be the largest and most attractive research grant there is in Sweden. This group made it all the way to the final round in a careful selection process with full applications and also an interview by a panel of appointed evaluators. It contained the last 40 applicants from originally over 500; this means that 20 of them received a grant and 20 did not.

This also means that there were probably very small differences between them in terms of merit, qualifications and future potential. Was it even possible to distinguish any differences among the last 40 applicants? In general, where is it reasonable to draw the rejection line? Where is it optimal to draw the rejection line? Is it possible to distinguish any differences among the last four or five percent? Can any evaluation process however careful distinguish the best four or five percent, and not just five percent of the best ones more broadly? Such questions form the starting point for this study.

However, this funding programme had other criteria attached to it, which we will describe. Our point is not one of suspicion towards those ones selected or criticism of the evaluation process as such. Rather, our curiosity is oriented towards the very selection of some before others as the result of a careful but still common evaluation process, and the implications this may have for the future research career, both for those approved and for those rejected.

A less good performance at the interview could have meant the difference between approval and rejection. Were there any distinguishable and measurable differences between those who got the grant and those who did not, and how did it go afterwards? What did it mean to get such a grant early in a career? What did it mean to be rejected? As an attempt to approach these and the previous questions, a couple more specific questions will be investigated empirically:

- What scientific merits did the applicants have?
- How have the scientific merits developed after the decision to fund/reject?

Before describing the methods used, the features of the specific programme will be presented in brief.

**INGVAR funding programme**

Early in 2000, the Swedish Foundation for Strategic Research (SSF) announced a call for tenders within a new funding programme called Individual Grant for the Advancement of Research Leaders (INGVAR). SSF is one of Sweden’s largest foundations with an annual expenditure of roughly 100 million Euro. The sum fluctuates year by year depending on the initiatives that the foundation decides to be involved in, and the growth of the invested capital.

It is an endowed foundation and, in juridical terms, a private one. However, the endowment was made by the Government in 1993, and the Government appoints the members of the board. In reality, it is thus a semi-private–public body of a rather unusual kind. It may be noted that Sweden has several foundations of the same character. SSF supports research within medicine, science and technology through a range of activities. The supported research should have potential for development of industrial applications, widely defined.

The INGVAR programme was born as a result of a perceived lack of significant and stable funding possibilities for young researchers in, or right after, the so called post-doc phase. The research councils did not provide big enough grants, SSF decided, and did not target the critical period between the PhD degree and a tenured assignment. SSF wanted to select the future research leaders and provide them with a significant long-term grant, almost without restrictions on its use.

The call was announced internationally and anyone was welcome to apply. The research should be carried out at a Swedish university though. A
The grant included a leadership training programme, which was mandatory: it included a ten-day trip to Japan with frequent visits to universities and companies, a series of thematic two-day workshops and a psychological test of each person’s personal profile.
This measurement is problematic for two reasons. First, both groups contain individuals from different scientific fields in which the practice of co-authoring articles is more or less common. Second, some of the applicants have co-authored articles with each other, which means that, when using whole counts, an article may be counted several times. We therefore normalise the individual productivity using fractional counts. When calculating fractional counts an author is attributed a fraction of an article, and the size of the fraction depends on the number of authors in the author field; for instance, if an article has three authors, then each author is given one third of the article’s authorship.

The second aspect of the publication behaviour that is analysed is whether the individuals publish in high-ranked journals. We use the journal impact factor (JIF) as an indicator of the standing of the journals. The JIF is calculated as the number of citations to articles published in a particular journal during a two-year period, divided by the number of articles published in the journal during the same period. This means that the JIF is the average number of citations that articles in a journal have received during a two-year period.

To make this indicator comparable among scientific fields we use a normalised JIF. This procedure is very important as the citation behaviour differs greatly depending on the field (Podlubny, 2005). For instance, articles published in some medical journals receive on average far more citations than articles published in, for instance, engineering journals. The normalised indicator is calculated for each article by dividing the JIF for the journal in which the article is published by the median JIF for the journal category. This operation neutralises substantial intra-field variation concerning the size of the JIF and makes comparisons among different fields meaningful.

We also conducted a small email survey. Both the approved and the rejected applicants were asked to answer a few questions regarding their research group, their funding, patents and eventual spin-offs from the group into new groups. In total, 37 responses were returned after one reminder: 20 from the approved group (of 21) and 17 from the rejected group (of 20).

### Publication results

Both the approved group and the rejected group consist of highly productive individuals. Both groups also increase their productivity in the latter part of the investigated period: 2001–2004. On average, the approved group increase their productivity by 4.4 articles in period 2. The rejected group increase their productivity by 3.2 articles, but starts from a slightly higher average level in period 1 than does the approved group does. The standard deviation is relatively high; this is because some in each group are very productive while others have only written a few articles. In the rejected group, there are a few who have not published articles at all in period 2. They may have published results through other channels than scientific journals, or they may have worked with industrial applications and patents rather than journal articles.

It is interesting to note that the variation decreases in the approved group, while it increases in the rejected group. Partly, this can be explained by the different fields of study they work in. The use of fractions when counting authorships will to some extent compensate for the tradition of higher article production in certain fields than others. Table 1 presents the figures for the approved group and Table 2 for the rejected group.

Other comparisons are of interest as well. Before the grant, the approved group had published slightly less than the rejected group. Was there a difference in the journals in which they published? We assume that the market of scientific journals is separated in layers, where journals of different status are placed in different layers, for each field. The measure often used to indicate the layer of a journal is the normalised JIF, which can be retrieved from the Journal Citation Report, published by Thomson Scientific (formerly Thomson ISI).

### Table 1. Publication productivity for the approved group

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<tr>
<td>Average number of articles per applicant (whole counts)</td>
<td>11.4</td>
<td>15.8</td>
<td>581</td>
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<tr>
<td>Standard deviation (whole counts)</td>
<td>8.8</td>
<td>8.1</td>
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<tr>
<td>Average number of articles per applicant (fractions)</td>
<td>2.5</td>
<td>3.9</td>
<td>136</td>
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<tr>
<td>Standard deviation (fractions)</td>
<td>2.1</td>
<td>2.4</td>
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### Table 2. Publication productivity for the rejected group

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<tr>
<td>Average number of articles per applicant (whole counts)</td>
<td>12.6</td>
<td>15.8</td>
<td>625</td>
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<tr>
<td>Standard deviation (whole counts)</td>
<td>11.2</td>
<td>15.3</td>
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<tr>
<td>Average number of articles per applicant (fractions)</td>
<td>3.3</td>
<td>3.9</td>
<td>160</td>
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<tr>
<td>Standard deviation (fractions)</td>
<td>2.0</td>
<td>3.3</td>
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Both groups tend to publish in the high layers of the respective journal category. However, the approved researchers publish in journals with slightly higher JIF within that category, than the rejected researchers. The approved researches show a slight positive development from 2000 onwards, while the rejected group remain much the same. The variance is higher for the approved group though, but decreasing, which means that the positive development is relatively comprehensive for the group.

Each dot in Figures 1 and 2 represents an individual. If the individuals appear on the diagonal line, nothing has changed between the two periods. The diagonal represents a steady-state in terms of publication pattern with respect to JIF. The conclusion is that most of the approved researchers are close to the line, or deviate positively from it. The same is true of the rejected researchers. Some of those with extremely high scores during the first period get a lower ratio during the second period, however.

To what extent do the groups differ when it comes to international co-operation? Has the degree changed between the two periods? We use co-authored journal articles as an indicator of international collaboration, something which is generally accepted but still not without reservation (Melin and Persson, 1996). The share of internationally co-authored articles is very high for both the groups (Table 4). Approximately every second article is written in collaboration with foreign colleagues. The approved group has a slightly higher share than the rejected group. The variance decreases for both groups, with respect to co-authored articles. The difference between the groups is smaller during period 2 than during period 1.

**Table 3. Changes in publication pattern regarding choice of journal**

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<tr>
<td><strong>INGVAR</strong></td>
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<tr>
<td>approvals</td>
<td>Average deviation</td>
<td>3.4</td>
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<td></td>
<td>from journal category</td>
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<td></td>
<td>(JIF/JIF-median)</td>
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<tr>
<td></td>
<td>Standard deviation</td>
<td>2.5</td>
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<tr>
<td>rejections</td>
<td>Average deviation</td>
<td>2.4</td>
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<tr>
<td></td>
<td>from journal category</td>
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<td></td>
<td>(JIF/JIF-median)</td>
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<td></td>
<td>Standard deviation</td>
<td>0.9</td>
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**Note:** The journals *Nature* and *Science* are not included in the analysis, both of which are classified as multidisciplinary and are extremes in their category in terms of JIF; if they are included, the ratio JIF/JIF-median changes significantly for both investigated groups: *Nature* has a JIF of 32.2 citations per article and belongs to a journal category where the JIF-median is 0.5, meaning that a publication in *Nature* weighs 67 times higher than the median for its journal category.
Development of applicants for grants

Questionnaire results

Through an email questionnaire sent out to both the approved and the rejected applicants, a few questions were asked with reference to the development from the time before the application up until today. All recipients were asked to provide the following information:

- number of people in the applicant’s research group including the applicant at the time of the application (year 2000);
- number of people in the applicant’s research group including the applicant today (year 2005);
- total amount of annual research money that the applicant and his/her group had at the time of the application (year 2000);
- total amount of annual research money that the applicant and his/her group has today (year 2005);
- number of patents that the applicant and his/her group has generated from 2001 up until today;
- number of spin-offs from the research group in terms of firms or new research groups since 2001;
- an overall estimation of how the approval/rejection has affected the research conditions.

The questions are not always very precise, and it is possible that one respondent includes some money, for instance, that someone else has not included. It is also possible that someone makes mistakes when trying to remember and count from a few years back. No figures coming out of the questionnaire have been checked with registers of any kind. They must be viewed as self-reported approximations with all potential deficiencies such data might have. Consequently, the results are indications, and not much heed should be paid to small differences. Big differences in the questionnaire results are, however, likely to reflect real circumstances. We have made efforts to give the data a plausible interpretation.

Figure 2 shows the average size of the research groups for the approved and rejected in 2000 and 2005. The sole noteworthy result is that there is no difference between the two groups; they have developed and grown similarly during the measured period. They both have approximately five group members in 2000; in 2005 they have about ten. The small size of the sample means that a more precise interpretation would be risky. Both groups have thus been successful in recruiting new personnel.

Is there no difference between the approved and the rejected applicants when it comes to their research budgets either? The answer is yes, there is a

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Table 4. Average share of internationally co-authored articles

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<tr>
<td><strong>INGVAR approvals</strong></td>
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<tr>
<td>Internationally co-</td>
<td>54.3%</td>
<td>52.8%</td>
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<tr>
<td>authored articles (mean)</td>
<td>54.3%</td>
<td>52.8%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>29.3</td>
<td>25.7</td>
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<tr>
<td><strong>INGVAR rejections</strong></td>
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<tr>
<td>No of countries per</td>
<td>2.0</td>
<td>2.0</td>
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<tr>
<td>article</td>
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<tr>
<td>Internationally co-</td>
<td>42.4%</td>
<td>48.4%</td>
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<tr>
<td>authored articles (mean)</td>
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<tr>
<td>Standard deviation</td>
<td>28.8</td>
<td>23.6</td>
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<tr>
<td>No of countries per</td>
<td>1.5</td>
<td>1.6</td>
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<td>article</td>
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clear difference (Figure 4). In 2000, the two groups
had essentially the same economic resources but, in
2005, it is clear that the approved group has been
significantly more successful in attracting financial
support to their research group. The INGVAR grant
in itself is one such source of money, but as the
grant approximates to 1.7 million SEK per year, that
grant does not explain the whole difference. In 2005,
the rejected group had some 4.2 million SEK on av-
erage, while the approved had over 8 million SEK.

If the rejected group has on average less research
money, could it be that they to a larger extent have
chosen to leave the academic sector and move into
industrial research? The next question in the ques-
tionnaire concerns the number of patents that the
research group has generated since 2001. The purpose
of the question is to find out whether there is a dif-
fERENCE between the approved and rejected appli-
cants and their research groups after the INGVAR
grant was approved. If they have moved into indus-
trial research, it could be that the research group has
less money for its use but that it survives on industrial
coopération and instead generates patents.

This seems not to be the case. The approved
group reports that, on average, they have over four
patents while the rejected groups reports less than
one patent on average. The standard deviation is
relatively high and figures are generally low, so the
result should be regarded with caution. Still, the ap-
proved group clearly generated significantly more
PATENTS than the rejected group.

Obviously, spin-off firms are in various ways re-
lated to patent figures. It is also a sign of how the
research activities expand in different directions.
How do the groups differ when it comes to spin-off
firms and new research groups? Clearly, the group
of approved applicants has generated more spin-offs
than the rejected group, both in terms of new re-
search groups and companies. Figure 5 displays the
summarised number of each group.

The approved group contains 20 individuals and
the rejected one 17 individuals; thus the difference
in spin-offs is much larger than the difference in size
between the groups. On average, each approved ap-
plicant has generated 0.65 spin-off research groups
and 0.70 spin-off firms; each rejected applicant has
generated 0.47 spin-off research groups and 0.41
spin-off firms. It can be concluded that the approved
group has been far more successful in terms of gen-
nerating spin-off groups and firms.

The questionnaire also included a question where
the respondent could give a free comment regarding
what the approved/rejected grant had meant for
his/her research situation. Generally, the approved
applicants are very optimistic and think that the
grant has provided an unusually good base for their
work. Some of their remarks are overwhelmingly
positive even. A few examples follow:

The INGVAR grant plays a very important role
in my research and career. It allows me to carry
out an independent research programme, of real
interest for me. It allows me to do basic re-
search and it stimulates me to searching for
new collaborations where I can apply the basic
knowledge. The INGVAR grant for a very long
time was the primary source of financial sup-
port for my group, and it still plays a most es-
sential role, being my largest external grant. I
would like to say, that I had a small group

The approved group has been
significantly more successful than the
rejected group in attracting financial
support, registering patents and
creating spin-offs: both groups publish
in good journals, have international
contacts and have grown to twice their
original size
before I received the INGVAR grant. The INGVAR allowed me to keep the group, and to expand it. The grant had a big influence on my work situation.

The impact of the INGVAR grant has been huge since it has allowed me to develop long-term projects, recruit new scientists and it has had a knock-on effect on my academic career.

The grant has been absolutely crucial for my career. Through it I have been able to run long-term projects, which are now starting to pay off in terms of high ranked publications. A more limited grant would have meant that I had to produce less comprehensive and less qualitative publications.

The rejected applicants are correspondingly negative, even bitter. The grant would have meant a lot to them, we understand, and even though they often have managed to get other grants instead, their situation would have been much better if they had got the INGVAR grant. A few quotations may illustrate this feeling:

I cannot afford to employ post-docs (but have still been successful in recruiting very talented post-docs who come to my group with their own funding). We cannot afford to undertake relatively costly high-risk/high-impact projects, which we might have done if we had the additional INGVAR funding. I am constantly looking for additional funding, which takes a fair amount of time, and thus I have much less ‘peace and quiet’ to focus on research than I imagine would have been the case if I had been awarded the INGVAR grant. For example, my current situation is that I don’t have the funds to cover my own salary for the next year (since there is no university/faculty funding available).
It meant that I had to look for financing from several small sources. The funding I did obtain elsewhere was diverse and the focus was lost.

After failing to secure an INGVAR grant in 2000, I decided that my long-term future was not going to be in Sweden. I therefore looked elsewhere and found better opportunities for developing my research in Australia.

My view on it seems very clear. Had I received an INGVAR grant I would have had the possibility for leading-edge research and deep science, including more freedom and creativity (thus more following my passion). The research group would perhaps have moved more towards scientific rather than industrial research.

A few report that their group no longer exists. A few have moved to other countries and established there. The last quotation above indicates one interesting thing: that more applied and industrially oriented research was chosen instead of ‘scientific’ (within academia). There is a logic to this but at the same time we have seen that the approved group has been more successful in terms of spin-off firms, possibly indicating a closer relationship with science parks, incubators and industrial funds. The mechanisms behind this require a more thorough investigation.

Conclusions and discussion

This study targets the consequences for relatively young and potentially promising researchers of receiving a major research grant on the one hand, versus being rejected on the other. Out of over 500 applicants, 40 individuals submitted full applications and participated in an interview session. This means eight percent of all applicants. Twenty of them received the grant.

The key assumption is that there were probably no significant differences among the last 40 applicants, in terms of scientific merits and potential of the planned research ideas. It can be questioned whether it is actually possible to separate the best four percent from the second best four percent in a set of applicants like the one at hand. Sometimes an organisation has to, and probably tries its best to, apply selection criteria that hold for evaluation and seem reasonable and functional.

Still, the underlying assumption in this study is that there cannot have been any clear differences, if any at all, between the approved and the rejected candidates in the final round. Some were approved because of their performance at the interview or because the design of the project happened to seem more interesting to the final evaluators, or because of other intuitive reasons rather than quality-related ones. With different people in the panel or a different order of the interviews, the outcome could very well have been different. In the end, a little bit of luck went a long way.

This implies no criticism of the grant-giving organisation. Even though SSF and many other organisations make real attempts to find distinguishable selection criteria, it is in the end very difficult to distinguish among the last candidates in an application round. To find the best 50 or 25 percent is not so hard, but to find the best four percent is indeed very difficult. Given that the scientific potential and the merits of the approved and the rejected applicants in the final round are similar, it is interesting to investigate what has happened after the grant was approved/rejected.

We have made attempts to find out how the approved group and the rejected group of applicants differed at the time of the application, in 2000, and a few years later, in 2005. Were there any visible differences then, and are there any differences today?

A few conclusions can be drawn from the empirical results:

1. There is no difference between the approved and the rejected groups in terms of number of articles in scientific journals, either during the period before the grant (1997–2000) or after (2001–2004). They publish significantly and they increase their publication activity in the second period. The minor differences that can be seen actually favour the rejected group; still, such nuances in the figures should be treated with great caution as the sample is very small.

2. Both groups publish in perceived good journals, that is, journals with high impact factor. However, the approved group publish in slightly better journals than the rejected group. The approved group furthermore improve their publication record in the second period by publishing in better journals than in the first period, while the rejected group remains on the same level.

3. The approved group seems slightly better connected internationally. This is indicated by the higher share of internationally co-authored journal articles. The difference is more emphasised during the first period than during the second, when the approved group and the rejected group converge. The number of nationalities involved in the co-authorships are higher for the approved group than for the rejected, and this difference remains in the second period.

4. From the time of handing in the application in 2000 until 2005, the research groups that the applicants direct have grown to approximately twice the size in terms of individuals. At the same time, the approved applicants have been significantly more successful in securing funding for their groups. In 2005, the approved group has approximately four times the research budget it had in 2000, while the rejected group has less than twice the budget. This is a remarkable difference given the range of similarities in so many other ways.
The consequence of small research grants is a system where it is almost impossible to engage in projects that require a little longer time-span: this greatly limits the possibility of growth by recruiting post-docs and PhD students, even for successful project leaders.
over quite some time ought to be made to back up such a conclusion; still we believe that the findings show signs that cannot easily be neglected.

Whether the scientific achievements that this study revealed do justify the approval of twice as many applicants the next time there is an INGVAR call, is really a matter of available resources on that occasion. In general, though, this study gives support to the funding of more than four percent in any call, because there is not a legitimate evaluation system in place to distinguish such a low number of applicants, and secondly, it is beneficial for a society to finance talented young scientists whenever they can be located.

The cost of not having provided the 20 rejected applicants in this study probably exceeds the cost of 20 additional INGVAR grants substantially. ‘Good practice’ in research policy would locate the point of break-even in any application round, where the quality of the applications and the potential of the applicants are good enough for a grant to be beneficial. It would also include considering how large a grant ought to be to achieve optimal effect, given the available resources. These recommendations might hold for other countries that are in a similar situation to Sweden.

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