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Up or out? How individual research grants affect academic careers in the Netherlands

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Abstract:

This paper investigates the effect of obtaining an individual research grant (IRI -grant) on the careers of Dutch scientists. The main goal of this scheme is to provide relatively young, talented scientists with appealing career opportunities in academia. We evaluate the causal effect of an IRI-grant on labor-market outcomes by taking advantage of the discontinuity in the relationship between the priority scores given to each application and the actual receipt of a grant. We find that the receipt of an IRI-grant enhances the probability of a successful career in science. In particular, grant recipients are more likely to stay in academia, to become a full professor and to receive follow-up grants. However, grant recipients do not seem to benefit in terms of higher wages and have a lower probability to be employed on a permanent contract.

JEL-code: H24, J24, J62, I23

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1 Introduction

The way in which public funds are allocated to academic research is a topic of interest in the economic literature on science policy (e.g., David et al., 2000, Aghion et al., 2010, and Stephan, 2010). One possibility is to distribute long-term funds to universities; another possibility is to allocate funds to individual researchers who compete for grants. Long-term budgeting stimulates riskier projects with higher expected returns while competition for grants selects the most talented researchers. The way in which funds are allocated has consequences for the labor-market outcomes of scientists.[5]

This paper adds empirical evidence on how the allocation of funds influences academic careers. We investigate the effect of an individual research grant program on the subsequent careers of Dutch scientists. The Dutch Research Council (NWO) has been handing out individual grants to researchers at different stages in their career since 2000 (the so-called *Vernieuwingsimpuls* or 'Innovational Research Incentive' (IRI)). The main goal of the IRI-grants is to provide relatively young, talented scientists with appealing career opportunities at academic institutions (Bongers et al., 2007). Grantees receive funds to execute their own research for the next three to five years. Researchers are selected on the basis of their research ability and the originality of their research proposal. As such, an IRI-grant buys scientists 'freedom' to conduct research which will often translate into a smaller amount of teaching. We study all IRI-applications that have been filed in the period 2000-2008. IRI is a relatively important funding program in the Dutch system, certainly in terms of prestige. In terms of budget, about 2% of total government spending on public research was allocated towards the IRI-program in 2008. In terms of people, about 5% of those who received a PhD at a Dutch university between 2000 and 2006 were eventually awarded with a Veni-grant.[6]

To identify causal effects, we apply a regression discontinuity approach (e.g. Imbens and Wooldridge, 2009, and Angrist and Rokkanen, 2012). NWO allocates IRI-grants on the basis of priority scores given to individual research proposals by independent academic committees. Applications are ranked on the basis of these priority scores and grants are then allocated to those researchers with the lowest priority scores. When we compare applicants just above and below the cut-off, there will be virtually no difference in their characteristics but a large discontinuity in the likelihood of receiving the IRI-grant. Any observed difference in labor-market outcomes between researchers can therefore be attributed to the IRI-grant receipt. We use a relative novel regression discontinuity technique to determine dynamic effects. This method is both efficient and takes into account the possibility that individuals file new applications in subsequent years (e.g., Cellini et al., 2010).

[5] The economic literature also pays considerable attention to the labor market for scientists (e.g., Goolsbee, 1998, Ginther and Kahn, 2004, Stern, 2004, Combes et al., 2008, and Pezzoni et al., 2012).
[6] Numbers based on own calculations.

We find evidence that the receipt of an IRI-grant enhances the probability of a successful career in science. Six years after application, grant recipients are more likely to stay in academia (six percentage points), more likely to be a full professor (seven percentage points) and more likely to receive future grants (five percentage points). However, grant receipt does not yield higher wages. Apparently IRI-grantees are purely rewarded for winning a grant in terms of the opportunity to do their self-selected research. It seems likely that this free research time is combined with a lower teaching load. In addition, we find that successful applicants suffer in terms of their contract type. Six years after application, the probability to work on a permanent contract is ten percentage points smaller for the successful applicants. This is not only driven by those applicants leaving academia for a sector in which permanent contracts are more customary. Also within the large group of applicants who stay in academia, those who win an IRI-grant are less likely to have obtained a permanent contract.

More research has to be conducted to understand the mechanism at play here. The positive effects of obtaining an IRI-grant could be driven by direct supply effects. The researcher that brings cash into the department is allowed to stay, while others might have to leave due to financial constraints of the department. But also long-term productivity effects could play a role. The free research time improves the skills and expertise of an IRI-grantee. Even signaling effects might be important. When it is hard to distinguish researchers in terms of quality, obtaining a grant is seen as an important quality signal. The negative effect of an IRI-grant on the probability of obtaining a permanent position could be explained by procrastination behavior. Employment in the near future is secured for those who just won the IRI-competition, while the opposite is true for those who just lost the competition. The latter group is then more likely to start looking for long-term positions. It is even possible that unsuccessful applicants negotiate permanent contracts with unfavorable conditions such as a higher teaching load. At the moment we do not have enough information on contract conditions to investigate this however.

Our results show that the demand for a career in academia with a high degree of ‘freedom’ is higher than the supply of such opportunities. The dense competition for individual grants has both advantages and disadvantages. On the one hand, there might be large benefits of such a granting system in terms of general productivity. It provides incentives for researchers to remain productive throughout their academic lifecycle. On the other hand, the importance of receiving a grant justifies spending a large amount of resources on the application procedure. Some of the time, energy and means spent could be considered ‘wasted’.

There are a number of economic papers about the impact of individual grants on academic careers. The majority of papers investigating individual grants focus on the productivity effect in terms of publications and citations. For example, recent Dutch evidence finds that IRI-grant recipients do better than unsuccessful applicants in terms of publication quality

and number of citations (e.g., Van Balen and Van den Besselaar, 2007, and Bornmann et al., 2009). Most of the international studies on individual grants find that grantees do only marginally better in terms of productivity (e.g., Averch, 1987, Godin, 2002, Holbrook, 2005, Arora and Gambardella, 2010, Jacob and Lefgren, 2011, and Lanser and Van Dalen, 2013). Jacob and Lefgren (2011) for example estimate a causal impact of grant funding on publications. They find that individual research grants awarded by the National Institutes of Health (NIH) lead to one additional publication per grantee over the next five years. Rather than on research productivity, our paper analyses the impact of receiving a grant on individual careers, which is consistent with the main goal of the IRI-program. Unlike bibliometric practices, career outcomes are relatively comparable across academic disciplines.

This paper continues as follows. Section 2 introduces the most salient detail about NWO's IRI-grant program. Section 3 continues with a description of the dataset that we use for our analysis. The dynamic regression discontinuity approach is discussed in Section 4. The results of our empirical analysis are presented in Section 5. Section 6 concludes.

2 The Innovational Research Incentive

In 2000, the Dutch Research Council (NWO) started a new individual grant program, the so-called *Vernieuwingsimpuls* or Innovational Research Incentive (IRI). This program was designed to stimulate rejuvenation of both personnel at universities and research institutes and to stimulate novel types of research within Dutch universities. The main goal of IRI-grants was to make sure that relatively young, talented researchers could and would choose a career in science. Those who receive an IRI-grant receive funds to carry out their own research proposals for the following three to five years. There are relatively little obligations associated to an IRI-grant - and grantees hence experience considerable 'freedom' to conduct research (e.g., Bongers et al., 2007).

In 2000 and 2001 the program was relatively small and consisted of one type of grant only for moderately experienced researchers. Researchers qualified when they obtained their PhD-degree in the eight previous years. In 2002 the program was expanded and three types of grants, for researchers in different stages in their career, were introduced. These types were a) Veni-grants for junior researchers who obtained a PhD in the previous three years, b) Vidi-grants for researchers who obtained a PhD in the previous eight years and c) Vici-grants for more senior researchers who obtained a PhD somewhere between eight and fifteen years ago. The initial grants that were awarded to researchers in 2000 and 2001 are comparable to the Vidi-grants from 2020 onwards, and will hence be treated as such in this paper. Table I summarizes the application requirements and grant characteristics of the various IRI-grants. The three types differ mainly in who is allowed to apply, in the total amount of money associated with the grant and whether one is allowed to spend the grant on additional personnel. In the period under investigation all hosting institutions were obliged to match any grant with own funds. The matching requirements were such that 67%

is financed by NWO and 33% by the hosting institution. From 2009 onwards, the total amount of money for each type of grant was increased (towards 250,000, 800,000 and 1,500,000 Euros, respectively). Some application requirements were dropped and the matching obligation was lifted. In this paper, we focus on all applications before 2009. Individuals are entitled to receive the three types of IRI-grants sequentially, but are allowed to enter at most three times in a given experience category. Table II shows that 75% of our final sample consists of applications from researchers who applied only once.

The application procedure has been roughly the same for all types of IRI-grants since 2000. There exist 27 independent competitions: applications are divided in three types (Veni, Vidi and Vici) and nine research fields (Earth & Life Sciences, Chemical Sciences, Mathematics, Physics, Humanities, Social Sciences, Technology, Medical Sciences and Multidisciplinary). Each year there is one, or at most two, round(s) for each of the 27 competitions. In our dataset we identify 207 different competitions. Table III presents the number of competitions by field and the number of applications from each field in our final dataset.

The application procedure consists of three stages. First, a selection committee composed of academics assesses the proposals and rejects more than half of the applications immediately (i.e., desk rejections). These proposals do not receive a priority score and are not used in our empirical analysis.[7] Second, the remaining proposals are sent to referees. For the Veni scheme a minimum of 2, for Vidi a minimum of 3 and for Vici a minimum of 4 referee reports are collected. In many cases more reports are available. The referees provide a written report on the proposal and score the proposal on predetermined criteria on a standardized form. The criteria are an assessment of the quality of the researcher, the quality of the proposed research, and the extent to which the proposal is likely to yield innovative output. The applicant receives the referee reports and is allowed to address the concerns raised. Third, a committee of independent academics from the relevant research fields convenes to discuss the proposals using both the referee reports and the applicants' response. The applicants of the best proposals are invited to present in front of the committee. The committee than decides on the priority score of each proposal and the proposals are ranked accordingly. The proposals that have received the lowest priority score are in principle rewarded. In a very small number of cases, out-of-order funding is observed (less than 2 percent in our dataset).[8]

The size of the annual IRI-budget - ranging between 25 to 125 million Euros in our sample period - determines how many proposals can be rewarded in each competition. As it is unknown how many and what quality opponents one faces, applicants do not know in advance what quality level will secure them a grant. Table IV shows considerable differences from year to year in the number of successful applicants and in the relevant success rates.

[7] We have obtained priority scores for 39.6% of all applications, i.e., 4,565 out of the 11,514 applications. Our final dataset contains fewer observations as we were not able to match all applicants to our administrative dataset on labor market status, see Section 3.

[8] Our results do not change if we exclude these observations.

On average about one third of all submitted proposals are granted. Competition seems strongest among junior scientists (Veni-grant), who apply for an IRI-grant shortly after having obtained a PhD. The table also shows that success rates are considerably higher in our final sample than in the total pool of applicants. This makes sense, as we exclude those applications that were rejected in an early stage. The final column in Table IV identifies the relative importance of IRI-grants in terms of absolute numbers. It turns out that on average about 5% of all new PhDs receive a Veni-grant eventually.

Applicants in different years and in different research areas are faced with different likelihoods of obtaining an IRI-grant. To show this, we pool all applications in our sample to explain priority scores and the probability of receiving a research grant by type of grant, applicants' background information and research field. Table V shows the estimation results[9]. Interestingly, given the priority score of their proposal, both women and researchers based in the Netherlands are more likely to obtain a grant. This suggests that there is some non-random allocation of grants around the cut-off based on the applicants' characteristics. We will correct for this in our estimation procedure.

The entire application procedure lasts about half a year. NWO transfers the money to the host institutions about half a year after a grant has officially been rewarded. Not only Dutch universities can serve as host institutions. A selected group of Dutch research institutes, mainly those belonging to NWO itself and to the Royal Dutch Academy of Sciences (KNAW), also qualify.

3 Data

Our main dataset covers information on all accepted and rejected research proposals for IRI-grants in each round in the period 2000-2008. For most of the 11,514 proposals we have information on the applicant, such as name, gender, birth date and the associated research institution. Moreover, for 4,565 of these research proposals we know the associated priority score and whether the applicant received the grant. All research proposals that are rejected in the first stage do not obtain a priority score, and are hence not included in our analysis.

Using surnames and birth dates, we were able to match the vast majority of the applicants in the NWO register to three administrative data sources from Statistics Netherlands (CBS).[10] Eventually our sample for estimation contains information on a maximum of 3,826 applications for 2,861 unique applicants, 83% of our initial sample. We combine information from the general tax register (SSB) with information from the personnel records of all Dutch universities (*Wetenschappelijk Onderwijs Personeels Informatie*) to compose a dataset on applicants' labor-market status. Using the addresses of Dutch universities and research

[9] Here our sample shrinks from 3,826 applications to 3,535 applications because of missing covariates.
[10] IRI-applicants are matched to a file of the Dutch tax authority called 'customer relations management', that contains the birth dates and names of all individuals that paid taxes or received subsidies between 2001-2006, in 2008 or in 2011. We lose ten percent of applicants either because their names and birth dates are not unique or because they are not registered in this file. The latter is more likely for applicants from abroad.

institutions (see Appendix A), we were able to identify whether individuals are employed by (a broad definition of) academic institutions. We also use records from the municipal administration (GBA) to obtain information about immigration and emigration to and from the Netherlands.

The general tax register and the municipal records are available for the period 1999-2009. Our panel dataset of IRI-applicants thus contains information for each tractable applicant in the period 1999-2009. Note that this means that we observe individuals both before and after their IRI-application. Information about the type of contract of each employee is only available for the period 2006-2009. The university personnel records, that contain information on faculty positions, are only available for the period 2003-2006 and the year 2008.

For our analysis we use as dependent variables seven different measures. Five types of labor-market outcomes are considered: 1) a dummy for working in academia, 2) a dummy for being a full professor, 3) log of annual earnings, 4) a dummy for having a permanent contract and 5) a dummy for living in The Netherlands; and two additional outcomes: 6) a dummy for ever having applied for a follow-up grant in IRI, and 7) a dummy for ever having obtained such a grant. A follow-up grant is a Vidi- or Vici-grant for those who applied for a Veni-grant before or a Vici-grant for those who applied for a Vidi-grant before. To obtain unbiased estimates it is important to track all applicants in the years after application. To do so, we have constructed the variables such that information is available for all applicants. This means for example that the dummy variable for whether one is a full professor equals zero for those who left academia. Also, the dummy whether one received a follow-up grant equals zero for those who did not apply.

Our most important independent variable is a dummy for having received a grant in a given competition. As a covariate we use the priority score that the research proposal obtained from the committee in this competition. The priority scores is the assignment variable in our regression discontinuity design. Based on this priority score and a cut-off rate in each competition, grants are assigned. The lower the rate is, the higher the perceived quality of a proposal. In principle, research proposals with rates below the cut-off receive a grant and proposals with rates above the cut-off are not awarded. Only in 27 out of 3,826 cases we observe out-of-order funding, i.e., 27 applications with priority scores above the cut-off have been rewarded. In 64 cases we observe the opposite phenomenon; the priority scores of these applications were below the cut-off, yet the applicant did not receive a grant.[11] For our analysis, we rescale the cut-off priority score in each competition to zero.

Table VI provides descriptive statistics of the dependent and independent variables in our estimation sample. The table displays averages and the numbers of observations for those that did (G) and did not (NG) obtain the grant for the period before and after the grant

[11] Our results do not change if we exclude these observations, see footnote 6.

application. The table shows that the number of observations differs between the several dependent variables. This is both because of differences in missing values and because of the lower number of years for which we have university personnel records (full professors) and contract information (permanent contract). The descriptive statistics indicate that those who received IRI-grants are more likely to work in science, earn slightly more, are more likely to be a full professor and are more likely to obtain a follow-up grant compared to those who did not receive an IRI-grant. Interestingly, those who receive a grant are less likely to work on a permanent contract. Of those who receive a grant and who work in academia, 68% has a permanent contract, whereas of those who receive a grant and who do not work in academia 73% has a permanent contract.

4 Empirical Strategy

The main goal of this research is to estimate the causal effect of receiving an IRI-grant on career outcomes. To do so, we have to take into account that there could be initial quality differences between researchers that did and that did not receive such a grant and that these differences will have a separate effect on careers. From an econometric point of view, we exploit the fact that IRI- grants are granted based on a priority score. This yields a strong discontinuity in the likelihood of obtaining a grant around a cut-off in this score. We isolate the effect of the IRI-grant when we optimally control for the priority score. The estimated coefficient is then irrespective of quality differences between the successful and unsuccessful applicants.

We use the dynamic regression discontinuity approach proposed by Cellini et al. (2010). This approach has considerable efficiency benefits. It enables us to exploit both the panel structure of our dataset and to use all observations of individuals who applied more than once. Moreover, the individual fixed effects dimension of the method makes sure that any non-random assignment of grants around the cut-off, based on for example gender, will not bias the estimated coefficients.

We focus on what Cellini et al. (2010) call the 'intent to treat'-effects of obtaining the IRI-grant. This means that we estimate the full impact of obtaining a grant including the possibility of individuals obtaining follow-up grants in subsequent years, which may be a result of obtaining the initial grant. We thus allow that one of the channels through which obtaining a grant could have an impact on later outcomes is by receiving a follow-up grant.[12]

We estimate the following equation:

$$(1) \qquad y_{i\mu\tau} = b_{i\mu}\theta_{\tau}^{ITT} + f_g\left(p_{i\mu}, \gamma_{\tau}\right) + \alpha_{\tau} + \omega_t + \varphi_{i\mu} + \varepsilon_{i\mu\tau},$$

[12] 'Intent to treat' has a different interpretation in the dynamic regression discontinuity approach. It does not refer to the effect of an assignment to a status that gives a higher possibility to obtain a grant, but to the effect of grant receipt that has not been purged from the possibility that an individual obtained (higher order) grants in subsequent time periods.

where $y_{i\mu\tau}$ represents the outcome of individual i who has applied for a grant μ number of times, τ years after she applied for a grant in year t and where α_τ, ω_t and $\varphi_{i\mu}$ represent fixed effects for years relative to the application year τ, for calendar years t, and for the μ'th application of individual i respectively. $b_{i\mu}$ represents a dummy variable that indicates whether individual i received a grant following her μ 'th application in year t and $f_g(p_{i\mu}, \gamma_\tau)$ represents a polynomial of order *g* in the priority score $p_{i\mu}$ with parameters γ_τ. $\varepsilon_{i\mu\tau}$ is the idiosyncratic error term. By including a polynomial in the assignment variable (i.e., the priority score), the error term is uncorrelated with both the obtained grant and outcomes. This ensures that we obtain unbiased estimates for the causal impact of the grant. θ_τ^{ITT} is the parameter of interest, which represents the effect of obtaining the grant on the outcome τ years later. Both the γ_τ and the θ_τ^{ITT} are allowed to vary with τ, which means that interactions of α_τ with $b_{i\mu}$ and $f_g(p_{i\mu}, \gamma_\tau)$ are included in the models. An implicit assumption in this model is that the impact of the grant τ years after application does not depend on the application year.

To estimate this model, we select observations from individual *i* in years *t-2* to *t+9*. For example, if an individual applied for a grant in 2001 and 2005, the included observation windows are [1999, 2009] and [2003, 2009], respectively (our outcomes are available up and until 2009). This means that the 2003-2009 observations are included in our dataset twice. To clarify this, we provide an example of our data browser in Appendix B. We highlight the observations that are used for estimation in order to show how the variables enter the model. To estimate equation (1) we apply OLS. We cluster standard errors on the level of the individual applicant to account for dependence created by the use of multiple applications of the same applicant in the sample or by serial correlation in $e_{i\mu\tau}$. Note that estimates of θ_τ^{ITT} become less precise as τ increases: the number of observations that can be used for estimation of the long-term impact is smaller than those that can be used for estimation of the short-term impact. While we are able to exploit all applications from 2000 to 2008 to estimate the effect one year after application, we are only able to exploit the applications from 2000 for the impact nine years after application.[13]

5 Results

Table VII shows the impact of receiving an IRI-grant on the seven outcome variables, estimated using our preferred fixed effect regressions. Besides the depicted interaction terms of having obtained a grant with the time since application, the model also includes interaction terms of the time since application and the linear priority score and calendar year dummies. The coefficients document the causal effect of an IRI-grant on the seven different outcomes at different points in time. The point estimates in columns (1)-(4) and (6) and (7) should be interpreted as an increase (+) or decrease (-) in percentage points as the

[13] We will report estimates up to 8 years after receiving a grant, as the ninth year impact is too imprecise.

outcomes are dummy variables. The positive impact of receiving an IRI-grant two years after application on the probability of staying in academia is for example four percentage points. The point estimate in column (5) should be interpreted as a percentage increase (+) or decrease (-) as the outcome is log earnings. We have performed various robustness checks from which similar results were obtained. [14] Table VIII for example shows estimation results when, rather than a linear term, we include a fourth order polynomial of the priority score that is allowed to be different at either side of the cut-off.

For illustrative purposes, we show the estimated effects in Figures 1a - 7a. In the figures, the estimated impact (y-axis) is presented for one to eight years after obtaining the grant (x-axis). We provide the 95% confidence interval of our estimates. This interval is displayed by the dotted lines. Estimates should be interpreted as the difference in outcome between the applicant who obtained the grant and a comparable applicant who did not.

Because the IRI-program contains three separate categories we are able to identify the effectiveness of grants in different stages of an academic career. Figures 1b - 6b and 1c - 6c show the estimated effects for selected outcomes for the Veni- (young scientists) and Vidi-subsamples (middle level scientists), respectively. Because of the smaller sample size we do not show separate results for the Vidi-sample.

The pattern obtained in Figure 1a suggests that the IRI-grant achieves its main goal: keeping talent within academia. Obtaining a grant has a statistically significant impact on staying in academia. Scientists who obtain the grant have about a five percentage-point higher probability to work at a university or research institute up to six years after their IRI-application. Thereafter the estimated coefficients become smaller and insignificant. It is important to note that with a relatively fixed number of positions at Dutch research institutions there may be displacement effects. This means that the positive effects of having obtained an IRI-grant are likely to be inflated by the negative effects of not having obtained a grant.

Although the results for the Veni- and Vidi- subgroups are qualitatively similar, Figures 1b and 1c suggest that the effects for the Veni-subsample are larger. On the one hand, we expect larger benefits in terms of the probability to stay in academia for Veni-researchers, because young researchers who recently obtained a PhD-degree have weaker ties to academic institutions and better outside options. On the other hand, a Vidi-grant comes with a larger amount of money and is valid for a longer period of time, which could likely have had a larger impact. The estimated coefficients suggest that the first mechanism is likely to dominate.

[14] The results are obtained from regressions including a linear term in the priority score. We experimented with other polynomials, including a fourth order polynomial (that was allowed to be different at either side of the cutoff) and with various estimation windows closer to the cutoff. Additionally, we estimated a traditional regression discontinuity model without fixed effects. Our estimation results are robust to the chosen specification.

We also distinguish between research fields. Figure 1d shows the point estimates of the effect of an IRI-grant on the probability of staying in academia for the four largest research fields, i.e., Earth & Life Sciences, Humanities, Social Sciences and Medical Sciences. It seems that the effects on staying within academia are strongest in the Earth & Life Sciences. Interestingly, Table V also showed that competition for IRI-grants is strongest in the Earth & Life Sciences. This could potentially indicate that in this particular field the effect of obtaining an IRI-grant on staying in academia is driven by limited academic options for non-successful applicants.

Figure 2a suggests that obtaining an IRI-grant increases the probability of becoming a full professor. The estimated effects gradually increase to 20 percentage points eight years after the initial application. From Figure 2b and 2c it becomes clear that this effect is likely to be driven by the subsample of Vidi-applicants. In fact, the probability to be a full professor is the only outcome variable where we observe a large difference between the subsamples. This could be the result of the limited number of years in our data. It probably takes more than six years after their initial IRI-application for the junior scientists in our sample to become a full professor.

In Figure 3 it can be seen that obtaining a grant increases the probability of applying for a follow-up grant four years after application. The fact that the probability decreases in the first three years is consistent with the structure of IRI. Researchers whose proposal was rejected will be more likely to apply (again) in subsequent years, while researchers whose proposal was awarded will not. Figure 4 shows that obtaining a grant increases the probability of obtaining a follow-up grant four years after application. The estimated effect is about three percentage points, and gradually increases to five percentage points seven years after application. Obtaining an IRI-grant thus has an accelerating effect on obtaining future research money in terms of IRI-grants.

The results in Figure 5a point out that the IRI-grant has no significant impact on individual earnings. The estimated coefficients are positive for most of the years, but the effects are never statistically significantly different from zero. Although the point estimates for the younger subsample are slightly higher, the effect of an IRI-grant on income remains statistically insignificant if we split the sample in Veni- and Vidi-applicants (see Figures 5b and 5c). These estimated effects suggest that successful grant applicants are not able to translate part of the grant amount into higher wages. It seems to be the case that they are purely rewarded for winning a grant in terms of the opportunity to do their self-selected research.

Figure 6a shows that, perhaps paradoxically, those who have obtained an IRI-grant are less likely to be employed on a permanent basis. The first year after application the difference is five percentage points. Six years after application this effect has increased up to ten percentage points less permanent contracts among grantees. This effect could be driven by the group of young researchers in the database, as more senior faculty members already

have a permanent contract. This turns out not to be the case. Figures 6b and 6c show that in all likelihood the negative impact is larger among the Vidi-sample than among the Veni-subgroup.

How to explain the negative impact on contract type? A potential explanation could be that unsuccessful applicants have moved to other sectors in the economy in which permanent contract are more customary. Figure 6d shows the estimation results when we restrict our sample to those applicants that remain in academia. Although these estimates are troubled by selection issues, they do show that the proposed explanation doesn't seem to hold. The negative effect of obtaining an IRI-grant on the probability of having a permanent contract remains, even for those who stay in academia. Another possible explanation related to mobility is that successful applicants are more likely to move to more prestigious institutes that are less likely to provide permanent contracts. If this is this case, we would probably see more job changes among the winners. However, additional estimates on job mobility show that if anything, successful IRI-applicants are more likely to stay in their jobs than to move elsewhere.[15] Yet another explanation could be the procrastination behavior of IRI-winners. Employment in the near future is secured for those who just won the IRI-competition, while the opposite is true for those who just lost the competition. The latter group is hence more likely to start looking for long-term positions. Unsuccessful applicants - realizing that they just lost out on a lucrative grant - might even decide to negotiate permanent contracts that have unfavorable conditions such as a higher teaching load. Unfortunately, we do not have information on other contract conditions such as teaching or administrative tasks to check this potential explanation.

Figure 7 finally assesses the effect of IRI-grants on migration behavior. It shows that applicants have a significant higher probability to be in The Netherlands up to three years after receiving the grant. The difference is about three percentage points. Thereafter this impact decreases slightly and is not significant anymore, but point estimates are in the order of a two percentage points higher probability up to seven years after application. This suggests that successful IRI-applicants are not very likely to move elsewhere during our observation window.

6 Conclusions

This paper documents a positive impact of IRI-grants on the likelihood of a successful career in science. This suggests that the main goal of IRI, i.e., keeping talented researchers within academia, is achieved. We find that IRI has positive effects on the probability to stay in academia, on the probability to become a full professor and on the probability to receive a follow-up grant. Four years after application, grantees have a seven percentage points higher probability to be in science and a six percentage points higher probability to be a full professor. We find no effect on individual income. In addition, we find that successful

[15] Estimates available upon request.

applicants are likely to be disadvantaged in terms of their contract type. The probability to work on a permanent contract is ten percentage points smaller for those who obtained an IRI-grant, six years after application. Hence, successful IRI-applicants seem to be rewarded mainly in terms of free research time and in terms of future research opportunities.

One possible explanation for the paradoxical finding on contract type could be that those who just lost the competition have more need to start looking for long-term positions than those who just won. They might even negotiate a permanent contract that has other, more unfavorable conditions such as a higher teaching load. Unfortunately, we do not have information on contract conditions to check this potential explanation.

There are four possible, and perhaps complementary, explanations for the positive effects of IRI-grants on the careers of scientists. First, in a world of scarcity there is a direct impact of raising funds on the employment possibilities offered by research institutions. Second, the attractiveness of a career in science diminishes for those who fail to obtain free research time provided by an IRI-grant. Third, free research time associated with an IRI-grant improves the skills and productivity of the researcher. Fourth, obtaining a grant serves as a quality signal to the researcher's employer. The analysis in this paper has been unable to answer the question which of these explanations is most salient. Future work, by for example analyzing productivity measures of scientists such as publications and citations information, should shed light on these channels.

Although our results show that the main goal of IRI seems to be achieved, our analysis does not imply that the scheme is a success. First, there could be displacement effects given the relatively fixed number of positions at Dutch research institutions. We have been comparing researchers who are identical up until the application procedure. This means that it is not necessarily fair that the unsuccessful applicants are confronted with worse labor-market outcomes ex-post. Second, our results suggest that it is worthwhile for a scientist to spend time writing a research proposal to obtain an IRI-grant. Depending on whether or not this time would have been spent anyway, it could be considered 'wasted' when success rates are low. The large amount of resources spent on application procedures is often an argument against a funding system based on individual grants. This being said, there could be benefits of a granting system in terms of general productivity within the science system. That is, individual grants provide incentives for all researchers to remain productive throughout their academic lifecycle.

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Tables & Figures

Table I: Application requirements and grant characteristics of IRI-grants before 2009

	Veni	Vidi	Vici
Period	2002/2008	2000/2008	2002/2008
Application requirements			
Maximum number of years since PhD	3	8	8-15
Open for full professors	No	No	Yes*
Grant characteristics			
Maximum total amount in Euros	€ 208,000	€ 600,000	€ 1,250,000
Number of years	3	5	5
Hiring of other personnel possible	No	Yes	Yes
Matching by institution	33%	33%	33%

*Only if applicant is a full professor for less than 3 years

Table II: Multiple applications

Row	Description	N	% of total
	Number of total applications in our final sample	3,826	-
1	Number of applicants that applied for grant once	2,861	75%
2	Number of applicants that applied for grant twice	771	20%
3	Number of applicants that applied for grant >2 times	194	5%

Table III: Number of competitions and applications over 2000-2008 by research field

Research field:	N (competitions)	N (applications in sample)
Earth & Life Sciences	26	664
Chemical Sciences	26	462
Mathematics	26	401
Physics	19	200
Humanities	26	449
Social Sciences	26	643
Technology	25	325
Medical sciences	26	636
Multidisciplinary	5	39
Undefined	2	7
Total	207	3,826

Table IV: Number of successful applicants and success rate by year

	All applications			Applications in final sample			
Year	Veni	Vidi	Vici	Veni	Vidi	Vici	Perc. of new PhD's (at t-2) that obtain a Veni
2000		43			42		
		39%			33%		
2001		45			45		
		53%			36%		
2002	125	75	27	111	69	25	
	23%	*17%*	*45%*	*40%*	*29%*	*42%*	*5%*
2003	82	79	26	78	57	20	
	N.A.	*N.A.*	*N.A.*	*39%*	*31%*	*45%*	*3%*
2004	88	79	28	77	63	19	
	26%	*29%*	*45%*	*44%*	*35%*	*26%*	*4%*
2005	179	79	27	71	67	19	
	22%	*26%*	*40%*	*43%*	*30%*	*25%*	*7%*
2006	93	85	30	84	71	29	
	19%	*24%*	*46%*	*2%*	*30%*	*36%*	*3%*
2007	180	84	31	130	66	24	
	22%	*19%*	*36%*	*32%*	*27%*	*26%*	*6%*
2008	116	82	31	90	64	28	
	18%	*21%*	*41%*	*45%*	*39%*	*41%*	*4%*

Table V: Coefficients and standard errors of priority scores and grants receipt regressions.

	Priority score	**Grant receipt**	**Grant receipt**
Priority score		-0.275***	-0.293***
		(0.005)	(0.006)
Cut-off score			0.211***
			(0.014)
Veni		Reference category	
Vidi	-0.078	-0.037**	-0.008
	(0.053)	(0.015)	(0.015)
Vici	-0.642***	-0.109***	-0.014
	(0.094)	(0.026)	(0.025)
Female applicant	-0.024	0.057***	0.059***
	(0.049)	(0.014)	(0.013)
Applicant resides in The Netherlands	-0.220***	0.075***	0.086***
	(0.084)	(0.024)	(0.023)
Birth year	-3.768*	-0.330	-0.988*
	(2.258)	(0.605)	(0.570)
Birth year square	0.001	0.000	0.000*
	(0.001)	(0.000)	(0.000)
Attempt number	-0.110***	-0.006	-0.011
	(0.033)	(0.011)	(0.010)
Research field			
Earth & Life Sciences		Reference category	
Chemical Sciences	0.311***	0.080***	0.023
	(0.070)	(0.019)	(0.019)
Mathematics	0.427***	0.098***	0.097***
	(0.083)	(0.022)	(0.021)
Humanities	-0.201**	0.105***	0.087***
	(0.084)	(0.023)	(0.022)
Social Sciences	-0.281***	0.071***	0.076***
	(0.065)	(0.022)	(0.021)
Physics	0.496***	0.213***	0.110***
	(0.104)	(0.027)	(0.026)
Technology	0.464***	0.205***	0.110***
	(0.073)	(0.024)	(0.024)
Medical sciences	0.319***	0.155***	0.045**
	(0.062)	(0.019)	(0.020)
Observations	3,535	3,535	3,535

- * p<0.010, ** p<0.05, *** p<0.01
- Results of OLS regressions in which standard errors are clustered on the individual level. Standard errors in parentheses. Year dummies are also included.

Table VI: Descriptive statistics estimation sample (using unique applicants)

		Total sample		Veni		Vidi		Vici	
		G[#]	NG	G[#]	NG	G[#]	NG	G[#]	NG
A. Dependent variables									
- Working in academia	pre-application	0.87	0.86	0.86	0.86	0.89***	0.86	0.88	0.88
N##=2,778. N=24,510 [1999-2009]	post-application	0.87***	0.79	0.85***	0.74	0.89***	0.80	0.86	0.88
- Being a full professor	pre-application	0.06	0.05	0.00	0.00	0.00	0.00	0.34	0.31
N##=2,281, N=13,352 [1999-2009]	post-application	0.13***	0.10	0.01	0.01	0.12***	0.05	0.56	0.52
- Income	pre-application	38,916	38,400	30,171	30,852*	40,997**	39,985	55,946	56,608
N##=2,777, N=24,455 [1999-2009]	post-application	51,833***	50,775	43,177	43,373	54,902***	51,008	71,054	70,583
- Working on a permanent contract	pre-application	0.50***	0.43	0.22	0.19	0.59	0.55	0.90	0.89
N##=2,636, N=13,465 [2006-2009]	post-application	0.68	0.73***	0.46	0.56***	0.82	0.80	0.94	0.93
- Applied for higher order grant	pre-application	-	-	-	-	-	-	-	-
N##=2,861, N=23,905 [2000-2008]	post-application	0.05***	0.01	0.06***	0.03	0.05***	0.01	-	-
- Obtained higher order grant	pre-application	-	-	-	-	-	-	-	-
N##=2,861, N=23,905 [2000-2008]	post-application	0.02***	0.00	0.03***	0.01	0.02***	0.00	-	-
- Living in The Netherlands	pre-application	0.90	0.91*	0.87	0.89**	0.92	0.92	0.97	0.96
N##=2,861, N=27,731 [1999-2009]	post-application	0.94***	0.89	0.92***	0.84	0.96***	0.90	0.97	0.97
B. Covariate									
- Standardized priority score	post-application	-0.32	1.34	-0.49	1.12	-0.37	1.49	-0.31	1.24
N##=2,861, N=23,905 [2000-2008]									

 # Ever obtained a grant (Veni, Vidi or Vici)
N=number of unique applicants on which we cluster our standard errors
** p-value < 0.1 (two-sided t-test of means of granted vs. non-granted applications)*
*** p-value < 0.05*
**** p-value < 0.01*

Table VII: Estimated impacts of receiving the research grant on seven main outcomes for 1 to 8 years after applying for the grant.

	Dependent variable:						
	Prob. to stay in academia	Prob. to be full professor	Prob. to apply for follow-up grant	Prob. to obtain follow-up grant	Log income	Prob. to work on a permanent contract	Prob. to live in The Netherlands
1-year impact	0.0470***	0.0093	-0.0058**	-0.0009	0.0327	-0.0458*	0.0345***
	(0.0107)	(0.0093)	(0.0023)	(0.0010)	(0.0265)	(0.0269)	(0.0098)
2-year impact	0.0437***	0.0155	-0.0176***	-0.0031*	0.0428	-0.0891**	0.0253*
	(0.0147)	(0.0147)	(0.0045)	(0.0018)	(0.0293)	(0.0349)	(0.0140)
3-year impact	0.0683***	0.0490**	0.0060	0.0136***	0.0303	-0.1190***	0.0331**
	(0.0172)	(0.0224)	(0.0098)	(0.0053)	(0.0312)	(0.0410)	(0.0164)
4-year impact	0.0749***	0.0643**	0.0654***	0.0319***	0.0230	-0.1360***	0.0038
	(0.0188)	(0.0264)	(0.0164)	(0.0106)	(0.0330)	(0.0462)	(0.0183)
5-year impact	0.0575***	0.0633*	0.0626***	0.0276**	0.0211	-0.1080**	0.0164
	(0.0212)	(0.0330)	(0.0214)	(0.0135)	(0.0348)	(0.0504)	(0.0206)
6-year impact	0.0640**	0.0740*	0.0368	0.0479***	0.0234	-0.1050**	0.0307
	(0.0258)	(0.0395)	(0.0269)	(0.0160)	(0.0406)	(0.0532)	(0.0246)
7-year impact	-0.0121	0.1490**	0.0714	0.0471*	0.0196	-0.1080*	0.0316
	(0.0350)	(0.0623)	(0.0451)	(0.0247)	(0.0534)	(0.0554)	(0.0291)
8-year impact	-0.0130	0.2310**	-0.0501	0.0120	-0.0498	-0.0807	-0.0114
	(0.0583)	(0.1000)	(0.0766)	(0.0438)	(0.0795)	(0.0693)	(0.0516)
Observations	24,510	13,352	23,905	23,905	24,455	13,465	27,731
Individuals	3,727	3,056	3,826	3,826	3,726	3,569	3,825

Notes: Each column represents an OLS-regression with application fixed effects. Standard errors between parentheses. They are robust to heteroskedasticity and clustering at the individual level. Regressions also include interaction terms of the time since application and the priority score and calendar time dummies.
***p<0.01, ** p<0.05, *p<0.10

Table VIII: Robustness analysis with fourth order polynomial: Estimated impacts of receiving a grant on seven main outcomes for 1 to 8 years after applying for the grant.

	Dependent variable:						
	Prob. to stay in academia	Prob. to be full professor	Prob. to apply for follow-up grant	Prob. to obtain follow-up grant	Log income	Prob. to work on a permanent contract	Prob. to live in The Netherlands
1-year impact	0.0471***	0.0027	-0.0043*	-0.0009	0.0571	-0.0993**	0.0305**
	(0.0168)	(0.0132)	(0.0024)	(0.0010)	(0.0378)	(0.0393)	(0.0122)
2-year impact	0.0457**	0.0205	-0.0136***	-0.0013	0.0882*	-0.1610***	0.0502***
	(0.0212)	(0.0252)	(0.0049)	(0.0021)	(0.0459)	(0.0505)	(0.0189)
3-year impact	0.0659**	0.0716*	-0.00198	-0.0022	0.0783	-0.1780***	0.0612***
	(0.0260)	(0.0376)	(0.0159)	(0.0054)	(0.0541)	(0.0578)	(0.0219)
4-year impact	0.0663**	0.0869*	0.0491*	0.0205	0.0637	-0.2110***	0.0222
	(0.0297)	(0.0459)	(0.0292)	(0.0215)	(0.0590)	(0.0621)	(0.0241)
5-year impact	0.0131	0.0714	0.0842**	0.0359	0.0702	-0.1870***	0.0245
	(0.0429)	(0.0554)	(0.0423)	(0.0275)	(0.0608)	(0.0679)	(0.0271)
6-year impact	0.0647*	0.0761	0.0732	0.0448	-0.0269	-0.1940**	0.0154
	(0.0351)	(0.0644)	(0.0514)	(0.0337)	(0.0723)	(0.0763)	(0.0359)
7-year impact	-0.0618	0.1420	0.0227	0.0551	0.0992	-0.2330***	0.00834
	(0.0557)	(0.1360)	(0.1010)	(0.0489)	(0.0655)	(0.0804)	(0.0447)
8-year impact	-0.0626	0.2450	-0.1380	0.0299**	0.0828	-0.1790**	-0.0204
	(0.0838)	(0.1990)	(0.1170)	(0.0150)	(0.0784)	(0.0830)	(0.0916)
Observations	24,510	13,352	23,905	23,905	24,455	13,465	27,731
Individuals	3,727	3,056	3,826	3,826	3,726	3,569	3,825

Notes: Each column represents an OLS-regression with application fixed effects. Standard errors between parentheses. They are robust to heteroskedasticity and clustering at the individual level. Regressions also include interaction terms of the time since application and the priority score up to its fourth polynomial, interaction terms of the time since application and the priority score above the cut-off up to its fourth polynomial and calendar time dummies.
***p<0.01, ** p<0.05, *p<0.10

Figure 1a: Estimated impact on staying in academia (total sample)

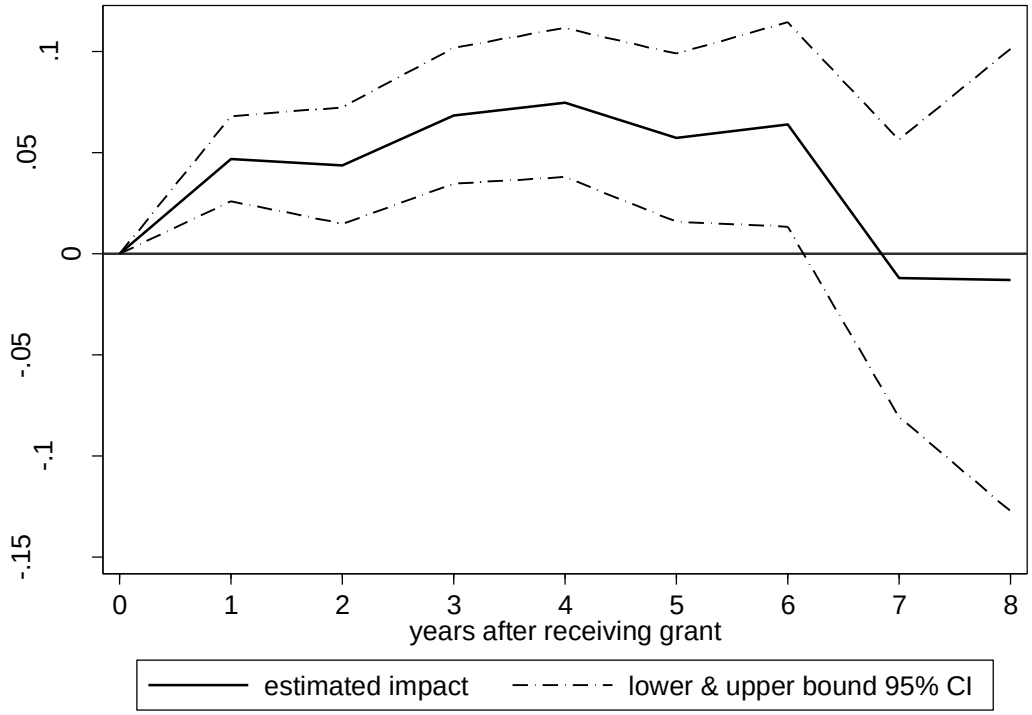


Figure 1b: Estimated impact on staying in academia (Veni sample)

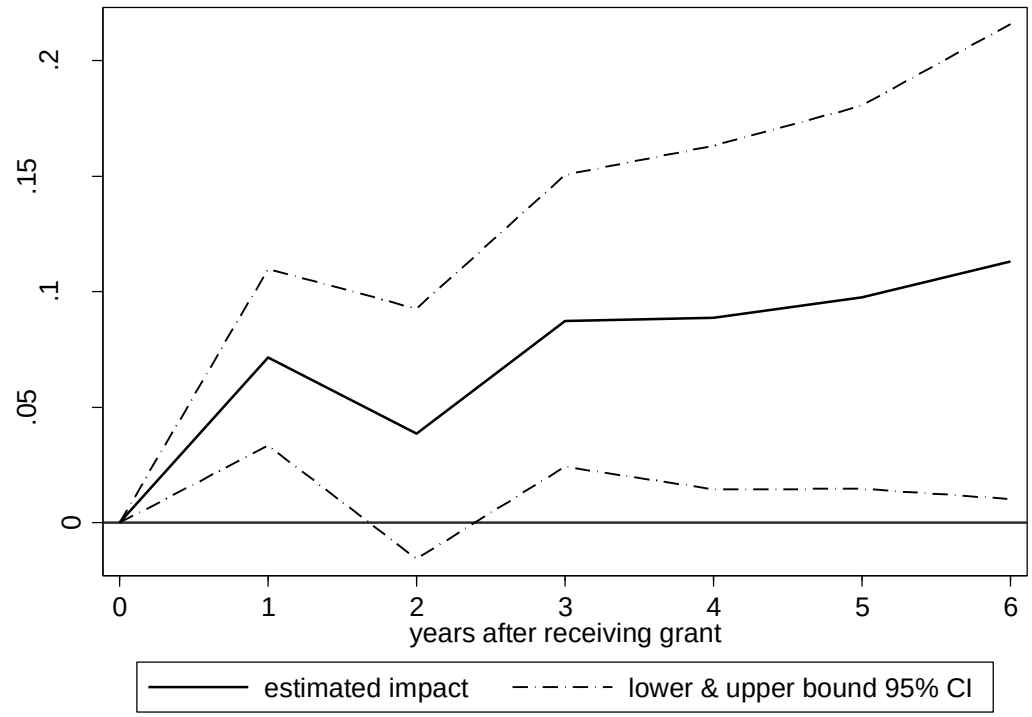


Figure 1c: Estimated impact on staying in academia (Vidi sample)

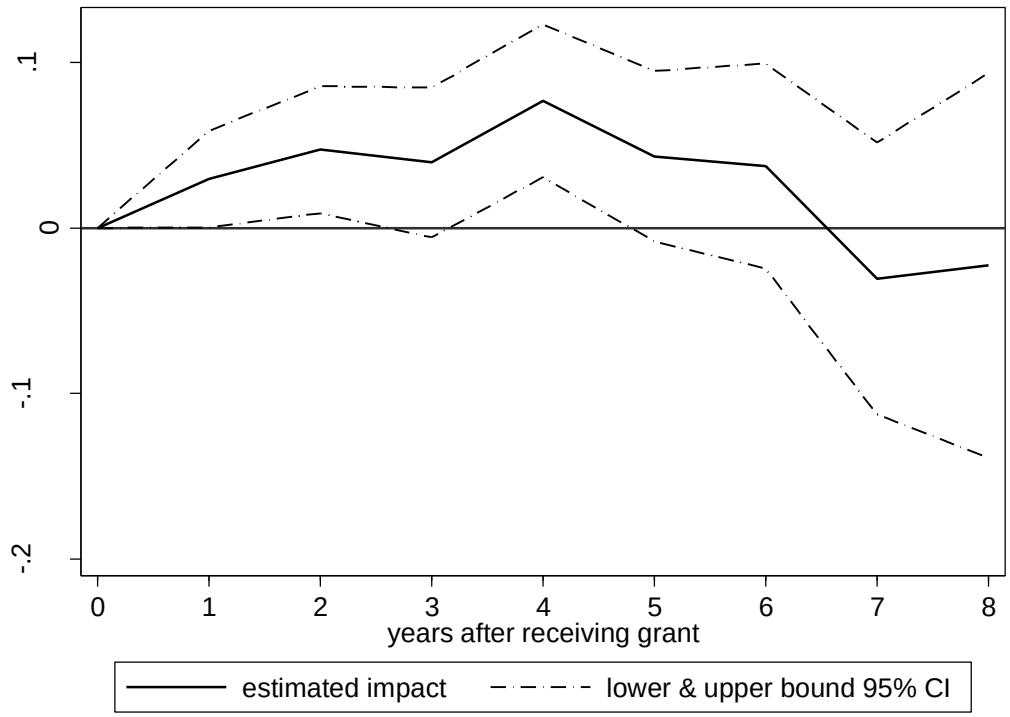


Figure 1d: Estimated impact on staying in academia (per major research field)

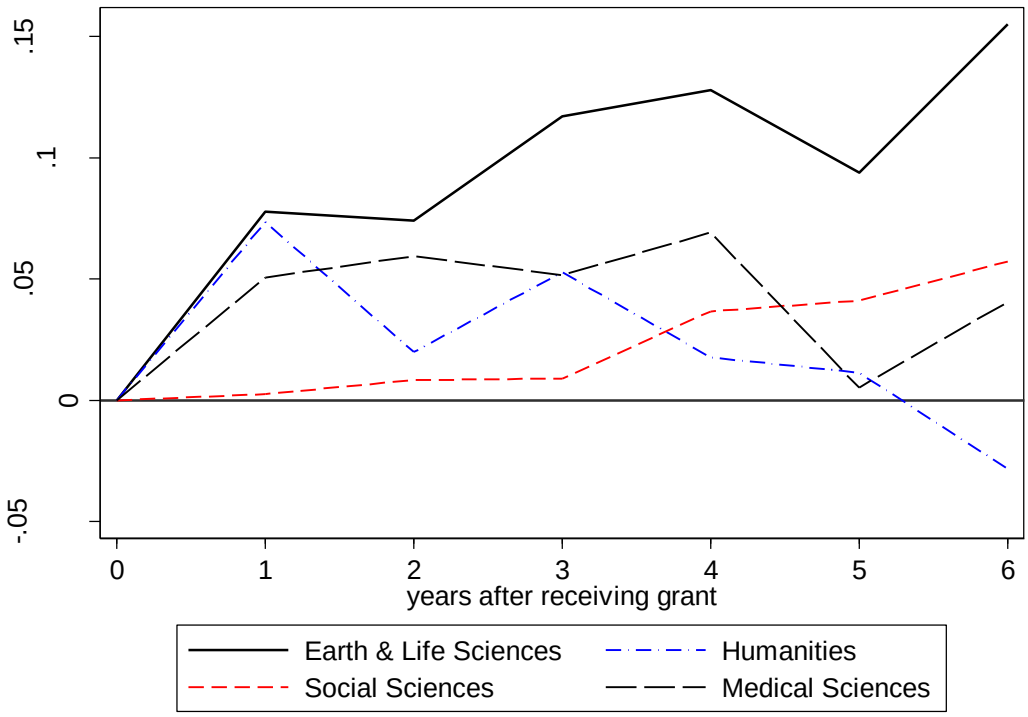


Figure 2a: Estimated impact on becoming a professor (total sample)

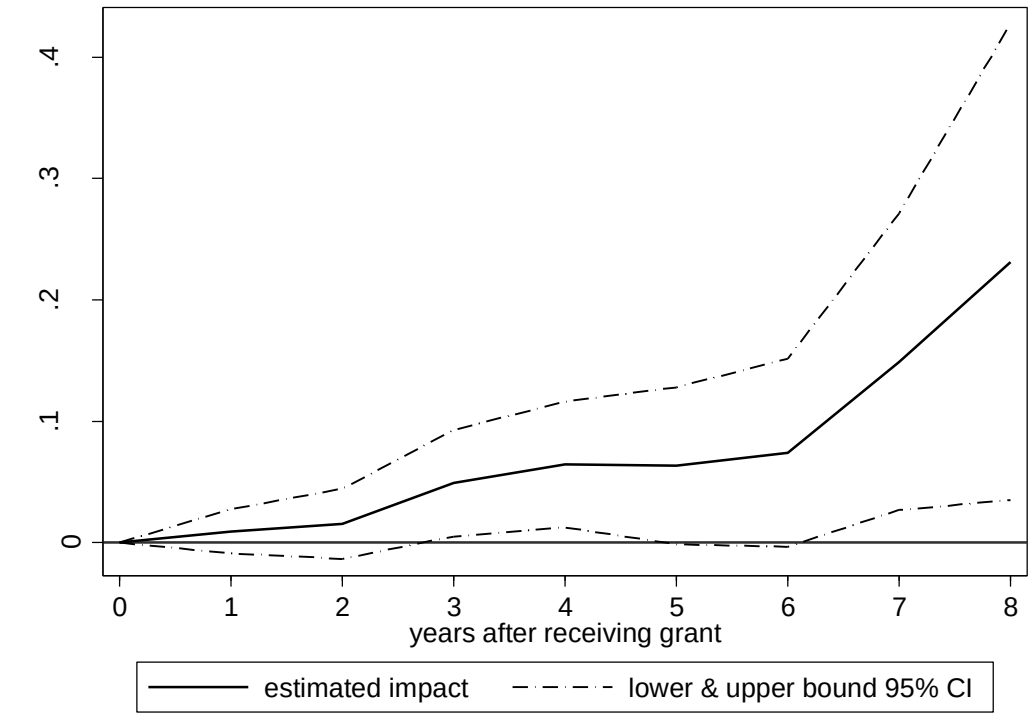


Figure 2b: Estimated impact on becoming a professor (Veni sample)

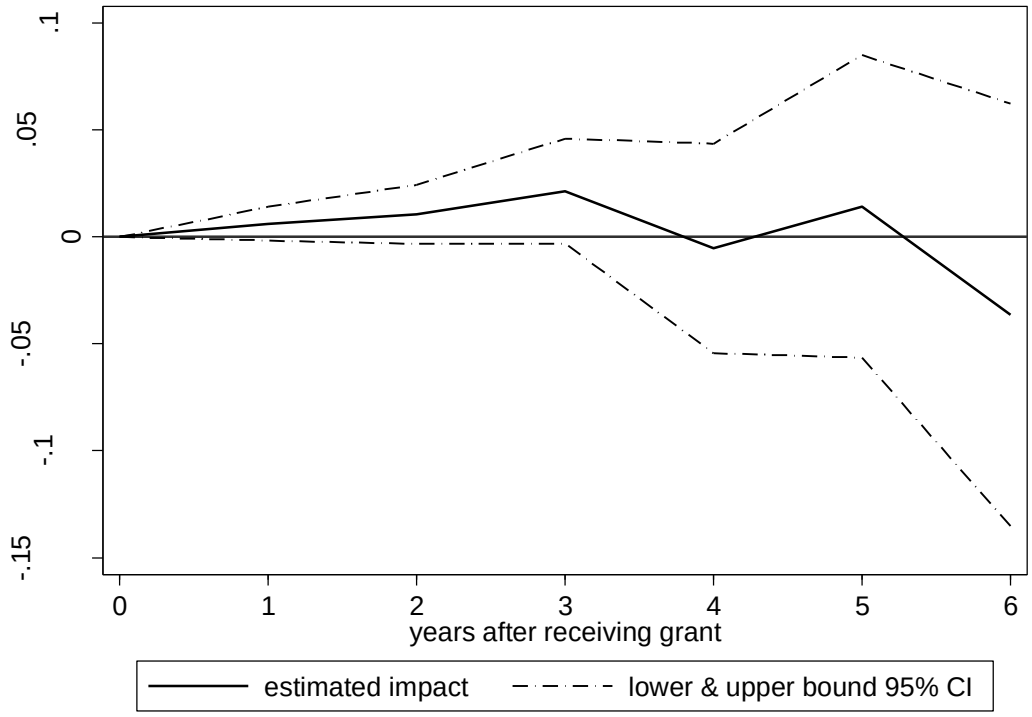


Figure 2c: Estimated impact on becoming a professor (Vidi sample)

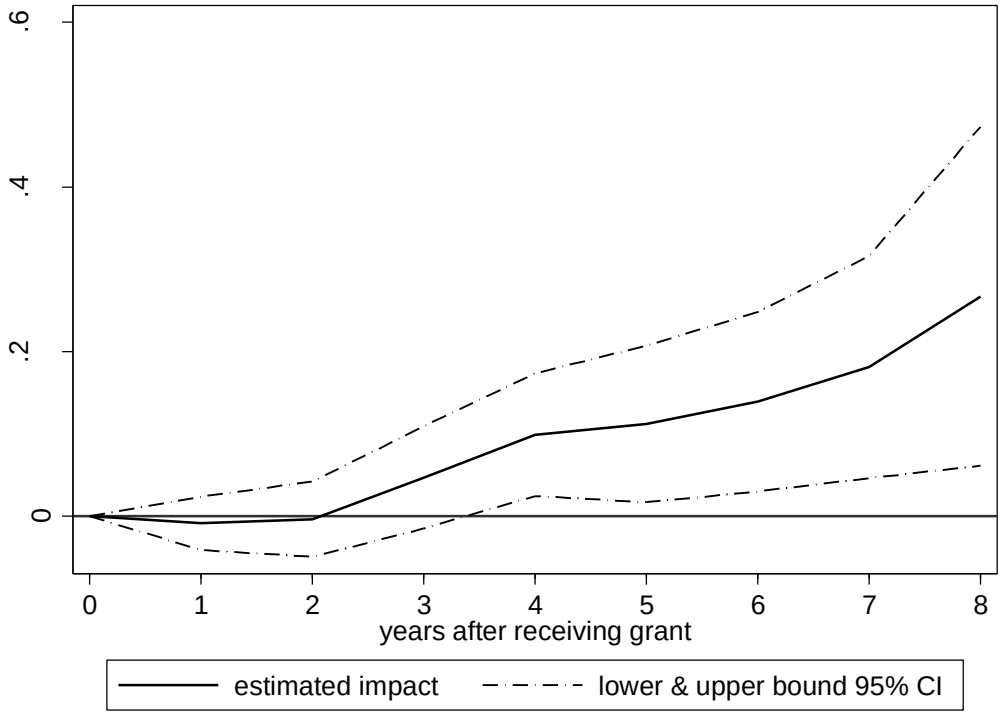


Figure 3: Estimated impact on ever applied to a higher order grant (total sample)

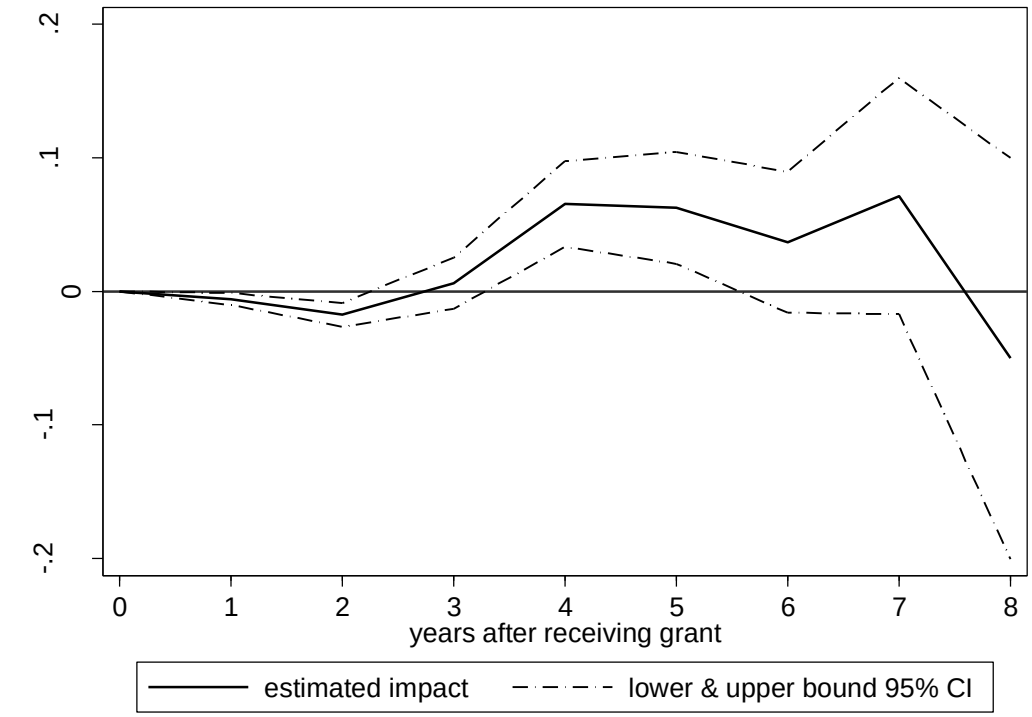


Figure 4: Estimated impact on ever obtained a higher order grant (total sample)

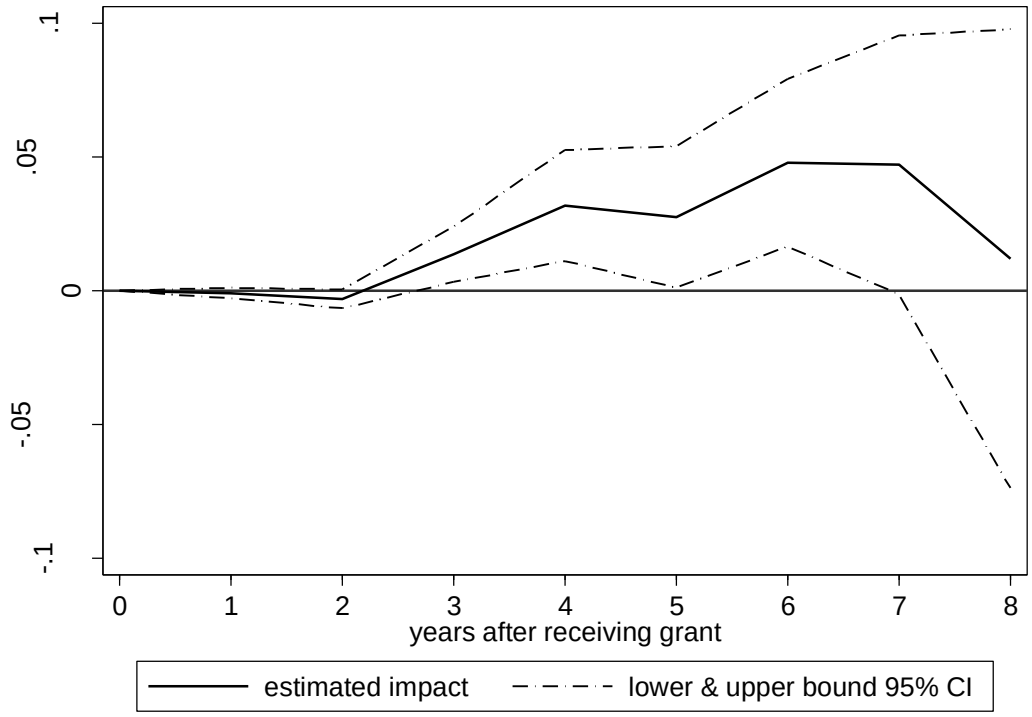


Figure 5a: Estimated impact on income (total sample)

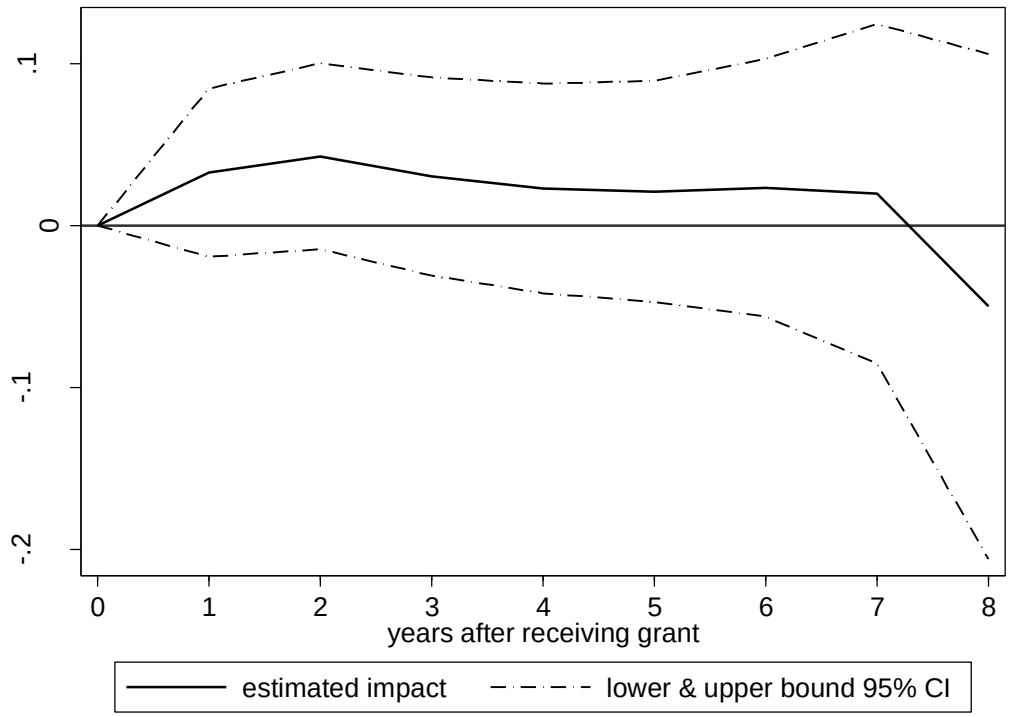


Figure 5b: Estimated impact on income (Veni sample)

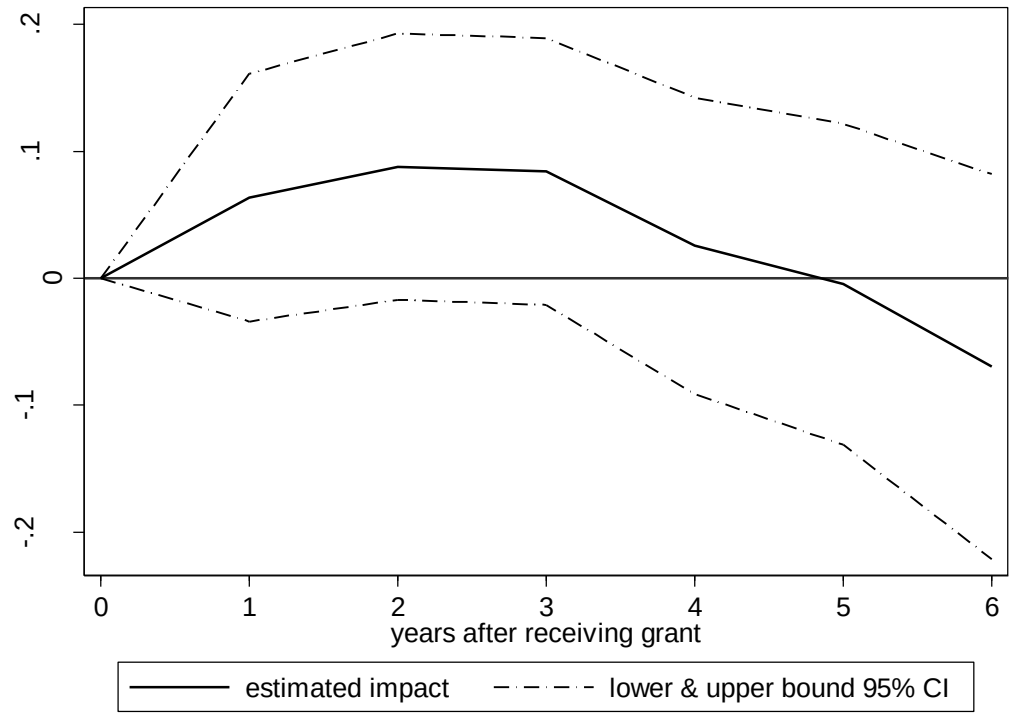


Figure 5c: Estimated impact on income (Vidi sample)

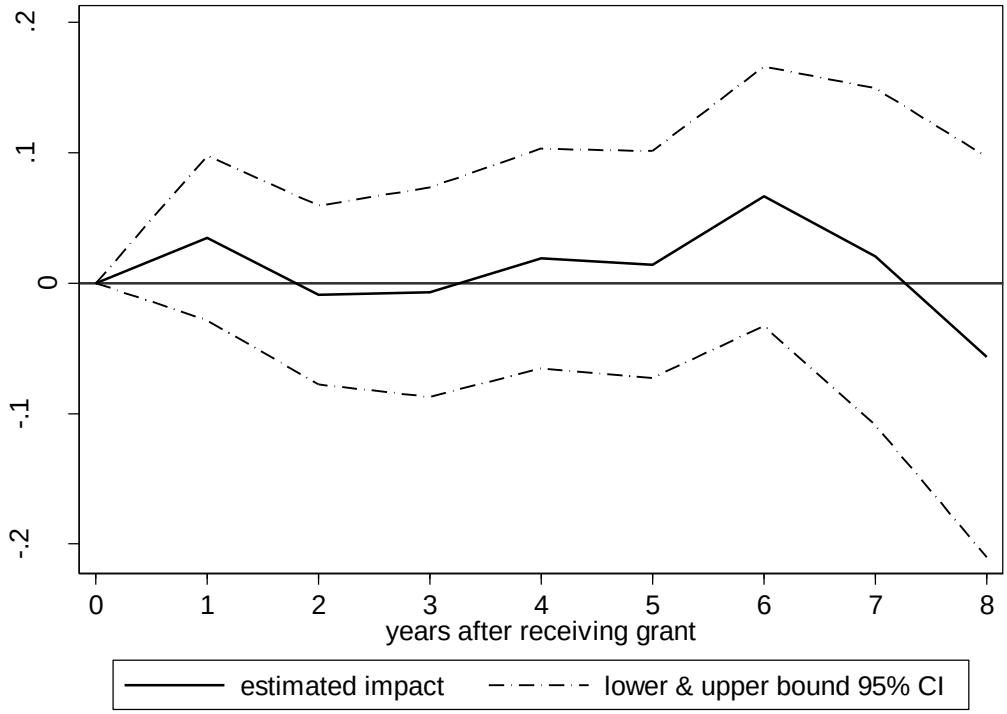


Figure 6a: Estimated impact on having a fixed contract (total sample)

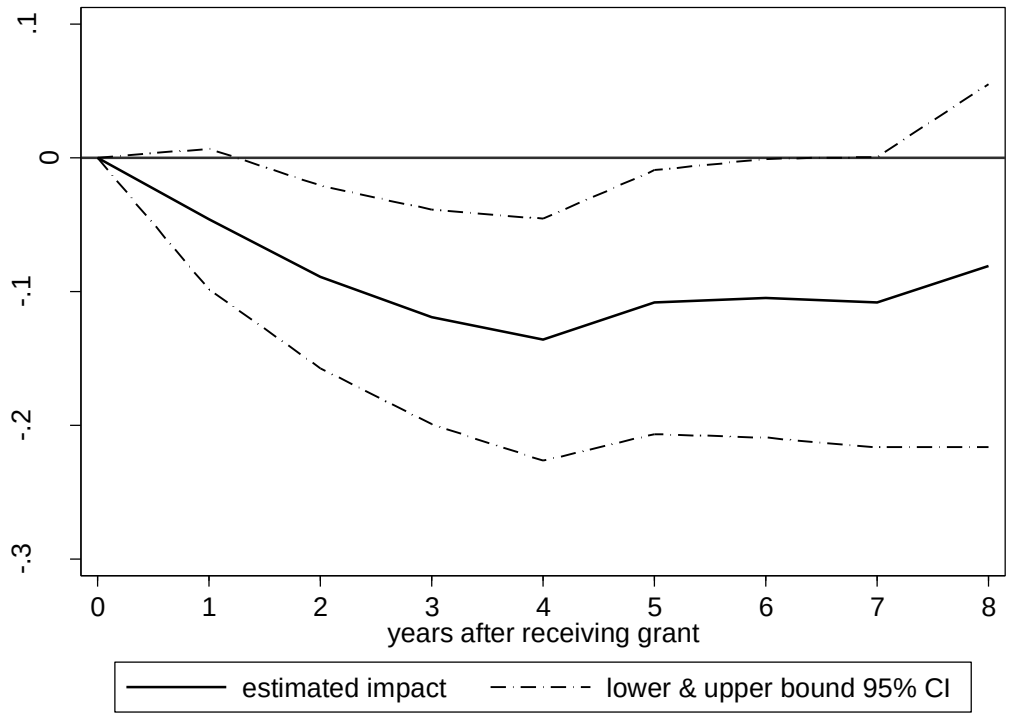


Figure 6b: Estimated impact on having a fixed contract (Veni sample)

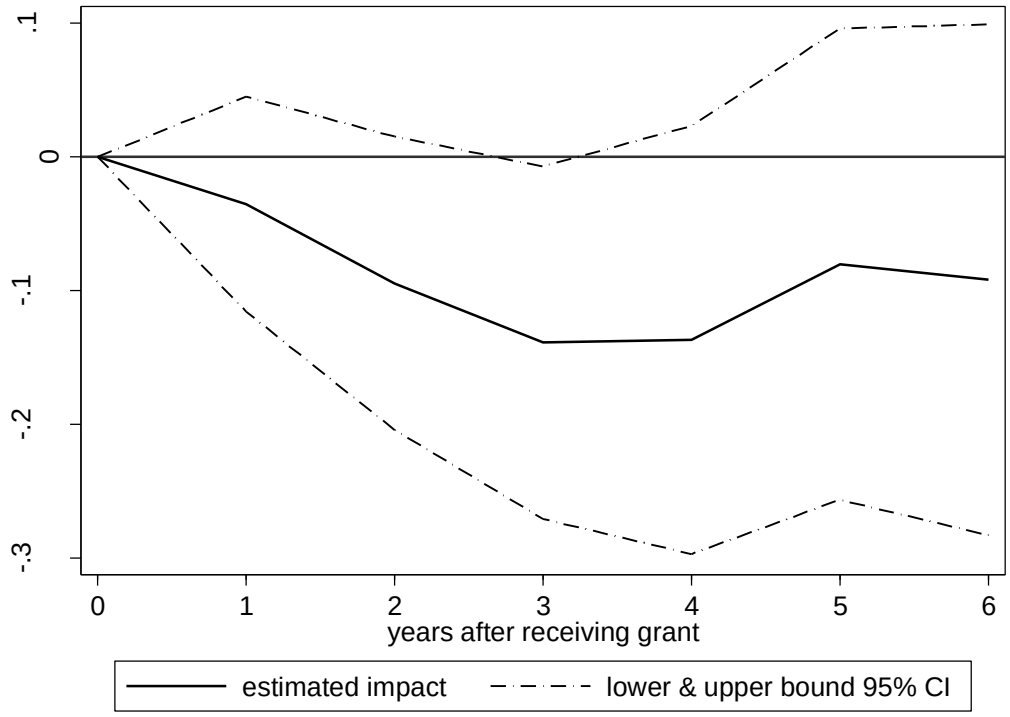


Figure 6c: Estimated impact on having a fixed contract (Vidi sample)

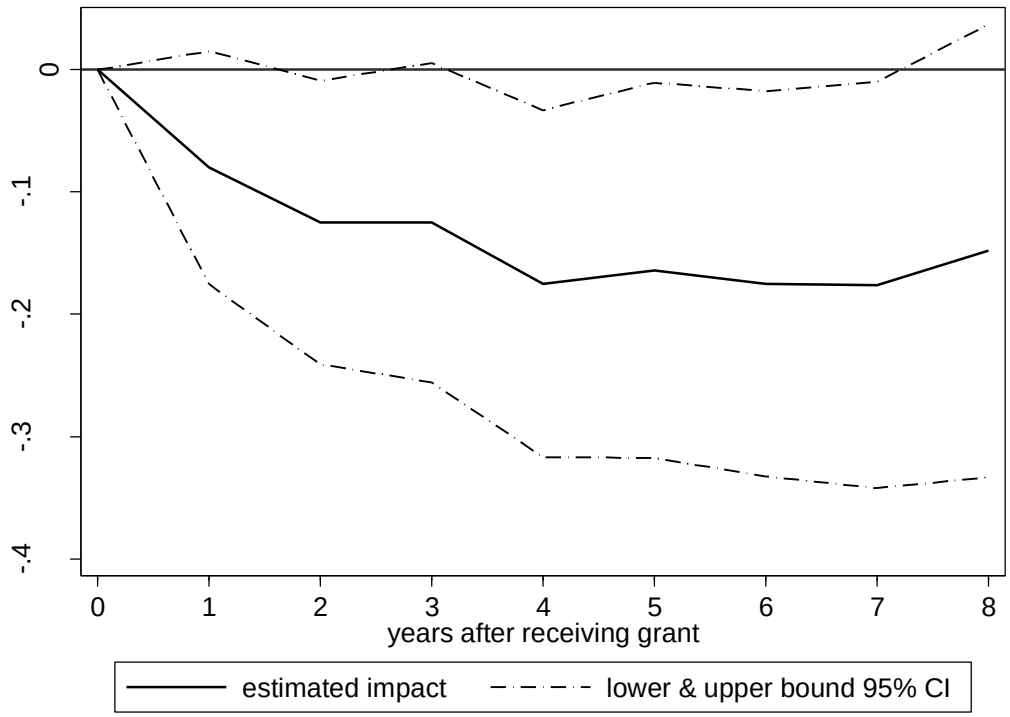


Figure 6d: Estimated impact on having a fixed contract (only for those in academia)

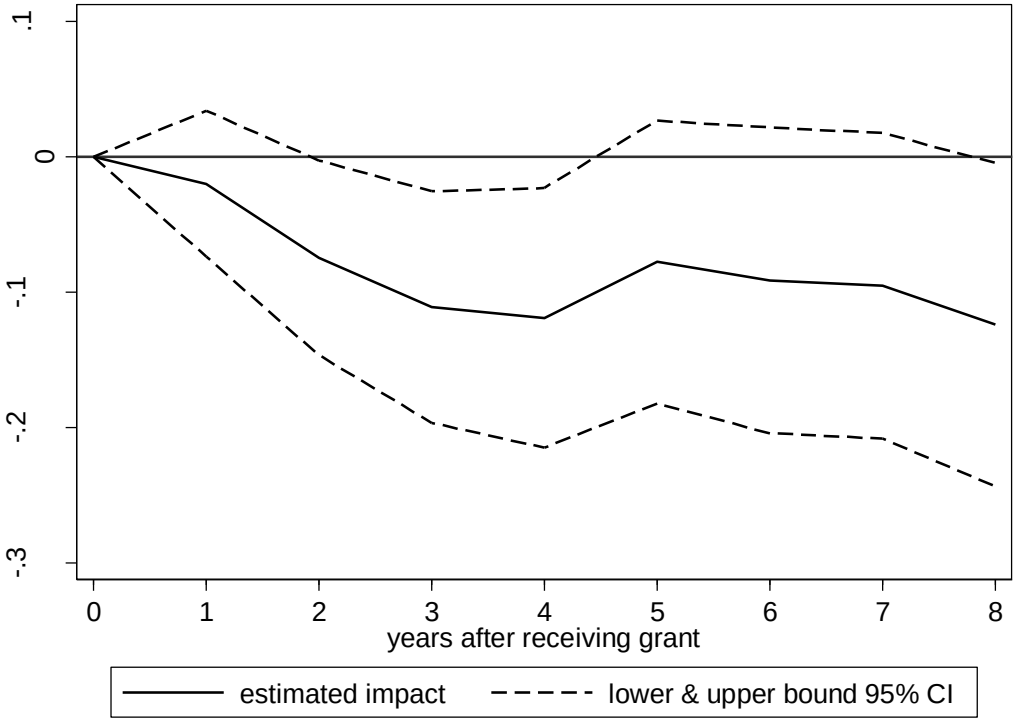
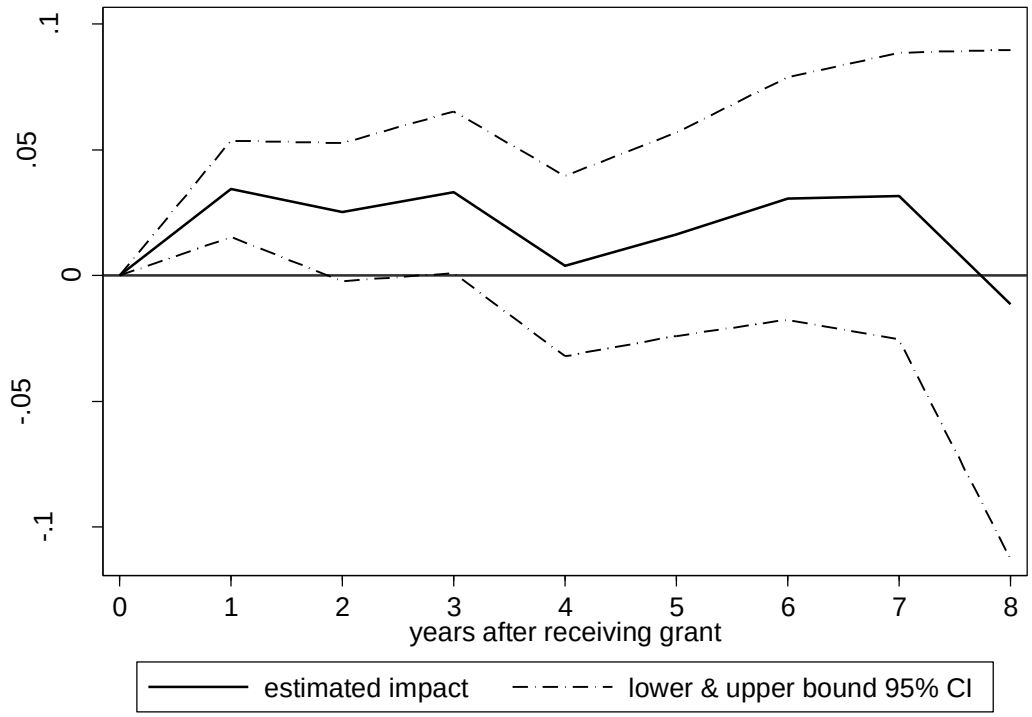


Figure 7: Estimated impact on being in The Netherlands (total sample)



Appendix A

List of institutions which are part of 'academia'

Technische Universiteit Delft (TUD)
Technische Universiteit Eindhoven (TUe)
Universiteit Twente (UT)
Erasmus Universiteit Rotterdam (EUR)
Universiteit Leiden (LEI)
Universiteit Maastricht (UM)
Radboud Universiteit Nijmegen (Radboud)
Tilburg University
Universiteit van Amsterdam (UvA)
Rijksuniversiteit Groningen (RU)
Universiteit Utrecht (UU)
Vrije Universiteit Amsterdam (VU)
Open Universiteit (OU)
Wageningen University
Centrum voor Wiskunde en Informatica (CWI)
FOM-instituten
Koninklijk Nederlands Instituut voor Onderzoek der Zee (NIOZ)
Stichting Astronomisch Onderzoek in Nederland (ASTRON)
Instituut voor Nederlandse Geschiedenis (ING)
Nederland Studiecentrum Criminaliteit en Rechtshandhaving (NSCR)
Netherlands Institute for Space Research (SRON)
Data Archiving & Networked Services (DANS)
Fryske Akademy
Nederlands Interdisciplinair Demografisch Instituut (NIDI)
Nederlands Instituut voor Neurowetenschappen (NIN)
Nederlands Instituut voor Ecologie (NIOO)
Huygens Insituut
Internationaal Instituut voor Sociale Geschiedenis (IISG)
Koninklijk Instituut voor Taal-, Land- en Volkenkunde (KITLV)
Meertens Instituut
Nederlands Instituut voor Oorlogsdocumentatie (NIOD)
Netherlands Institute for Advanced Study in the Humanities and Social Sciences (NIAS)
Roosevelt Study Center (RSC)
Virtual Knowledge Studio for the Humanities and Social Sciences (VKS)
Centraalbureau voor Schimmelculturen (CBS)
Hubrecht Instituut
Interuniversitair Cardiologisch Instituut Nederland (ICIM)
Rathenau Instituut
Waddenacademie
TNO
Nationaal Lucht- en Ruimtevaartlaboratorium (NLR)
Energieonderzoek Centrum Nederland (ECN)
The Leiden/Amsterdam Center for Drug Research
Nationaal instituut voor subatomaire fysika
Nederlands Kanker Instituut
Maritiem Research Instituut Nederland (MARIN)
Onafhankelijk instituut voor Deltatechnologie (Deltares)

Appendix B

Fictitious data browser, only observations in grey are used in the regressions (empty spaces are filled with zero's)

Individual i	calendar year t	application year	year relative to the application, τ	yitτ (for example income)	bit (received grant)	pit (rate)	ατ	...	...	ωt	...	...	μit	...	...	bit*ατ	...	...	pit*ατ	...	...
1	1999	2001	-2	22317	0	8	1			1			1			0			8		
1	2000	2001	-1	12583	0	8		1			1		1				0			8	
1	2001	2001	0	19984	0	8			1			1	1					0			8
1	2002	2001	1	23468	0	8							1								
1	2003	2001	2	11500	0	8							1								
1	2004	2001	3	16978	0	8							1								
1	2005	2001	4	18723	0	8							1								
1	2006	2001	5	12268	0	8							1								
1	2007	2001	6	14758	0	8							1								
1	2008	2001	7	20531	0	8							1								
1	2009	2001	8	20792	0	8							1								
1	1999	2005	-6	22317	0	3				1				1							
1	2000	2005	-5	12583	0	3					1			1							
1	2001	2005	-4	19984	0	3						1		1							
1	2002	2005	-3	23468	0	3								1							
1	2003	2005	-2	11500	0	3	1							1		0			3		
1	2004	2005	-1	16978	0	3		1						1			0			3	
1	2005	2005	0	18723	0	3			1					1				0			3
1	2006	2005	1	12268	0	3								1							
1	2007	2005	2	14758	0	3								1							
1	2008	2005	3	20531	0	3								1							
1	2009	2005	4	20792	0	3								1							
2	1999	2001	-2	30701	1	4	1			1					1	1			4		
2	2000	2001	-1	18938	1	4		1			1				1		1			4	
2	2001	2001	0	15300	1	4			1			1			1			1			4
2	2002	2001	1	9816	1	4									1						
2	2003	2001	2	23491	1	4									1						
2	2004	2001	3	13466	1	4									1						
2	2005	2001	4	15149	1	4									1						
2	2006	2001	5	24194	1	4									1						
2	2007	2001	6	25476	1	4									1						
2	2008	2001	7	21507	1	4									1						
2	2009	2001	8	28658	1	4									1						

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