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Dirty dances: academia-industry relations in Russia

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Abstract

Many commercially successful innovations are now arising from basic research carried out at universities. The boundary between pure science and applied research is blurred. In this context, governments worldwide have been promoting the concept of synergy between basic research carried out in academic institutions and applied research in the commercial sector. By applying different models they are trying to establish the most efficient way of facilitating this relationship with funding from the private sector. In this article, we have explored the case of Russia and overviewed the effects of 'innovation enforcement' policy developed by the Russian government in the late 2000s. As our case demonstrates, the outcome of such a policy is rather negative. However, there are also some positive side effects of the current Russian public policy. One example is the practice of the shared-used equipment. It allows developing trust between university-private company and results in mutually beneficial partnership. Moreover, it stimulates changes in industrial vision of the academic partner. Hence, in some cases, the policy of 'innovation by coercion' can have positive outcomes for it forces academia and industry to see joint collaborations more as a help rather than as a hindrance.

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Abstracto

Son muchas las innovaciones de éxito comercial que, actualmente, surgen de investigaciones básicas llevadas a cabo en universidades. La frontera entre ciencia pura e investigación aplicada se está desdibujando. En este contexto, gobiernos de todo el mundo ha promovido el concepto de sinergia entre la investigación básica realizada en instituciones académicas y la investigación aplicada llevada a cabo en el sector comercial. Mediante la puesta en marcha de diversos modelos se está intentando crear, con financiación del sector privado, una forma lo más eficiente posible que facilite este tipo de relación. En este artículo, examinamos el caso de Rusia y abordamos los efectos de la política de 'ejecución de innovación' desarrollada por Rusia a finales de la década de los 2000. Tal y como nuestro caso demuestra, los resultados de esta política son bastante negativos. Sin embargo, como consecuencia de la actual política pública rusa, se producen algunos efectos colaterales positivos. Un ejemplo es la práctica de equipo usado compartido, que permite generar confianza entre la universidad y las empresas privadas, lo que acaba resultando en colaboraciones beneficiosas para ambas partes.

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Además, estimula modificaciones en la percepción de la industria por parte de los socios universitarios. Por tanto, en algunos casos la política de 'innovación por coerción' puede producir resultados positivos al obligar a la universidad y a la industria a entender la colaboración más como una ayuda que como un obstáculo.

Résumé

De nombreuses innovations à succès commercial proviennent aujourd'hui de la recherche fondamentale menée dans les universités. La frontière entre science pure et recherche appliquée est floue. Dans ce contexte, les gouvernements du monde entier ont promu le concept de synergie entre recherches fondamentales menées dans les établissements universitaires et recherches appliqués du secteur commercial. En appliquant plusieurs modèles, ils tentent d'établir le moyen le plus efficace de faciliter cette relation avec le financement privé. Dans cet article, les auteurs explorent le cas de la Russie et présentent les effets de la politique « de mise en application de l'innovation » développée par le gouvernement russe vers la fin des années 2000. Comme le démontre notre étude de cas, les résultats de cette politique sont plutôt négatifs. Cependant, on dénote certains effets secondaires positifs de la politique publique russe actuelle. Un exemple en est la pratique de la mutualisation d'équipements. Cela permet de développer la confiance université-entreprise et résulte en un partenariat mutuel bénéfique. De plus, cela stimule des changements dans la vision que l'industrie a du partenariat académique. Ainsi dans certains cas, la politique « d'innovation par contrainte » peut avoir des résultats positifs en ce qu'elle force l'université et l'industrie à voir ces collaborations conjointes plus comme une aide qu'un obstacle.

摘 要

许多商业上成功的创新现在都来自在大学进行的基础研究。纯科学和应用研究之间的边界是模糊的。在此背景下, 世界各国政府一直在推崇在学术机构进行的基础研究和在商业部门进行的应用研究之间协同的理念。通过运用不同的模型, 他们正试图找到最有效的方式利用来自私营部门的资金来促进这个关系。在这篇文章中, 我们探讨了俄罗斯的情况, 并综述由俄罗斯政府在二十世纪后期发布的‘创新强制执行’政策的影响。正如我们的案例所证明的那样, 这一政策的结果是相当消极的。不过, 俄罗斯目前的公共政策也有一些积极的副作用。一个例子是共享使用设备的实践。它促进了大学–私营公司之间的信任, 并产生互利合作的结果。此外, 它还刺激了学术合作伙伴产业视觉的改变。因此, 在某些情况下‘被迫创新’政策能产生积极的结果, 迫使学术界和产业界把共同合作更多地看作是个帮助, 而不是个障碍。

Аннотация

Многие успешные с коммерческой точки зрения инновации основываются на базовых исследованиях, проводимых в университетах. Связь между чистой наукой и прикладными исследованиями представляется нечеткой. В данном контексте, правительства стран по всему миру всячески продвигают концепцию синергии между базовыми исследованиями, проводимыми в академических институтах, и прикладными исследованиями, проводимыми в коммерческом секторе. Применяя
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различные модели, они пытаются определить наиболее путь реализации данных взаимоотношений с привлечением капитала со стороны частного сектора. В настоящей статье мы исследовали пример Российской Федерации и обобщить эффекты от реализации политики «стимулирования инноваций», разработанной российским правительством в конце 2000х годов. Рассмотренный случай показывает, что результаты данных инициатив скорее негативны. В то же время наблюдается ряд положительных моментов. Одни из примеров - практика коллективного пользования оборудованием. Она позволяет сформировать доверительные отношения между университетом и частной компанией и приводит к взаимовыгодному партнерству. Более того, это стимулирует изменения во взглядах на потребности промышленности со стороны академического партнера. Иными славами, в некоторых случаях стратегия «принуждения к инновациям» может иметь положительные эффекты для университетов и промышленности, становясь для них помощником, а не помехой в сотрудничестве.

Resumo

Muitas inovações de sucesso comercial estão surgindo à partir de pesquisas básicas realizadas nas universidades. A fronteira entre as pesquisas de ciência pura e as aplicadas não é mais nítida. Nesse contexto, governos ao redor do mundo têm promovido o conceito de sinergia entre pesquisa básica, realizada nas instituições acadêmicas, e a pesquisa aplicada no setor comercial. Aplicando diferentes modelos, eles estão tentando estabelecer o caminho mais eficiente para facilitar esse relacionamento com o financiamento do setor privado. No presente artigo, nós analisamos o caso da Rússia e apresentamos uma visão geral dos efeitos da politica de 'aplicação da inovação' desenvolvida pelo governo russo no final dos anos 2000. Como demonstrado, o resultado de tal politica é um tanto negativo. Contudo, existem alguns efeitos secundários positivos dessa atual política pública. Um exemplo é a prática de uso compartilhado de equipamentos. Isto permite desenvolver a confiança entre os atores universidade-empresa privada e resulta em uma parceria mutuamente benéfica. Além disso, isso estimula uma mudança da visão industrial sobre as parcerias acadêmicas. Por isso, em alguns casos a 'inovação por coerção' pode ter resultado positivo em forçar a academia e a indústria a verem estas colaborações conjuntas mais como uma ajuda do que um impedimento.

Multilingual abstract

Please see Additional file 1 for translation of the abstract into Arabic.

Introduction

The role of universities has long been vital in the development of innovations around the world. To mention just two examples, consider the TRANSIT satellite system, the predecessor of the GPS, launched by the U.S. Defense Advanced Research Projects Agency (DARPA) in collaboration with the Johns Hopkins Laboratory of Applied Physics in 1964, and a few years later in 1969, the DARPA launched ARPANET, predecessor of the modern internet, which was the culmination of research carried out at MIT's Lincoln Laboratory (Belfiore 2010).

Many commercially successful innovations are now arising from basic research carried out at universities. A university is the natural seedbed for inventions and groundbreaking

ideas. Professors explore novel areas and generate new ideas. These ideas can be developed, applied and transformed into something that has never existed before. The boundary between pure science and applied research is blurred (Etzkowitz et al. 1998; Slaughter and Leslie 1997; Tudiver 1999), and a growing awareness of the potential for partnership has led to changes in the perceived role and importance of academic research in the society. These changes have given rise to a transformation in institutional practices and inter-organizational communication strategies within the academic community (Owen-Smith 2003; Packer and Webster 1996) and also in the role played by universities in global, national and local economies as a whole (Etzkowitz and Leydesdorff 1998; Feller 1990; Slaughter and Rhoades 1996). In this context, governments worldwide have been promoting the concept of synergy between basic research carried out in academic institutions and applied research in the commercial sector. By applying different models, they are trying to establish the most efficient way of facilitating this relationship with funding from the private sector (Biegelbauer and Borrás 2003). The equation is straightforward in its logic; industry funds a proposed research project, for which universities provide the supporting groundwork, so that the society gets new products and technologies; and government gets to reduce its budget commitment to academic institutions. Nevertheless, all too often, tripartite relationships between the government, industry, and academia will unavoidably be fraught with uncertainty and projects are liable to fall short or fail (Zomer et al. 2010).

Russia is far from oblivious to the revitalizing potential of academic research. In order to keep pace with global developments, the government is putting increasing emphasis on collaboration, with respect to innovations development, between the industry and academia. From the late 2000s, the creation of a new and dynamic research and development sector of the economy has been put at the top of the list of priorities for government policy-making (Maximova-Mentzoni 2012). Unlike some countries in the developed world, where federal funding for academic research is steadily decreasing, thus forcing universities to look more to industrial partners for funding, the Russian government has chosen a more direct approach and has to set up controllable space for academic-industrial cooperation to take place[a]. By providing massive financial support for academic research, on the one hand, and compelling companies to enter into partnerships with academic institutions, on the other, it is hoped that growth will be stimulated through the generation and the production of valuable new products for domestic and possibly for export markets. Whether or not such a strategy can succeed is still highly controversial topic and one that forms the focus of this paper. We will overview national public policy for innovation development in Russia, give an analysis of the initial impact of this policy on innovations and technologies development in the country and review some examples, both constructive and unsuccessful, of the emerging relations between universities and private companies.

Methodology

Our analysis is based on the findings of the project 'Academic-industry partnerships in Russia', launched in 2012, and continued in 2014, when the focus was shifted towards the activities of the universities in the field of technology commercialization and the interaction with industry. The first project has assembled a huge mass of

qualitative empirical data on research activities inside Russian universities, industry's expectations vi-a-vis the spin-offs of academic research, and on the various modes of collaboration between the two entities. We have used data from various sources: legislative acts, face-to-face interviews and media publications. Most of the fieldwork was carried out in September to December 2012 in the cities of St. Petersburg, Moscow and Tomsk, all of which are flagged as 'hotbeds of innovation' in terms of their developed innovation ecosystems. Overall, we interviewed 34 academic respondents and 20 experts from the industrial sector. Each interview lasted from 20 to 180 min (in case of scholars) and from 15 to 90 min (in the case of representatives from the industrial sector). Our industrial experts were representatives from the following: The Skolkovo Foundation[b], The Russian Venture Company[c] and The Russian Foundation for Technological Development[d], The Open Innovations Framework Program FRUCT, Intel, Nokia, as well as several Russian microelectronic and engineering companies. Additionally, we interviewed foreign experts in technological transfer and academic-industry collaboration from the UK, Israel and Finland (consulting companies Cambridge Technology Innovations Ltd., Royston, UK, and Otaniemi Marketing Ltd, Finland; Tel Aviv University and Tampere University of Technology).

We also conducted interviews with scholars from Saint-Petersburg State University, The ITMO University, The Moscow Institute of Physics and Technology, The Higher School of Economics, The Tomsk University of Control Systems and Radioelectronics, The Tomsk State University and others. In most cases, these interviews were held in the research organizations themselves, where several scholars (two to four university managers, professors and heads of research labs and departments) described different practices of academic-industry relations. These relations and practices vary and depend heavily on the relevant area of research, past experience and, last but not least, on the personality of the laboratory head or professor. The chosen models for university-industry links were analogous to each other only in IT (software development sector), where we observed comparable practices and assume that the institutionalization of academic-industry relations in this field was driven by cooperation with multi-national corporations. In other fields, each case was unique, different from lab to lab or from faculty to faculty.

The second project comprised 30 interviews in five cities - St. Petersburg, Moscow, Tomsk, Kazan and Nizhny Novgorod. This time, we were more interested in interaction at the lower level - laboratories and professors/students with industry and businesses.

Starting positions of academic-industrial relations

In some sense, academic-industrial interactions in Russia resemble relations between dancers trying to master the basic dirty dancing hold. Dirty dancing with anyone is usually performed in a relatively closed position with one's partner. So, it has been with Russian universities; as of the late 2000s, they find themselves forced to collaborate from very intimate and tightly closed position with an industrial partner. In general, there have been different starting positions for academic-industrial interactions, including those R&D partnerships forged during Soviet times and successful IT startups created during the 'first wave' innovations of the 1990s. In this paper, we will focus only

on 'top-down' state strategies to enforce close positions between academic and industrial partners. Top-down strategy is the core characteristic of the 'second wave' innovations, which being such, is known as 'coerced innovations'. That is, while Russian government uses different financial stimuli to promote academic-industrial partnerships, the main engine is still compulsion. There is no non-punishable way for agents to refuse the proposed dance.

According to neo-institutional theory, the creation of institutions through coercion and formal laws is effective only if such a policy is supported by norms and values already existing in that society (North 1990; Jepperson 1991; Scott 2008). In the case of Russia, we observe a lack of shared norms and values in the field of academic-industrial relations; therefore, there are many cases of institutional mimicry (DiMaggio and Powell 1991) or the imitation of formal rules rather than of their actual implementation. In most cases, Russian universities and corporations generate energetic initiatives, which demonstrate their productive overtures, their 'dance moves' in relation to each other. Academia creates numerous instances of technology transfer and commercialization and business-oriented invention and proudly reports to officials about the rising numbers of university spin-offs. In turn, corporations are keenly on the look-out for any projects that would allow them to demonstrate their strengthening ties with the university.

In practice, however, as the neo-institutional school of organizational change predicts, there are many examples of partnerships going awry. As a representative of The Transfer Office reports: 'Is there a universally-available productive technology transfer model from any Russian university to the private sector? Nope. We see only erratic contracts for some trivial development issues'[e]. The industry argues back, 'We are disappointed with the outcomes of R&D projects contracting out to our universities. We pay for projects and get nothing new in the end'[f]. In other words, most academic participants as well as industrial representatives prefer to copy the most widespread (rather than the most effective) practices to show some kind of compliance with government policy. Informal practices in academic-industrial relations are operating here as 'organizational myths' (Meyer and Rowan 1977). It is worth noting that we can observe cases of both coercive isomorphism and a combination of coercive and mimetic isomorphism (the second arising as a reaction to uncertainty) (DiMaggio and Powell 1991). In some cases, actors are able to cope with established rules and adapt them to suit external conditions.

The typical response, however, is a coercive isomorphism, which is largely accountable for misaligned expectations. Industry expects to receive commercial samples ready for production and resale, but academia is unable to convert the outcomes of its basic research into products viable for the market. Recent research indicate that inspiration is very important for Russian scholars who are determined to follow creative ideas and fail to consider technological or business feasibility and/or the saleability of their inventions. The inability to convert the outcomes of the original research into products becomes a defining condition for a love of creativity (Kharkhordin, 2014). Other factors are said to be a lack of funding for basic research and scientific training in post-socialist Russia that led to the disintegration of the cross-sector networks between science and industry carefully constructed and maintained in Soviet times. Regardless of the reason behind it, there is a certain pattern to interactions between these agents in the country. In many cases, Russian science and industry have different takes on this

issue and approach each other with only sporadic overtures, some of which we will consider below.

Main steps and overtures

It is generally accepted that innovation and knowledge are the drivers of economic development. The governments support them through the creation of a special framework, viz. the national innovation system (Metcalfe and Ramlogan 2005). One of its most important elements is its legal framework, i.e. formal institutions. Over the last 4 years, the Russian government has introduced a number of decisions that were supposed to target the issue of innovations and the desired academic-industrial interactions. The most famous decisions were Federal Law No. 217 introduced on 15 August 2009 and Russian government decree No. 218 introduced on 9 April 2010. Federal Law No. 217 sets up the legal framework for commercialization of by-products of basic research. Before that, Russian universities, being public entities funded by the federal budget, were not allowed to create startups and sell the results of their research projects outside of academia. Russian government decree No. 218 stipulates conditions for state corporations to enter the joint R&D projects, to be described below.

However, companies and universities had to follow independently organized procedural channels within these formal rules. There are different moves that a university or a company can make in the context of these legislative acts. We will discuss three of them:

- University/academic spin-offs
- Joint R&D projects between company and university as prescribed by the Russian government
- Arrangements for shared use of equipment

Move no. 1: creation of university/academic spin-offs

This form of collaboration produces university/academic spin-offs, i.e. companies that are able to transform by-products of the basic research into tradable items. In Russia, it is arranged around the so-called university innovation infrastructure that was developed in almost every university after the introduction of Federal Law No. 217 in 2009. This infrastructure includes offices of technology transfer, offices of commercialization and business incubators. As was expected, these departments would actively engage in the creation and development of academic spin-off companies and assist researchers in their desire to develop products useful for Russian industry.

As some industry representatives claim, however, these offices are doing everything apart from search for possible sellable ideas/products inside the university or organization of technology transfer. They focus mainly on marketing strategies of universities' enormous R&D capacities and 'organize constant presentations and exhibitions' notwithstanding the fact that sometimes there is a lack of potentially suitable ideas for market promotion inside their organization. 'These offices are black holes that grow bigger and bigger every day. They absorb everything around them, and have no particular meaning or task'[g].

Most respondents were highly sceptical about this form of interaction and questioned the ability of Russian universities to produce marketable ideas let alone create real spin-offs. In their opinion, universities lack relevant personnel to ensure the meaningful and effective performance of such offices. As one Russian expert who immigrated to Finland concludes, 'every university hastily made business-incubators. Of course, there are a certain number of spin-offs that any university claims to have created every year. However, their activities are being developed only on paper- a paper which is signed by the university in question…In real life, technology transfer is managed through social networks between company and professor, not with the help of these business-incubators'[h]. Certainly, there are some successful stories of start-ups originating from Russian universities, especially during the first innovation wave when the forming of independent companies was in vogue. However, most such companies were created either outside of the official innovation infrastructure as construed by the state or in areas that required less human and financial resources, like IT or e-commerce companies.

Another problem associated with Federal Law No. 217 is the uncertainty concerning intellectual property rights after a small innovative enterprise has been created. As in stands, the universities use the following procedure to protect intellectual property: the organization tries to get patents for as many results of the research as possible by patenting the inventions, utility, models or designs. Under these, the institution is the rights holder and the employee is the author. This means the educational or research institution is responsible for payment of patent taxes as well as of royalties to the inventor, if the patent brings commercial profit. Further use of the patent is regulated by license agreements. That is, if the author wants to develop the innovation himself, the patent is transferable to a small innovative enterprise affiliated to the university under the conditions of a share capital subscription. Otherwise, the organization seeks to find a customer interested in using the patent in the production process.

On the whole, the transfer of rights by license agreement to a third party, not being the author of the patent, remains inadequately regulated and most often, the commercialisation of the fruits of intellectual labour is limited to the format of the small innovative enterprise (SIE). Moreover, the majority of these SIEs are pseudo-R&D structures created for the purposes of compliance and report and attraction of the grant funding, rather than functional startups. What was the reason for this? According to Federal Law No. 217, the college owned 33% of shares with no dilution of ownership possible[i]. This proportion was too big and made it difficult to attract investors. Besides, the university's share is a constant if invisible presence in the regulatory control organs and thus confers obligations of compliance to certain rules and regulations, for example - Rosstat (Federal State Statistics Service) registration: 'You have to register with the Rosstat which makes the keeping of accounts much more complicated due to the fact that Rosstat adopts a huge amount of absolutely unintelligible reports. Whereas a normal company does not have to register; and nothing untoward occurs; SIE's are nevertheless obliged to do so'[j].

The owner, namely, the State, is too abstract, so the interests of bureaucrats of different levels are likely to supersede the aims/interests of national policy. It is not unusual for officials to comply to the letter rather than to the spirit of the law making it and this makes it really difficult to come to an agreement with them. This opinion is widely endorsed, not only by the researchers but also by the experts training the technological

entrepreneurs: 'The academicians who taught us told us that investors are not typically interested in companies with a university as a shareholder because nobody knows who this university is, or who it is represented by. It is very possible that the university can later start to get whimsical with the company. This makes the SIEs a less attractive investment prospect, and, generally, they are told: "Please do apply; as long the application fulfils all the criteria, numbers etc., everything is fine", but at the same time they hint: "You have no chance of getting an investor"'[k]. In this connection, although there are lots of SIE's in the universities (according to the reports the government gets), they are hardly ever an efficient commercialization tool.

Move no. 2: joint R&D projects between companies and universities

This model of interaction is enforced by Government decree No. 218, which stipulates the creation of research maps for every state corporation and requires them to provide funding for universities in accordance with these roadmaps. In a case whereas sellable product is the outcome of such collaborations, the state promised to reimburse expenses incurred by the corporations concerned. The State can co-finance the joint R&D projects of the universities and companies in a ratio of 1:1, so that means that the government can provide a subsidy equal to the sum the company spends on this project. At this juncture, the business often invests into the projects their assets rather than ready money: 'The government themselves understand that nobody is going to put out forty million rubles just like that, everybody shows everything they can find - depreciation of equipment, intellectual property and whatever … And the main idea is that the State provides the university with money and they go through with the development [together with the company - authors] and later with the commercialization'[l].

This law has channeled a great deal of money to the universities for R&D work. 'Where we see funding sufficiency on the scale such has developed over the last five years, it allows us to work with a number of such organizations and so we have raised the R&D budgets accordingly. If five years ago, say, it was about 250 millions, now we are well over the billion'[m]. As for the industrial companies, many of them who used to have contractual links with some developer teams in the universities are now saying that they are interested in the project from the point of view of being able to participate in larger projects the future, which could not have been approved by the corporate management before. Still, there are many problems with the state projects and money, as the rules and the priorities of the game can change very fast both for major corporations and, largely, for the state corporations. The seemingly generous disposition of the government has turned out to be less beneficial than was originally thought. For example, 'If before the money started coming from the moment the contract between the federation and the company was signed, now the money does not come - the company has to invest their own money and later the federation can return something if they think it necessary. Perhaps, if the terms of the competition had been announced at the beginning of 2014 the situation would not have been so bad, but it was announced in the second half of October when all the financial plans of the company had already been drafted. Naturally, nobody knew that the rules would change but they had been advised about the competition and the company had committed; providing funding with its own money for the project in the same way as before. The rules of the game changed and the finance plans had been already approved by everybody up to, say, the

headquarters of the corporate structure, so nothing could be changed. In this scenario the winners are, let's say, private companies. That is the companies not belonging to a corporation'[n].

At the same time, industry representatives complain of the needlessly strict reporting stipulations that are a negative influence affecting motivation in favour of prolonging collaboration with the universities: 'The volume of reporting we finally had to provide is one of the biggest drawbacks of this program, because not a single company manager who was involved with the project wants to repeat the experience - namely having to spend three hours every day writing the reports. Not only was there a field audit; it being state money which means a particular way of keeping the tax records, – it also means government attorney inspections, having to deal with the ministry of science, communicate with the universities and, besides all this, there's a monitor, who also checks all the papers'[o].

In many cases, however, Russian companies decide to enter this game and spend money on the joint projects. The most popular form of cooperation was the creation of centralized R&D centres or engineering labs in a particular university. Some experts believe that such centralization solves the problem of defragmentation of research efforts and prevent dissipation of resources: 'They give us 100 million rubles. I can spread it out over all departments, but no one will notice it, no one will notice! Alternatively, I use those 100 millions to create two resource centers, two really big research labs'[p]. In practice, however, the ideal of research centralization often fails. In one case, two centralized labs were indeed created, but for some reason remained empty. As a scholar from this university explains: 'We have two new labs with high quality equipment designed for many people. But surprisingly nobody wants to use them. Why? I think because researchers are afraid of cooperating with top management of the university. It is less unpredictable to interact directly with company rather than create something new and potentially lose product ownership'[q].

Overall, many academic and industrial representatives believe that 'like any other coercion, "enforced R&D projects" result in the growth of cheating strategies. Industry drafts the joint R&D plan with $15 mln budgets and pretends to be doing something. We take the money for this something and again pretend to produce something'[r]. The outcome of this pseudo interaction is the 'fake innovation' product, something that was developed by university back in 1970s and now is presented as a new invention. To play with this 'put on', on the one hand, an encouraging temptation for industry, 'Corporations… are forced to spend money on inventions. They… approach university and ask professors to knock up some projects. Then the company can cut the ribbons launching a new project and develop a report for the government'[s]. These numerous R&D projects are presented to the Russian government and used as indicators for the successful collaborations between the academia and private sector. On the other hand, however, it produces a lack of trust between partners: 'We contracted out for some projects. In a month, they sent a progress report and claimed to be doing this and that. We have no way of finding out whether they are actually doing it… They could just as well shake the dust off a report prepared thirty years ago for the Soviet Ministry of Defense, – just change the dates and names and hand it to us'[t].

Experts have noted that in the light of this high degree of uncertainty, companies would probably rather look for R&D projects within their personal networks than initiate new partnerships. New contacts mean high risks, additional time and

unpredictable outcomes. 'Large companies are not interested in playing these games … If they have an R&D problem, they solve it through their own connections. For example, GAZPROM has long-term relations with GAZPROM VNIIGAZ[u]. They have many joint R&D projects and do not need to look for anything else'[v]. There have still been some exceptions to the rule where companies actively established new relations. Usually this happened in cases where companies went to an eminent professor or research group not having previously worked with them, in order to solve a new, atypical research problem.

Move no. 3: the shared-use equipment arrangements

Yet, one mode of interaction which is slowly growing is that of the creative partnerships. These are the more unpredictable off-shoots of the innovation enforcement policy rather than the positive outcomes. In this group, the types of academic-industrial interactions can be quite different. We allude for an example to the stories of shared equipment arrangements between company and university. Shared-use equipment is a vital element in the research infrastructure in many universities around the world. It provides a cost-effective way for groups of researchers from different departments or different universities to use commercially-available equipment that costs more than certain amount (for instance, for National Institute of Health, USA, it is more than $100,000,000; for post-Soviet countries, it can be lower costs). Examples of shared-use equipment include protein and DNA sequencers, nuclear magnetic resonance systems, mass spectrometers, biosensors, X-ray diffractometers and cell sorters.

Shared-use equipment arrangements can be highly beneficial for big corporations as well as for small businesses. In the case of big companies and their subsidiaries, advantages lie in the added rationale it provides in persuading shareholders to support an expensive new R&D initiative. In the case of small and medium-size companies, which have limited budgets for acquisition of expensive equipment, it is a way of getting access to it.

In Russia, equipment share is highly popular with universities. Two basic models for this interaction have emerged. Firstly, from the 1990s, cooperation between companies and universities in exchanging and using equipment together was underpinned by the universities' need to provide free educational resources for students and, especially in the context of the under-funding of Russian universities at the time, on using the companies' equipment to teach them and to conduct experiments. Secondly, when in the 2000s, the Russian government provided massive financial resources which then being used, at least by a select number of leading Russian universities, allowed them to acquire both basic and advanced equipment. To expound, there are shown to be two possible ways for the development of interrelationships between universities and companies underpinned by the sharing of research equipment: firstly, interaction at the lower level whereby the university is invited by the company to use its equipment and, secondly, via government-subsidized requisitioning, whereby universities, having acquired some very expensive equipment, are invited by the company to share it on site, or even, in some cases, to transport it to the company premises for use *in situ*.

The first model - where the equipment belongs to the company - is most often used for educational purposes. There are several options: the companies provide the equipment to universities to accustom the future users to their product or to invite the professors and students to work for the company a certain period. In the first case, the

company allows the university free access to their resources, e.g. the computer equipment or medical equipment etc. In the second scenario, the university representatives work for the company for a period of time.

This model, first of all, works to create a specialized human resource competency that will allow students to work with the technology either produced by the company or required for its production demands, on a commercial or market project commissioned by the enterprise. As one of the respondents noted, the product of this interaction model is 'not something specific that has been produced [in case of the respondent it was a program code]… but the competence that can exist around this ….[code].. and accompany it'[w]. This is a kind of interaction where the company does not expect a real product ('If there is a result - that's fine, if there isn't - (it's understood that its perfectly possible) well, nobody seems to mind'[x]); however, while aiming at educating the customer, the company can sometimes end up with a product or an assigned project team for their projects. The experts say that this kind of collaboration often helps to build efficient developer teams made up of talented students and instructors who use the company products and show good results: 'This is about shaping not even the people but teams, when what you get is not only some results for the project and some research data but also a team.. You can take it and start working at once'[y].

This strategy is used, for example, by RTI Systems. As a company representative explained, they create different teams for various purposes. This approach is now 'already an adopted blueprint for some laboratories», and «when the task is beyond the skills base of the university we integrate the R&D through company specialists or just get the solution and start earning money with it'[z]. This mode is used by nearly all western companies in Russia (including Intel and Microsoft): 'these were, in fact, student laboratories where as a part of their extra-curricular education, small tasks, small projects were done by the students …'[aa].

For the companies, beside the abovementioned benefits, another possible option is to delegate the higher-risk research projects to research teams outside the company to be tried out - 'try this, try that' - as a pilot programme. The companies hand out some of the risky projects to the students for whom this project is a testing ground to foster creativity and expertise. The companies can, by using this method get a negative or a positive answer to their question for a small outlay: 'Here, please look into this method». And themselves they… Well, maybe this method is a dead-end, they do not use it, they have their own that is now working, and this one is just a contingency for the future, for some kind of research project or other…'[ab]. In these cases, the universities are '[a kind of] facility that can be used to develop some brand new projects that sometimes can't be developed on your own territory because the risks are too high (that is - something completely new). A university is more suited to this purpose because the human resources there are younger, with unconditioned brains they can openly express some absolutely new ideas and even carry them through somehow, which is not always possible [in the corporation]'[ac].

For the university, besides getting some free equipment and extra valuable competence training for the students, it is also important that a system of trust is established between the university and the industry - small projects (for small money and sometimes even free) done by the students under the direction of a professor allow the company to assess the department's competence and see if it's worth working with them again: 'nobody wants to commission R&D as a pig in a poke. Everybody is afraid of

swindlers, of a failure. And this way we already have a prototype, we already have… a result we can show and say: "You want some real R&D? Do you? Then we can do it for money". and they commission some work"[ad].

The classic case of using the alumni human and intellectual resources *in situ* with the equipment broadens the scope of the possible ways to interact with them - it's not only developments from the alumni that work in the industry and employment of the new alumni with them but also the access to the equipment the university does not have - the number of the research topics going through the university structure always causes a shortfall in resources vis a vis the equipment purchased by the university through state and private grants and research support programs. 'Take, for example, the Ecoilcompany. Its director let's just say is a very well-known person in YNAO, KhMAD in Tomsk region, everywhere in oil-producing regions. So he works in our laboratory, see?, and he has installed some equipment, some big industrial fermenters, at his plant, and our alumni will work as, let's say, specialists when they graduate, and our students are working there in the summer, for example…so, if we need an experiment - we come to him, let's do an experiment, he never refuses"[ae].

Let us consider now the second model of sharing the equipment - placing it on the premises of the university. Two options are available for cooperation here: the equipment either stays within the university or, very occasionally, is transferred to the industrial enterprise. The first option: the equipment is in the university and, in theory, it can be used not only by the employees of the university for research purposes but also by the industry representatives interested in cooperative and applied research. The main limitation to the success of this kind of cooperation is that in many cases, the new equipment has been obtained mainly for internal usage, i.e. only researchers from the grantee institution would be allowed to use it. Some universities were not eager to share new instruments even within the academic circle let alone to give private companies the permission to use it.

Certainly, however, there have been exceptional, positive developments in this mode of collaboration. As the representative of a state corporation reports, they were able to set up the sharing arrangements with at least two Russian universities. As he claims, this cooperation allowed for a solution to some internal R&D funding problems within a corporation: 'Russian universities can obtain now very expensive equipment. Industry is eager to use it…. When a company starts new R&D project, the first question is always about the funding for this research. We can find money for salaries or for additional staff, but the average expenses required for research equipment are incredibly high. Given the fact that we have stockholders, we are almost never able to get their permission for expensive R&D ideas. A university provides a quick way out of this impasse. More than this, the university itself can be eager to learn from us too, because academic people are not always sure about the right type of equipment or about the volume of the potential users. Here, we find our sole mate"[af]. The shared equipment also affords a relaxation in competitive tension between state and private companies looking for new ideas and potential products. As experts argue, in some sense, shared equipment promotes cooperative relations between different companies. 'It is a kind of public space that can be used commonly by everybody. Nobody can claim its ownership inside the university. So, we are using equipment and occasionally meeting our competitors. This is the best way to enhance our economy"[ag].

Within this model, keeping the equipment in the university is the easiest method of co-operation, where the university researchers use it both for the grant and research projects and for the projects done together with the industrial enterprises. An example of this model is illustrated at one of the Russian universities in South-West Siberia and its SKIF Cyberia supercomputer based on intelxeon 5150 2.66 GHz, intelxeon 5670 2.93 GHz and InfiniBand network. Seventy-seven per cent of its capacities are used for research and 13% for external commercial projects. The computer was purchased by the university in 2007 within the framework of one of the first big Russian infrastructure projects, namely, 'Innovative Universities Nationwide' which proved to be aimed not so much at organizing the university-industry connection as at providing state-of-art equipment to be purchased by the Russian universities who came out as winners in the competition. It seems that at that point in time there was no clear state programme as regards innovations development, it came later, from 2010, with the next project 'National research universities (NIU)', and every university defined their priorities in the development of the infrastructure themselves. Tomsk State University had been far-sighted enough with this equipment, and it also got plenty of press in industrial spheres as the owners of the most powerful computer in the Asian part of the country. It served not only to perform the complicated calculations for the research projects of several faculties, laboratories and research institutes - the main consumers of this equipment - but also to attract attention of potential industrial partners for the university.

For example, throughout 2014, the computer was used by six companies one of them, registered in Skolkovo, was working with it for six months on a development project for the SukhoiSuperJet airplane wing. A further two companies at the university having already been once, have returned. The university team works together with the representatives of the commercial structures in providing the necessary computer 3D- modelling applications services for physical and chemical processes in '….the architecture of the projects: and the calculations are different for every customer…, in every case we have to adapt the customer's software to suit our own architecture'[ah]. This indicates that the work on the projects is being performed by teams belonging to other research institutions and businesses together with the university employees. However, it must be noted that for long-term projects, rather than for just calculations, the university is typically approached via the established personal connections of the researchers and those of the company representatives which existed long before the appearance of the equipment (for instance, two out of the six companies with representatives working on the equipment at the university this year came by virtue of its being the alma mater of one of that company's chief executives).

However, the equipment itself often becomes an important factor when choosing the associate university. One of the respondents tells of how at least one of the projects approved under Federal Law No. 218 would never have been possible without the particular equipment involved. These kinds of commissions create a long history of collaboration with the university. It means that when a similar task comes up, the company comes to a university it already knows. One of the examples of this kind of collaboration is a company that works in 3D graphics and has a long-term contract with the university for the calculations: it pays a small sum every month for a small amount of these calculations and if a larger commission comes up, 'They also phone us. They are our priority customers… When the work is done we calculate the costs, make up the final contract and the invoice'[ai]. This is a classic

example of a 'vacillating' contract relationship where it is impossible to calculate all the details of the contract beforehand and the final contract is made post factum, the relations being based on the mutual trust between partners.

Besides trying to work out some risky ideas for the companies, establishing trust, decreasing costs and increasing the possibilities for the business structures one of the respondents lends credence to the idea that university equipment, wherever industry has expressed an interest in it, becomes an 'anchor' for the researchers' thinking within a certain area of study, and this moreover attracts those companies interested in such developments - underlining the need for an anchor: 'human thought processes are intrinsically transient; Today a person does this and tomorrow, by common sense, it would be better for him to do something else. The project normally runs for three years. For three years the team does something, no matter whether it works out or not, the project is over, the equipment has been bought, they've been doing something, so now what? Now they are out of money. There is no chapter in research manuals to help them generate, money of their own from this development which is a whole epoch in research and development. There's no mechanism for that. Who'll put money into this? Only the investor, and only if they know about the development are they happy to come and ask for it…for instance saying, well this is where we are at the moment with wetlands and water cleaning'[aj].

Another, radical, albeit uncommon for applied use expensive university equipment bought within the terms of a NIU program consists of its being relocated to an associate company's premises. Here is one example: In a university, specializing in IT and optics, one of the departments had obtained unique equipment and wanted to explore ways in which it could be used more efficiently and productively. Typical problems are the maintenance, service and technical support and the appropriate staff to provide the required services. 'When I was a student in this university, I often witnessed the dreadful stories of the death of expensive equipment. Any machine will be a pile of metal scrap just in a year without appropriate support and maintenance. Years later, when the university had decided to obtain new equipment, I immediately reacted: OK, who will provide support services? Who will oversee the operating procedures Of course, we can buy it, put it in a lab and lock the door. Certainly, nobody will break anything in that case'[ak].

In this story, the department has come up with what is an uncharacteristic, for Russia, solution by deciding to transfer the expensive equipment to an industrial partner: 'The department is using this company as a training site. We can teach students right away about how to put theory into practice…. The company is motivated by this cooperation too. They can see that the university is not just talking, it is doing something. In a response the company is more interested in our projects and students. By the way, our research center is the direct product of our cooperation'[al]. However, such a transfer of equipment is not clearly institutionalized in current legislative rules on state property.

To recap, the possibility of sharing the equipment purchased through state grants with industrial enterprises is an extra resource for the efficient working of scientific tools which can otherwise be just 'ballast' for the laboratory or other organization unit. 'The state does of course provide, …they have a lot of money and a lot of equipment. That's good. But what is to happen to this equipment when the project is over is not quite clear. Assuming

another project is adjoined ready to start, a project that will be a winner or something. If it has continuation - that's really good. However, if it doesn't? Some of this equipment, the really `high tech stuff will go to some team, and the rest will be just ballast ..God willing, some connections with industry are established - then there is value to be gained from it"[am]. From a PR perspective, a constant connection between a company and a university, no matter what the sharing model; inside the university or on the enterprise premises, is a real feather in the cap for the company: 'when you come to a new customers, it is one thing to say just COMPANY, the other thing is saying "We are working in association with THE UNIVERSITY", or when foreign colleagues are visiting asking for direction directions: "We are just next to the university", the conversation takes a completely different turn"[an].

Conclusion

The appeal of productive academic-industrial collaborations remains high around the world. Yet, the effective and appropriate methods for promoting them remain unclear. Construction of such collaboration is complicated by the fact that governments want to combine two worlds with different norms and values (the world of industry and the world of academia), and often cannot predict the result of the introduction of formal rules. The consequences of implementation of formal rules of usage are impossible to predict, because they are bound to collide with current informal practices. To cite the Russian case, in this article, we have overviewed the effects of 'innovation enforcement' policy as formulated by the Russian government in the late 2000s.

Is the government able to force innovation? As the Russian case demonstrates, the answer is negative in many cases: Enormous budget spending and an obedient private sector are necessary, whilst the conditions for the birth of innovative ideas are inadequate. In short, the dance will fall flat if the partners are not interested in facing each other. The top-down techniques resulting in joint R&D projects have certainly created a relatively stable money flow for Russian academic institutions. However, they provide little in the way of incentives to pursue cutting-edge research and development. Today, many Russian universities lack the understanding of what industry needs and vice versa. What can be considered as valuable research results for one is quite possibly of no value to the other. Russian companies do not possess an in-depth understanding of academic potential for innovation development and often contract out only for trivial research ideas and pre-production samples.

However, enforced innovative policy (or in institutional terms, coercive institutionalization) can have positive effects too. The first outcome is the development of creative academic-industrial collaborations not always stipulated and predicted by policy programs. Consider the model of shared-use equipment that either was shared with companies inside a university or in some rare cases, given away to the company: Such model allows for developing trust between partners and sometimes results in mutually beneficial partnership. As the innovation studies demonstrate (Hwang and Horowitt 2012), trust is the main resource that curbs uncertainty bias and disaffection between two sectors and can connect them. To connect these two worlds - the world of science and the world of business - means bringing opposing sets of rules, everyday practices and expectations into one arena. The actors often lack mutual understanding and a common language. From this point of view, the emergence of trust and R&D collaborations between a few universities and private companies can be viewed as a

mark of success in Russian innovation policy. Moreover, this trust is supported by a material infrastructure - high-cost research equipment. As actor-network theory argues, non-human actors often stabilize human relations, reinforcing the emerging networks and physically supporting the slender fronds of trust (Latour 2005).

In the current debate, it is worthy of mention that as a consequence of 'innovation by coercion', there has been a certain change in industry's perception of its academic partner. In some cases, the policy may be forcing companies to see R&D collaborations more as a help rather than as a hindrance. It is hoped that such a vision will become more of a reality at a time in the future when both partners in academic-industrial relations are able to cultivate joint R&D practices and effect productive 'dancing moves' in relation to each other.

Endnotes

[a]Around the world, we can find some comparable sets of similar policy actions that involves certain amount of federal funding and forcible collaboration between university and industry, such as Centers of Excellence initiatives in Canada, Germany Excellence Initiative or National Innovation Challenge in Singapore.

However, Russian (as well as other post-socialist countries) historical and institutional context is profoundly different from other cases. In Russia, the interactions between university and industry had been re-constructed in the former state economy where all R&D activities were formally planned and strictly regulated by the government, federal departments and government-sponsored research institutes, where today, state corporations and enterprises are still the most financially and technologically powerful economic actors and where private business are too weak to be interested in expensive basic or applied research done by academia. While in other countries, state funding is aimed to stimulate interactions between academia and industry and demonstrate a necessity to increase business expenditures in R&D, in Russia, as it will be demonstrated later on, the main task is to enforce collaboration. The major policy tool is compulsion rather than persuasion; collaborators who fail to follow state initiatives incur severe penalties and risks, e.g. problems with future federal funding.

[b]The Skolkovo Foundation aims to stimulate innovation infrastructure growth and to concentrate international intellectual capital in the country. The Skolkovo Foundation is responsible for the creation of the Skolkovo Innovation Centre. Both the Skolkovo Foundation and Skolkovo Innovation Centre are Russian government initiatives (http://sk.ru/news/).

[c]RVC is a government foundation and a Russian development institute. RVC aims to stimulate investment activities and environments conducive to innovation development (http://www.rusventure.ru/en/).

[d]Russian Foundation for Technological Development is a government-supported foundation, which provides financial support to science and technology projects in the country. It combines financial support with various consultation services in innovation management and company development (http://www.rftr.ru/en/).

[e]Interview with a representative of The Transfer Office, Russian Academy of Science, 7 December 2012, Moscow.

[f]Interview with a representative of the state corporation (hi-tech production for defense sector), 31 October 2012, Moscow.

[g]Interview with a representative of Moscow State University, 26 November 2012, Moscow.

[h]Interview with a representative of a private company, 29 November 2012, Helsinki.

[i]No-dilution of ownership was changed in 2013; however, this rule applied for SIEs created before this year.

[j]Interview with a representative of Kazan Technical University, 17 September 2014, Kazan.

[k]Interview with a representative of Kazan Technical University, 17 September 2014, Kazan.

[l]Interview with a representative of The Moscow Institute of Physics and Technology, 14 October 2014, Saint Petersburg.

[m]Interview with a representative of Tomsk State University, 5 October 2014, Tomsk.

[n]Interview with a representative of Tomsk University of Control Systems and Radioelectronics, 15 October 2014, Tomsk.

[o]Interview with an industry representative, 13 October 2014, Tomsk.

[p]Interview with a representative of St. Petersburg State Electrotechnical Institute, 22 November 2012, St. Petersburg.

[q]Interview with a representative of St. Petersburg State Electrotechnical Institute, 27 November 2012, St. Petersburg.

[r]Interview with a representative of Tomsk University of Control Systems and Radioelectronics, 13 November 2012, Tomsk.

[s]Interview with a representative of a private company, 1 November 2012, Moscow.

[t]Interview with a representative of a private company, 1 November 2012, Moscow.

[u]GAZPROM VNIIGAZ is a subsidiary company of GAZPROM. GAZPROM VNIIGAZ coordinates scientific investigations within the framework of specific and engineering projects and programs. It carries out R&D, testing and design works (http://vniigaz.gazprom.com/).

[v]Interview with a representative of a private company, 29 November 2012, Helsinki.

[w]Interview with a representative of Saint-Petersburg Electrotechnical University, 13 November 2012, St.Petersburg.

[x]Interview with an ex-representative of an international corporation, 7 November 2012, St.Petersburg.

[y]Interview with a representative of Saint-Petersburg Electrotechnical University, 13 November 2012, St.Petersburg.

[z]Interview with a representative of the state corporation (radio and space technologies), 28 November 2012, Moscow.

[aa]Interview with a representative of an international corporation, 13 November 2012, Moscow.

[ab]Interview with a representative of St.Petersburg Polytechnic University, 16 November 2012, St.Petersburg.

[ac]Interview with a representative of the state corporation (radio and space technologies), 28 November 2012, Moscow.

[ad]Interview with a representative of St.Petersburg State University, 7 December 2012, St.Petersburg.

[ae]Interview with a representative of Tomsk State University, 11 October 2014, Tomsk.

[af]Interview with a representative of the state corporation (radio and space technologies), 28 November 2012, Moscow.

[ag]Interview with a representative of the state corporation (radio and space technologies), 28 November 2012, Moscow.

[ah]Interview with a representative of Tomsk State University, 5 November 2014, Tomsk.

[ai]Interview with a representative of Tomsk State University, 5 November 2014, Tomsk.

[aj]Interview with a representative of Tomsk State University, 5 November 2014, Tomsk.

[ak]Interview with a representative of ITMO University, 20 November 2012, St.Petersburg.

[al]Interview with the representative of ITMO University, 20 November 2012, St.Petersburg.

[am]Interview with a representative of Tomsk State University, 5 November 2014, Tomsk.

[an]Interview with a representative of Tomsk University of Control Systems and Radioelectronics, 20 October 2014, Tomsk.

Additional file

Additional file 1: Translation of the abstract into Arabic.

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References

Belfiore M (2010) The department of mad scientists: how DARPA is remaking our world, from the Internet to artificial limbs. Harper Perennial, New York

Biegelbauer PS, Borrás S (eds) (2003) Innovation policies in Europe and the US: the new agenda. Ashgate Publishing Co., Burlington, VT

DiMaggio PJ, Powell WW (1991) The Iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. In: Powell WW, DiMaggio PJ (eds) The new institutionalism in organizational studies. University of Chicago Press, Chicago

Etzkowitz H, Leydesdorff L (1998) The endless transition: a "Triple helix" of university-industry-government relations. Minerva 36:203–208

Etzkowitz H, Webster A, Healey P (eds) (1998) Capitalizing knowledge. New intersections of industry and academia. State University of New York Press, Albany, NY

Feller I (1990) Universities as engines of R and D-based economic-growth - they think they can. Res Policy 19:335–348

Hwang VW, Horowitt G (2012) The rainforest: the secret to building the next Silicon Valley. Regenwald, Los Altos Hills, California

Jepperson R (1991) Institutions, institutional effects, and institutionalization. In: Powell WW, DiMaggio PJ (eds) The new institutionalism in organizational theory. University of Chicago Press, Chicago

Kharkhordin O (2014) Is Russia doomed to creativity? A comparative study of technological entrepreneurship in Russia, Southeast Asia and Europe. Report at EUSP: http://www.eu.spb.ru/images/rector/technological_entrepreneurship_040414.pdf

Latour B (2005) Reassembling the social: an introduction to actor-network theory. Oxford University Press, Oxford, UK

Maximova-Mentzoni T (2012) The changing Russian University: from state to market. Routledge: Oxford

Metcalfe S, Ramlogan R (2005) Innovation systems and the competitive process in developing economies. In: Paper prepared for Conference "Regulation, Competition and Income Distribution: Latin American Experiences"
Meyer JW, Rowan B (1977) Institutionalized organizations: formal structure as myth and ceremony. Am J Sociol 83(2):340–363
North D (1990) Institutions, institutional change and economic performance. Cambridge University Press, Cambridge
Owen-Smith J (2003) From separate systems to a hybrid order: accumulative advantage across public and private science at research one universities. Res Policy 82:1695–1711
Packer K, Webster A (1996) Patenting culture in science: reinventing scientific wheel of credibility. Sci Technol Hum Values 21:427–453
Scott W (2008) Institutions and organizations: ideas and interests, 3rd edn. Sage Publications, Los Angeles; London; New Delhi
Slaughter S, Leslie LL (1997) Academic capitalism: politics, policies and the Entrepreneurial University. The Johns Hopkins University Press, Baltimore, MD
Slaughter S, Rhoades G (1996) The emergence of competitiveness research and development policy coalition and the commercialization of academic science and technology. Sci Technol Hum Values 21:303–339
Tudiver N (1999) University for sale. Resisting corporate control over Canadian higher education. James Lorimer and Company, Toronto
Zomer AH, Jongbloed BWA, Enders J (2010) Do spin-offs make the Academics' heads spin? The impacts of spin-Off companies on their parent research organisation. Minerva 48:331–353