



Royalty sharing, effort and invention in universities: Evidence from Portugal and Spain



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ABSTRACT

Portuguese and Spanish universities have adopted well-defined royalty sharing arrangements over the last fifteen years. We investigate whether such royalty sharing arrangements have been effective in stimulating inventors' efforts and in ultimately improving university outcomes. We base our empirical analysis on university-level data and two new self-collected surveys for both inventors and Technology Transfer Offices (TTOs). Evidence from the inventors' survey indicates that one third of respondents are incentivised by current royalty sharing arrangements, one third could be incentivised by higher royalty shares, and the remaining third is totally insensitive to royalty sharing. Plain regressions on university level datasets suggest that the incentive effects documented by the inventors' survey fail to translate into increased patenting or licensing income. It would seem that inventor royalty shares are not as influential as they could be, due to the poor commercial prospects of university inventions. Among other possible reasons, these poor prospects appear to reflect the fact that inventors are unable to produce potentially licensable inventions, or that eventually TTOs may not be focussing enough on commercialising their inventions.

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1. Introduction

It is well documented that the so-called third mission of universities, namely the transfer of knowledge to industry, has real effects on local economic development (Etzkowitz, 2002; Jaffe, 1989). Such knowledge transfer can be implemented via a number of routes, including the hiring of students, sponsored research, licensing, the creation of university spin-off firms, or simply via knowledge spillovers (Bercovitz and Feldmann, 2006). In this regard, one mechanism that has become increasingly important for researchers and policymakers alike is patent licensing (Geuna and Rossi, 2011; Perkmann et al., 2013).¹

A question that has aroused considerable interest of late is whether pecuniary incentives for inventors are a useful tool for

improving licensing outcomes. In the US, as in most European countries, university intellectual property policies grant the university control of rights over inventions (Sampat et al., 2003; Geuna and Rossi, 2011). The income from royalties from inventions is then shared between the inventor and the university, according to terms that are generally specified by the university. This naturally allows (or even forces) universities to decide which pecuniary incentives, in the form of inventor royalty shares, are to be offered to inventors. If inventors care about potential royalties, then universities can conveniently set inventor royalty shares in such a way as to incentivise their effort.

The purpose of our paper is to investigate the role of inventor royalty shares in incentivising scientists' efforts, and to ultimately provide advice on how to improve university patenting and licensing in Portugal and Spain.² Both countries have been particularly active over the last few years in developing an appropriate infras-

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¹ Patenting and licensing are important components of university technology transfer and have been the focus of many studies over the last two decades. Verspagen (2006) surveyed the literature on university patenting, while Baldini (2006) provided a review of the literature on patenting and licensing in universities.

² While license income is the main outcome of interest, patents are also useful in the context of this paper. Patents are an intermediate input for the generation of license revenues (inventions are patented, and then commercialised). It is precisely because patents come first that they might react with a shorter lag to variations in royalty sharing. Being able to capture early effects is important in countries such as Portugal and Spain, where royalty sharing splits have been set relatively recently.

structure for improving knowledge transfer (Geuna and Rossi, 2011; Lissoni, 2013; Cartaxo and Godinho, 2016). Among the many measures taken, has been the adoption of well-defined royalty sharing arrangements by universities. Are such royalty sharing arrangements producing the expected effects? The studies to date have presented mixed results regarding whether such royalty sharing arrangements are effective in incentivising academics' efforts, suggesting that they might be persuasive in certain institutional contexts, but not in others. Portugal and Spain have specific characteristics that make them an interesting case. Firstly, university patenting and licensing are recent phenomena, which remain at a low rate. Secondly, Technology Transfer Offices (TTOs) are relatively young, and are still in an early stage of their learning curve. Thirdly, the quality of applied research might not be as high as that in the US.

We build on the analytical framework proposed by Lach and Shankerman (2008) to understand the conditions that govern whether inventor royalty shares are likely to be effective. Intuitively, higher inventor royalty shares increase the premium for obtaining licensable inventions. Scientists are expected to react to this premium by increasing their effort in applied research. However, this incentive effect could be diminished if the revenues to be shared between the inventor and the university were trivial. Such a scenario with trivial royalties could arise if, among other reasons, TTOs were ineffective at commercialising good inventions, or if inventors were unable to produce inventions with good commercial prospects.

Within this framework, we seek to answer two research questions. First, are inventor royalty shares effective in stimulating inventors' efforts and in improving university outcomes? Second, are incentive effects diminished because TTOs are ineffective at commercialising inventions, and/or inventors are not good enough at generating licensable inventions? In order to empirically answer these research questions we employ a mix of objective evidence from university-level data and also subjective evidence from new self-collected surveys of TTOs and inventors.

Our paper is related to a vast conceptual and empirical literature that aims to understand the motives of academic patenting (Stephan, 1996; Lam, 2011). This literature has generally found university inventors to be more strongly motivated by traditional reputational and career rewards, rather than by pecuniary incentives. Instead of attempting to assess the relative value of the many potentially important motivations of academic patenting, we carry out an in-depth analysis of one such motivation: royalty sharing.

Our paper is therefore most closely related to the empirical literature concerned with estimating the effectiveness of royalty sharing.³ The papers in this literature typically rely either on university-level, or inventor-level datasets. Quite intriguingly, the former documents incentive effects, while the latter fail to identify these effects. Two of the papers that found positive incentive effects using university level data are those of Baldini (2010) and Caldera and Debande (2010). Like us, they too focus on low licensing income countries. Our paper however differentiates from theirs and from most of the remaining papers in the literature in two important ways.

First, instead of relying just on university or inventor data, we use both. This enables us to not only infer incentive effects indirectly, by regressing university outcomes on royalty shares, but also to do so in a more direct way, by explicitly asking inventors about the effectiveness of royalty shares. To the best of our knowledge, no one has ever done so before. Testing for incentive effects

with inventor level data is important in countries such as Portugal and Spain, where royalty sharing arrangements have been set relatively recently, and these might have produced incentive effects that have not yet translated into increased patenting and licensing. Additionally, inventor-level data enables us to understand some of the subtleties that go undetected with university-level data alone. For instance, we can infer the percentage of inventors that is already incentivised by royalty sharing, that which could be potentially incentivised by higher inventor royalty shares, and that which is totally insensitive to royalty sharing. The middle group is a potentially interesting target for decision makers.

Second, we not only study the presence or absence of an incentive effect, but also whether the conditions necessary for this effect to exist hold. While previous papers have studied whether incentive effects are diminished by TTOs' ineffectiveness at commercialising inventions (see Lach and Shankerman, 2008; Belenzon and Shankerman, 2009), we are the first to empirically test whether incentive effects are also diminished by inventors' ability to produce licensable inventions. Admittedly, due to limitations in our data, we are only able to provide tentative evidence of the existence of these two potentially important effects.

We obtain three main findings. Firstly, the inventor surveys reveal that one third of inventors are incentivised by current royalty sharing arrangements (although only a few find royalty sharing to be highly influential), one third could be potentially incentivised by royalty sharing (if royalty shares were increased, or if scientists have better information about royalty sharing), and the remaining third is totally insensitive to royalty sharing. Secondly, plain regressions on university level datasets suggest that the incentive effects documented by the inventors' surveys fail to translate into increased patenting, or licensing income. Thirdly, both the gatekeeper and ability effects seem to diminish royalty sharing incentive effects.

The paper is structured as follows. Section 2 presents the analytical setting and derives the research questions of interest. Section 3 offers a review of the institutional context in Portugal and Spain, and describes the datasets used in the empirical analysis. Section 4 empirically answers the research questions posed in Section 2. Section 5 concludes.

2. Analytical setting and research questions

In the traditional "Mertonian" world of scientific discovery, the main goal of scientists is to establish their priority of discovery by being the first to communicate an advance in knowledge. Accordingly, most scientists seem to be motivated by the traditional reputational and career rewards that are provided by the scientific community which come in the form of eponymy, prizes and publication (Stephan, 1996; Lam, 2011). In line with this traditional view, some studies conclude that reputation lies at the heart of scientists' decision to patent.⁴

While it is widely argued that academics respond to non-pecuniary incentives, recent research has sought to determine the extent to which pecuniary incentives also matter. Pecuniary incentives are of interest to policymakers as they can be used as a potentially effective means of involving scientists, not just in discovery, but also in the transfer of the knowledge generated beyond the boundaries of academia (Markman et al., 2004).

In this paper we seek to study the effects of a very specific form of pecuniary incentive: the share of royalty income apportioned to university scientists. Higher inventor royalty shares secure higher returns for applied research activities that are conducive

Furthermore, TTOs in both Portugal and Spain seem to be using royalty sharing to increase patenting.

³ This literature is exhaustively surveyed in Table 1, in Section 2.2.

⁴ See Bodas Freitas and Nuvolari (2012), Göktepe-Hulten and Mahagaonkar (2010), Baldini et al. (2007) and Owen-Smith and Powell (2003).

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