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David Tyfield, Rebecca Lave, Samuel Randalls, Charles Thorpe

Financing Technoscience

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Kean Birch

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FINANCING TECHNOSCIENCE

Finance, assetization and rentiership

Kean Birch

Introduction

Science was officially turned into an asset in 2008. How? In that year, the United Nations Statistical Commission adopted a new Systems of National Accounts (henceforth SNA 2008) in which research and development (R&D) spending – as well as expenditure on creative arts – was redefined as fixed investment. Previously, R&D spending was treated as an expense incurred during the production process – that is, as an expenditure incurred in the creation of products (or services) ranging from pharmaceutical drugs through cellphones to medical procedures. Following the SNA 2008 decision, then, R&D spending would be reframed as an investment because it produced an asset, in this case scientific knowledge. The USA’s Bureau of Economic Analysis outlined the change as follows:

Expenditures for R&D have long been recognized as having the characteristics of fixed assets – defined ownership rights, long-lasting, and repeated use and benefit in the production process. Recognizing that the asset boundary should be expanded to include innovative activities, such as R&D, the NIPAs will record private and government expenditures for R&D as investment.

(BEA 2013: 14)

As the Bureau of Economic Analysis note, the “asset boundary” was extended as a result of the SNA changes, thereby creating a new asset class comprising the knowledge outputs of research activities. The implications of this change will likely be as profound for social studies of science, technology and innovation – or science and technology studies (STS) – as they are for research and innovation policy-making and business. The SNA informs the development of national accounting systems that each country uses it to measure the “economic” activity (e.g. output, expenditure, income) undertaken within their borders. Specifically, the SNA changes imply that R&D costs will be capitalized rather than expensed at the time of “investment”. R&D spending will now be understood as creating an asset with annual depreciation costs, or capitalized property, meaning that the value of R&D spending will stretch beyond its immediate contribution to production. The extension of the “asset boundary”, in its rather bland terminology, can be seen more simply as the further extension of private property into scientific
knowledge (Frase 2013). This move reinforces the approach taken by “neoliberal economists” to delegitimize the treatment of scientific knowledge as a public good (Mirowski 2011: 61); this is done through the extension of legal rights and the creation of knowledge assets. And, in the extreme, it represents an end to the scientific “commons” altogether – however idealized that may be – as governments, businesses, universities and others are all incentivized to find ways to stop sharing “their” research and innovation (see Delfanti, Harrison et al., Johnson and Rampini, Muellerlisle; Pagano and Rossi; Randalls, this volume).

A key issue with the creation of knowledge assets is how to value them. The extension of the “asset boundary” suggests that more and more scientific research will fall within the remit of intellectual property (IP). Of particular importance, in this regard, is the fact that the “science business”, in Gary Pisano’s (2006) terms, involves the monetization of such IP rather than the development of new products and services. In the life sciences, for example, the early entrants like Genentech showed “that intellectual property could be packaged and sold independently of the final product” and that “IP was an asset that could be monetized” (ibid.: 142). Existing literature on the changing political economy of research and innovation (CPERI) highlights the particular – and peculiar – valuation logics, knowledges and practices in the business of science (e.g. Mirowski 2012; Birch and Tyfield 2013; Mittra 2016; Birch forthcoming). Primarily, this centres on the expected future earnings of IP rights like patents, copyright, trademark, and suchlike. However, it is also dependent on the (re)configuration of the financial system supporting the business of science, especially venture capital and capital markets. Consequently, the expansion of knowledge assets resulting from the SNA 2008 changes leads inevitably to the increasing monetization of scientific knowledge, necessitating, on the side of STS scholars, a significant engagement with finance, financial markets and financialization processes in order to understand the political economy of technoscience.

My aim in this chapter is to illustrate, in a small but hopefully useful way, how to pursue this sort of engagement. In one sense, I am arguing that STS scholars need to develop yet another competency in their research, particularly in understanding the financing of the scientific enterprise. Without developing this expertise, it is likely that scholars will miss some of the critical changes happening in the evolution of technoscience, of all shapes and sizes. In another sense, I am arguing that STS scholars also need to engage with finance on a normative level in order to challenge the negative implications of finance for technoscience, which I come back to in the conclusion. Before that, I provide a brief outline of the relationship between finance and technoscience. Then I discuss several key financial logics, knowledges and processes that impact technoscience. I illustrate these arguments with reference to the life sciences sector, before concluding.

Finance, assetization and rentiership

Finance has been a research topic in STS and cognate disciplines for some time now, especially in social studies of finance (e.g. MacKenzie 2009). This literature largely turns an STS gaze on finance and financial markets in order to understand how technoscience configures them. It is not my intention to get into these debates here, but rather to focus on how finance and financing come to configure technoscience. In this regard, I define *finance* primarily in terms of the financing of (scientific) business organizations, which includes equity investment (i.e. shares and shareholding), debt (i.e. loans), and other more exotic financial instruments (e.g. securities). Although it might appear as a neutral or insignificant aspect of science and innovation, as Mirowski (2011), Tyfield (2012a, 2012b) and others in this volume point out, the financing of science comes to shape science in important ways. Of relevance to this chapter, for example, are the claims that finance has come to dominate management and research strategies since the
1970s, especially as the pursuit of shareholder value (i.e. share price) has supplanted other concerns (Lazonick et al., this volume, Lazonick and O’Sullivan 2000). The dominance of finance and financial thinking has been defined as a process of financialization by a number of scholars: first, Krippner (2005: 174) defines it as “a pattern of accumulation in which profits accrue primarily through financial channels”; Leyshon and Thrift (2007: 102) define it as the “growing power of money and finance within economic life”; and Pike and Pollard (2010: 30) define it as “the growing influence of capital markets, their intermediaries, and processes”. Simply put, financialization can be seen as the influence of financial logics, practices, and knowledges on other activities (Chiappello 2015), in this case, technoscience.

Much of the existing research on the financing of science has been centred on the importance of inter-organizational collaboration and relationships to learning and innovation in high-tech sectors like the life sciences, in particular, the relationship between research-based firms and capital providers (e.g. venture capital). Examples of this literature include: Pisano (1991), who presents a range of different governance structures in the biotech industry, such as vertical or horizontal integration and collaborative partnerships; Powell et al. (1996), who argue that the “locus of innovation” is in the networks between firms and other institutions, since no single organization could acquire the capacity needed to develop new products; Powell et al. (2002), who argue that biotech firms and venture capital are co-located in particular places (e.g. San Diego, CA); and Pina-Stranger and Lazega (2011), who argue that personal ties between biotech firms and venture capital are critical to learning processes in firms. However, despite its insights, this literature does not really do much to analyse how finance shapes science.

A number of scholars in STS and related fields have sought to make these conceptual connections. Early work by Coriat et al. (2003) on the emergence of “new science-based innovation regimes” emphasized the importance of institutional inter-dependencies and complementarities in the expansion of high-tech sectors. For example, they explain how the outsourcing of research to universities is tied to the extension of strong IP regimes and the financing of private firms through venture capital, all of which helped turn research into a “product” and IP rights into an “asset” (ibid.: 17, 19). A number of other scholars have stressed the importance of new IP regimes to the emergence and expansion of high-tech sectors, especially the life sciences, noting the extent to which value “creation” is now underpinned by monopoly rents enabled by the expansion of IP rights (e.g. Serfati 2008; Tyfield 2008; Zeller 2008; Birch forthcoming). More recently, Andersson et al. (2010) argue that high-tech firms have adopted a “financialized business model” in which financing is driven by a relay of investment and exit decisions made by financiers; none of these decisions, it is important to note, necessarily entail the marketing of a final product. Similarly, Hopkins et al. (2013) provide a detailed account of the biotech financing process, highlighting the fact that finance has a significant influence on strategic decisions inside firms. Others, like Lazonick and Tulum (2011) and Styhre (2014, 2015), stress the impact of restructuring capital markets and corporate governance on the financing of sectors like the life sciences. For example, Lazonick and Tulum argue that financing focuses on shareholder value over and above research, while Styhre notes the relationship between finance and “rentier capitalism”, to which I return below.

This focus on finance means it is important to analyse science as a business, which means understanding what science is “selling”. As others note (e.g. Pisano 2006; Mirowski 2012), the science business does not necessarily entail the research and development of new products or services, which mainstream theories of innovation and entrepreneurship generally emphasize (Godin 2012). Rather, it involves the creation of assets. This “assetization” process, as I call it (Birch 2015, forthcoming), is an emerging topic in the STS literature. A number of scholars have sought to analyse the socio-economic implications of assets in the bio-economy (e.g. Birch and Tyfield
2013; Cooper and Waldby 2014; Lezaun and Montgomery 2015; Martin 2015), while others have sought to analyse how assets are constituted and constitute particular valuation practices (e.g. Muniesa 2012, 2014; Ortiz 2013; Doganova and Karnøe 2015; Doganova and Muniesa 2015). Almost anything can be turned into an asset with the right techno-economic configuration that enables the “transformation of something into property that yields an income stream” (Birch forthcoming). This transformation involves the construction of property rights so the thing – e.g. IP, business model, artefact, land, resource, skill, bodily function, personal popularity, pollution, building, infrastructure, life form molecule, etc. – can be enclosed and owned, using monetization technologies so it can be alienated and traded, and discounting practices so it can be capitalized and valued. As such, assetization involves both tangible materiality and intangible knowledge.

The focus on assets might sound overly technical, but it has significant implications for understanding the political economy of science (Birch forthcoming). In part, these implications result from the distinctiveness of assets, especially knowledge assets (e.g. IP rights), from commodities (i.e. products and services). First, knowledge assets (e.g. IP rights) give owners exclusion rights and use rights for copies derived from the asset; for example, when we buy a music CD we do not have the right to reproduce and distribute it. Second, assets are constructs of law and regulation, being dependent on the state for the enforcement of property rights. Third, assets have a distinct supply and demand logic because they are generally unique and full or quasi-monopolies; as a result, assets tend to rise in price as demand rises because new producers cannot enter a market (e.g. there is only one copyright to the music of Metallica). Fourth, as a result of being monopolies, assets generate monopoly and other forms of economic rent (Fuller 2002; Zeller 2008). Fifth, while the demand logic may entail rising asset prices, this does not preclude owners from seeking to decrease their value, transform an asset from one form to another, to transfer ownership, and so on. Finally, it should be obvious that asset prices are highly dynamic and dependent on active management of their value.

The discussion of assets, especially as they relate to scientific knowledge, highlights one key aspect that conceptually differentiates assets from commodities: they entail forms of rent-seeking, or rentiership, as opposed to entrepreneurial activity (e.g. developing new products, services, markets, etc.). As a concept, rentiership is underpinned by a number of theoretical assumptions. First, knowledge is a social process – à la social epistemology (Fuller 2002) – rather than an idea in our heads; as such, it entails our “habits of life”, to use Veblen’s (1908) terms, or the “general intellect” to use Marx’s (1993). Second, since knowledge is a social process, it can only be turned into an asset through specific techno-economic configurations – including legal-political rights and regulations, socio-technical instruments, and knowledge practices – that enable the extraction (cf. creation) of value through the reification and enclosure of knowledge. Profits thus stem from limiting access to an existing thing, rather than producing anything new (Fuller 2013). Third, and as alluded to already, this assetization entails rent-seeking rather than profit-making (Zeller 2008). Fourth, rent-seeking, however, is not intrinsic to assets; instead, rent-seeking involves a range of knowledge and practices that often involve a temporal or serial accrual of revenues (Andersson et al. 2010), in which the original creators do not necessarily benefit. Finally, rentiership is dependent on specific forms of social organization and governance, especially those relating to private business (Mirowski 2012).

Valuation, corporate governance, and the financialization of the life sciences

In order to understand the implications of finance, assetization and rentiership on science, it is important to unpack a range of political-economic organizational forms, practices, and knowledges. Here, when I use “political-economic”, I do so as a descriptive rather than analytical
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Term to define the kinds of political-economic activity often sidelined in STS perspectives, such as the allocation and distribution of societal resources. In this section, for example, my intention is to consider three political-economic aspects of science that are frequently black-boxed in the STS literature: financing, valuation, and organizational governance. I unpack these political-economic aspects of science in order to understand how finance and financialization come to configure the life sciences, which I use as an example of a “science business” (Pisano 2006).

Finance and financing in the life sciences

Several STS scholars have raised serious questions about the purported revolutionary nature of the life sciences; for example, Nightingale and Martin (2004) call the “biotech revolution” a “myth” (see also Birch 2006; Hopkins et al. 2007). Such claims often reflect technoscientific developments (or the lack thereof), rather than political-economic ones. For example, it is interesting to note that in 2014 the global market capitalization (i.e. total share value) of public “biotech” firms reached over US$1 trillion (Ernst and Young 2015), having risen from around US$400 billion in the immediate aftermath (2008–11) of the global financial crisis. The huge rise in market capitalization between 2011 and 2014 seems incongruous when put in relation to the revenues and profits of those same firms, as illustrated in Figure 12.1. First, the ratio of market capitalization to revenues fell from 6–7 before the GFC to around 4 afterwards, and since then it has risen to 7–8 in 2013 and 2014. This means that the share value of these firms has fallen and risen in response to factors other than revenues and profits derived from products and services. Second, the global “biotech” industry as a whole only became profitable for the first time in 2009 (ibid.). Unpacking these numbers in more detail reveals that, first, only ten predominantly American “biotech” corporations represented around 60 percent (i.e. US$600 billion) of that global market capitalization; and second, only the largest 10–15 corporations were actually profitable in 2011 (see Figure 12.1). In light of these revenue and profit numbers, the valuation of the biotech industry on public capital markets seems contradictory.

Other scholars have raised similar questions about the extent to which biotechnology has lived up to the expectations that many people have had of it over the years – e.g. policy-makers, investors, business people, academics, etc. Pisano (2006: 94, 112) argues that the biotech industry is characterized by poor returns on R&D investment, when judged on the introduction of new products and services, and by poor returns on financial investment, when judged on the aggregate share value performance of public corporations. Moreover, Pisano argues that returns on private investment (e.g. venture capital) have also been poor and that without Amgen the whole industry would have “sustained steady losses throughout its history” (ibid.: 114). However, and illustrating why biotechnology is interesting, this has not halted increasing levels of government funding and private and public capital investment in the sector over the years. As Figure 12.2 illustrates, the level of funding fell briefly after the global financial crisis, but subsequently rose again; the main difference has been an increasing reliance on financing through partnering and debt.

Part of the reason for this disjuncture between investment and returns can be explained by the financing process in the life sciences. Generally, life sciences businesses are dependent on “patient capital”, or long-term financial investments that can accommodate long product development times (e.g. 10–20 years) (Birch and Cumbers 2010; Hopkins et al. 2013). However, most private and public market investments are short-term. Private investment, like venture capital, for example, is driven by the time horizon of their managed funds, which is four to six years. This is because the source of these funds is institutional investors (e.g. pension, insurance, mutual funds), which need regular returns on their investments (Hopkins 2012). As a result, most life sciences financing is intrinsically configured as a relay or serial process in
**Figure 12.1** Global biotech industry: market capitalization ($b)

*Sources:* Lähteenmäki and Lawrence (2005); Lawrence and Lähteenmäki (2008, 2014); Huggett et al. (2009, 2010, 2011); Huggett and Lähteenmäki (2012); Huggett (2013); Morrison and Lähteenmäki (2015); reproduced with permission.

**Figure 12.2** Global biotech industry: financial investment ($b)

*Sources:* Lähteenmäki and Lawrence (2005); Huggett and Lähteenmäki (2012); Yang (2013); data for partnerships for the years 2009–12 includes global deals; reproduced with permission.
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which a financier is driven by the need for an exit before a business is necessarily profitable or even revenue-generating (Andersson et al. 2010). Consequently, a range and number of different financiers (e.g. business angels, venture capital, strategic venture funds, etc.) need to find an exit to recoup their investment and are largely reliant on finding other financiers to pick up the “baton” (Hopkins 2012). Each financier’s primary concern in this process is the dilution of the value of their investment which successive rounds of investment might engender; that is, an increase in the number of (private) shareholders who own shares in a business, but not in the value of the business itself. Hence, it is often “cleaner” at each refinancing stage for new financiers to replace rather than supplement existing financiers. How value is determined is itself an important question (see below). This short-term, serial process configures the research and business strategies that life sciences firms can actually undertake, and explains why scientific knowledge – protected by suitable IP rights – has become such an important asset. On the one hand, it is how firms generate revenues through partnerships, out-licensing, royalty arrangements, etc., and, on the other hand, it is how firms represent their fundamental value – a tricky concept in itself (Styhre 2014).

Financial practices and logics of valuation in the life sciences

Having considered the financing trends and patterns in the life sciences, it is now important to consider how this financing is translated into value by various political-economic actors. A starting point is to unpack the financial logics and practices that drive valuation decisions. The key social actors in this regard are financiers and investors, rather than a firm’s managers, scientists, etc. Consequently, it is important for STS analyses to engage with these political-economic actors, as much, if not more than, technoscientific actors (Birch forthcoming). This means, though, that STS scholars have to engage with a new set of knowledges, practices, logics, etc., sometimes in areas where they feel less intellectually comfortable.

It is difficult to judge the value of a life sciences business without a set of political-economic knowledges and practices to make and manage valuations (Ortiz 2013; Birch forthcoming). Here I want to discuss valuation practices and then consider the conceptual implications of these logics. First, there is a range of rather prosaic “valuation methods” that financiers can use. Bratic et al. (2014) split these among an “asset approach”, “income approach” and “market approach”. An asset approach involves valuing a business’s assets and liabilities at “fair market prices” – or, prices that would be received in a market exchange at that point in time; an income approach involves valuing (expected) future revenues; and a market approach involves valuing a business in relation to other businesses in terms of its market share, market position, market growth, etc. Each entails a set of judgements and practices that informs, or performs, the valuation of a business (Muniesa 2012). For example, IP rights might represent an asset, but they could also represent a risk from a litigation perspective, as others may challenge them in court, leading to significant legal costs. The point I want to get across here is that the valuation of a business is a complex social practice that involves particular financial logics; there is no objective way of determining what a business is worth outside of social conventions and practices for doing so.

Another example is represented by the work of STS scholars on “valuation devices”, which include business models and business revenue formulae (e.g. Doganova and Eyquem-Renault 2009; Baden-Fuller and Morgan 2010; Perkmann and Spicer 2010). These models and formulae are particularly important in new, high-tech sectors like the life sciences for at least two reasons: first, value is not intrinsic in new technoscientific sectors since future revenues are uncertain (at best) (Perkmann and Spicer 2010); and second, models and formulae provide a means to establish – or “perform” – new markets and valuations (Doganova and Muniesa 2015). For
example, such models and formulae are used to define and frame the expected customer base, revenue streams, value capture, etc., which help financiers and investors to work out what the value of a business entity *should* be if it is going to return the investment made in it. There are numerous business models according to Baden-Fuller and Morgan (2010), each with their own rationales, expectations, activities, etc., for example Wal-Mart, with low prices but high throughput; Google, with free services but targeted advertising; McDonald’s, with franchising but standardized products; etc. In some senses, a business model can even be considered a fetishistic representation of business activity, used to establish valuations on the basis of particular techno-economic organizational structures and relations, which I come back to below.

These valuation practices reflect certain financial logics, especially the logic of capitalization as outlined by STS scholars like Muniesa (2012, 2014), as well as others (e.g. Nitzan and Bichler 2009; Chiappello 2015). Working within a tradition which treats finance and capital as social practices – cf. Marxist perspectives that emphasize capital as a set of social relations embodied by commodity production – capitalization is underpinned by the idea that value is not inherent in a thing or relation. Rather, the concept of capitalization refers to the social practice of discounting future revenues to determine current valuation, for example calculating current share price on the basis of future earnings that a shareholder can expect to reap through dividend payments. According to Muniesa (2012), this is a dual process in which the construction of “value” (i.e. earnings) occurs simultaneously with the construction of the thing being “valued” (i.e. business entity). In the case of the life sciences, this entails valuing the future earnings of a business entity by valuing it as a “going concern” with the potential for a certain market share (ibid.). It involves an assessment of the value that can be “created” or “captured” from the creation of a business entity through particular business models (Doganova and Muniesa 2015), which, in light of the theoretical discussion above, ends up conflating entrepreneurship (i.e. creation of value) with *rentiership* (i.e. extraction or capture of value). For example, a life sciences business may have been created as a venture-backed, dedicated biotech firm with the goal of developing new biopharmaceutical products, but might actually capture value, for financiers and investors at least, through the strategic threat it represents to incumbents, leading to a buy-out by the incumbent or its competitors.

**Financial organization and governance in the life sciences**

As the discussion above illustrates, value and valuation are not intrinsic to particular assets, activities (e.g. product sales), or entities (e.g. businesses); some scholars, like Ortiz (2013), argue that value and valuation are not automatic or inherent processes, they are always necessarily (at least partially) subjective. The way political-economic actors, especially financiers and investors, value a business is driven by a set of financial logics and practices, and these can often conflict with or contradict the logics and practices of other social actors (e.g. scientists, managers, policy-makers, etc.). In the case of the life sciences, this process is reflected in the organizational structure and relations of financing and its governance. In particular, it is evident in the dominant narrative of the dedicated biotech firm as an entrepreneurial entity that creates value. This perspective is simplistic, if not downright inaccurate, on a number of levels.

To start with, the financial practices and logics of value and valuation I outlined above are embodied in the business entity itself, rather than in the production or other process. That is, the thing being valued, in financial terms, is the business; one of the primary reasons for this is that a business has a lifespan that enables capitalization, or the discounting of future earnings, whereas other entities or different processes do not facilitate this. It is helpful here to turn to the arguments of Philip Mirowski (2012) on the life sciences businesses; he explicitly defines biotech
firms as financial artefacts rather than integral to any production process. According to Mirowski, this is because “most biotechs never produce a drug or other final product” (ibid.: 295). In this sense, he goes on to argue, the biotech firm is really a “Ponzi scheme” designed “to lure exponentially increased investment and then to cash out before the inevitable collapse ensues” (ibid.: 296). I have interviewed informants from the venture capital world who have said exactly the same thing: “it is a bit of, can be a bit of a Ponzi scheme which is, you know, [phone rings], ‘I pay this for it, so that’s what it’s worth’” (see Birch 2016: 122 fn1). With this in mind, it is important to integrate this aspect of high-tech firms into STS analyses in order to avoid the conceptual ambiguity around notions of technoscientific promise, expectations, and suchlike; to financiers and investors, high-tech firms can represent nothing more than a financial return.

In order to achieve this return, however, financiers and investors are reliant on certain forms of corporate governance. Corporate governance has become an important academic, business, and policy issue since the 1970s as the result of the rise of the idea that corporate governance should maximize shareholder value (Lazonick and O’Sullivan 2000). As a concept, corporate governance refers to both an area of academic and legal research and a set of legal and economic mechanisms that centre on resolving the separation of “ownership” (i.e. shareholder) and “control” (i.e. manager). As an area of academic research it is mainly concerned with the “way in which suppliers of finance to corporations assure themselves of getting a return on their investment” according to one influential review (Shleifer and Vishny 1997: 737). But as this definition illustrates, it can be considered as a highly normative area of study focusing on how one group (i.e. investors) can best control another group (i.e. managers) on the basis of assumptions about who can and should control the societal allocation of capital (i.e. it should be investors because they are most efficient at allocating capital because they have the most to lose) (Styhre 2015). As a legal and economic mechanism it is less clear-cut who does and who should control business entities (Stout 2012). When it comes to the life sciences, Pisano (2006: 136) points out different forms of investment involve different forms of corporate governance: for example, venture capital involves more than an investment of capital, it also involves “close oversight” through “representation on the board of directors, covenants and contractual restrictions, incentive arrangements, and the staging of capital infusions”. Others, like Styhre (2015), note the difference in goals between financiers/investors and founders, in that the former are more concerned with selling their stake and the return they get than with product development. As such, they may represent rentiers, but they “are by no means passive” ones (ibid.: 161). How different social actors understand the rationale and mechanism of corporate governance has an enormous impact on the configuration of technoscientific businesses, especially in high-tech sectors like the life sciences.

An important aspect of this whole organization and governance of high-tech businesses is the dominance of finance and investment returns over other considerations (e.g. research spending). In his work over the years, William Lazonick and collaborators have demonstrated how shareholder value has come to dominate business strategies and decisions in high-tech sectors (e.g. Lazonick and O’Sullivan 2000; Lazonick and Tulum 2011; Lazonick and Mazzucato 2013; Lazonick et al., this volume). Starting with the incongruity between financing levels and lack of product development which others have highlighted (e.g. Nightingale and Martin 2004; Pisano 2006; Hopkins et al. 2007), Lazonick and Tulum (2011) examine the phenomena of stock repurchases (or buy-backs) in the life sciences. These stock repurchases are decisions by corporations to use their profits to buy shares back from shareholders and thereby boost share prices as fewer shares end up being traded on the market. For example, in drawing on Lazonick and Tulum’s work, Mazzucato (2013: 26) notes that Amgen, the leading light of the life sciences sector, “has repurchased stock in every year since 1992, for a total of $42.2 billion through
2011”. Moreover, the fact that Amgen borrows billions to repurchase stock distorts the seemingly “healthy” financing picture in Figure 12.2. As Lazonick and Mazzucato (2013: 1097) argue, this repurchasing activity represents the extraction of the value that is generated in organizations (e.g. life sciences businesses) through markets. Repurchasing and other market mechanisms do nothing to increase the investment in science or innovation; rather, they represent forms of rent-seeking enabled by policy changes in scientific, innovation, and market institutions.

**Conclusion: Implications of financialization for the life sciences**

In concluding this chapter, I want to consider the practical and theoretical implications of the various issues I have covered in the discussion above. In particular, I want to develop the notion of *rentiership* introduced in the theoretical section. I start here with the conceptual implications before addressing some of the broader policy implications not already mentioned above.

First, in terms of conceptual implications, it is worth developing the notion of *rentiership* as an analytical tool for understanding contemporary capitalism, especially varieties underpinned by (technoscientific) sectors like the life sciences. Theoretically this necessitates a renewed interest in intellectual property (IP) rights, although more attention needs to be focused on how IP rights are *used* by different social actors rather than assuming that they represent something of value. For example, IP rights are themselves both socio-technical configurations and part of broader configurations that enable the monetization and capitalization of knowledge as an asset. Consequently, value and valuation need to be rethought, as I have sought to do elsewhere (Birch forthcoming). My main point here would be to emphasize that value in knowledge-based economies is not constituted, conceptually speaking, by commodity relations; it is, rather, constituted by the turning of knowledge into assets (i.e. assetization). As a result, value is extracted, rather than created, through various forms of proactive rent-seeking (e.g. ownership, regulations, standards, etc.).

Second, the policy implications are broad when considering the political economy of science. However, I want to focus on one issue to do with the alignment of innovation policy and financial markets, which has been pursued in jurisdictions like the European Union (Birch and Mykhnenko 2014). Certain kinds of finance (e.g. venture capital) are frequently associated with innovation and high-tech sectors. For example, European policy debates and changes (e.g. Lisbon Agenda, Horizon 2020) have been shaped by the innovation imaginaries of *and* from the USA (Birch 2016). In particular, European policy-makers fetishized the financial markets in the US as an especially important component of the innovation “ecosystem” there. As a result, European policy-makers have promoted the restructuring of European financial markets and regulations to stimulate innovation. Whether it has succeeded in this regard is subject to debate. According to Birch and Mykhnenko (2014), for example, these financial policy changes have merely led to the financialization of the European economy, as well as the financialization of research and innovation. The implications of this financialization could be profound, in that rentiership comes to drive research and innovation towards particular areas that are easier to exclude, easier to alienate, easier to turn into capitalized property (Kapcyzynski 2014), and away from science in and for the public or global interest. For example, so-called “patent trolls” (or “non-practising entities”) have found that a profitable and relatively low-risk strategy for extracting value is to buy intellectual property (IP) and then sue possible infringers, especially in contrast to the risks and uncertainties related to developing new products or services (Chien 2013). Consequently, there are incentives to do research that can be easily turned into IP assets and sold to “non-practising entities”, rather than research that is complex and time-consuming precisely because it has uncertain and global implications (e.g. climate science).
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Note

1 Personally, I think that this would make a fantastic PhD project for someone; there is a real need for an examination and analysis of the SNA 2008 changes as they relate to science, technology, and innovation.

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