

This PDF includes a chapter from the following book:

Assetization

Turning Things into Assets in Technoscientific Capitalism

© 2020 Massachusetts Institute of Technology

License Terms:

Made available under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International Public License

<https://creativecommons.org/licenses/by-nc-nd/4.0/>

OA Funding Provided By:

The open access edition of this book was made possible by generous funding from Arcadia—a charitable fund of Lisbet Rausing and Peter Baldwin.

The title-level DOI for this work is:

[doi:10.7551/mitpress/12075.001.0001](https://doi.org/10.7551/mitpress/12075.001.0001)

7 Expropriating the Future: Turning Ore Deposits and Legitimate Expectations into Assets

Paul Robert Gilbert

Introduction

In this chapter, I draw on ethnographic fieldwork carried out in the City of London between 2012 and 2014 to explore the valuation techniques that underpin investment in mineral exploration. At the time of my fieldwork, carried out with investors, analysts, consulting geologists, and lawyers, the mining market was seeking out new frontiers as established resource-rich jurisdictions became less profitable, or began to show signs of what analysts termed “resource nationalism” (the desire to renegotiate contracts, taxation, and royalty rates in terms more favorable to host states). Against this background, the chapter explores the capitalization devices, narratives, and durable legal foundations through which mineral deposits are transformed into assets, valued in terms of the future revenue they promise their investors.

The first section of this chapter situates my concern with the assetization of mineral deposits in relation to existing ethnographic work that explores valuation and the political economy of mineral deposits, but which tends to emphasize commodity situations rather than the asset condition. The ethnographic portion of the chapter then moves to examine the socio-technical dimensions of capitalization, with an emphasis on the Real Options-based valuation techniques used to value mineral deposits as assets. Subsequently, I examine the discursive and narrative components of the capitalization process. Specifically, I focus on the manner in which discourses around resource nationalism are deployed by investors in tandem with Real Options-based valuation models to argue against fiscal redistribution in host jurisdictions, and in favor of rapid resource extraction. Finally, I emphasize the increasing levels of protection provided for investors’ “legitimate expectations” in international investment law. The chapter therefore

argues that it is the assetization of investors' legitimate expectations that future cash flows will materialize, unimpeded by putative acts of resource nationalism, which sustains mineral exploration and investment. These expectations in turn rely upon the techno-economic processes that enable the transformation of largely invisible mineral deposits into assets valued in terms of future revenue streams.

From Minerals as Commodities to Mineral Deposits as Assets

How—and why—do mineral deposits become valuable? Anthropologists studying sapphire (Walsh 2004, 2010), silver (Ferry 2002, 2005), and coltan (Mantz 2008; Smith 2011) extraction have approached this as a question about the value transformations to which minerals are subject as they become *commodities* (see Braun, this volume). Following Arjun Appadurai (1986), this means focusing less on the qualities of given minerals than on the commodity situations through which exchangeability becomes the socially relevant feature of a given metal or gemstone (Appadurai 1986, 13).¹ As such, attention may be given to the value transformations that mineral specimens undergo as they are diverted from circulating within the moral economy of a mining community, to become commodities valued for their beauty and “naturalness” among geographically distant collectors (Ferry 2005, 430; see also Walsh 2010).

Equally of concern for these anthropologists has been the manner in which sites of mineral extraction, and the lives of those involved in mineral commodity situations, are implicated in broader systems of political economy. A great deal of attention is thus given to the manner in which artisanal miners in the Democratic Republic of the Congo (Smith 2011) or Madagascar (Walsh 2004) speculate over the cause of fluctuations in the world prices² of the resources that they help transform into valued commodities. While seemingly the product of remote and opaque forces, these price fluctuations have profound implications for miners' capacities to build predictable economic futures for themselves. Hence for Jeffrey Mantz (2008, 41–42) an understanding of the coltan (or “digital mineral”) trade demands a perspective that integrates “the seductive virtual world of Halo 3” (and the boom in coltan prices that resulted from the launch of Sony's PlayStation 2), as well as “Citibank and other corporations [who] have negotiated directly with the ruthless occupants of the eastern DRC... who forced people to mine and plundered their villages.”

These ethnographies of mineral extraction, resource-making, and commoditization are powerful precisely because they operated on what Jean and John Comaroff term an awkward scale. Such ethnographies, the Comaroffs argue, are equally attentive to “processes occurring in virtual spaces as to those visible in ‘real’ places-under-production” (Comaroff and Comaroff 2003, 169). Yet, by locating the financial arrangements and capitalist agencies that format mineral commodity chains and the lifeworlds of artisanal miners, such ethnographies render finance a central and yet curiously neglected figure which remains “present, yet largely absent” (Ouma 2015, 163; also Visser 2017). By contrast, the socio-technical arrangements upon which financial agency relies has been central to social studies of finance (SSF). Suspicious of the treatment of finance as a virtual domain (see MacKenzie 2007), SSF scholars ask instead that attention be paid to the endless material and socio-technical work through which goods are marketized, prices calculated, and economic models performed (Callon 1998; Callon and Muniesa 2005; MacKenzie 2001).

SSF has given rise to a thriving literature that traces out the socio-technical arrangements through which securities and derivatives are priced, carbon markets are enacted, and algorithmic trading produces its effects (e.g., Beunza and Garud 2007; Coombs 2016; Lenglet 2011; Lepinay and Callon 2009; MacKenzie 2009; MacKenzie et al. 2012). But while recent work in this tradition has engaged with the relationship between particular models and the 2008 global finance crisis (e.g., MacKenzie and Spears 2014), there has been a tendency to shy away from questions of capital, capitalism, and political economy on the macro scale. Callon (2005; Callon and Latour 1997; also Barry and Slater 2002) has been particularly hostile toward the practice of conjuring capitalism as an explanatory force, and its short-circuiting of the careful tracing through which socio-technical market agencements can be discerned.³ Defenders of the SSF approach have thus accused the political economists who locate financial agency in elite pacts and capitalist interests (e.g., Froud et al. 2011) of overdetermined analyses resting on conspiratorial thinking (Beunza 2010), and have argued instead that “market institutions and their embedded political controversies are in fact *best* made visible through the description of *devices*” (Lenglet 2011, 46, emphasis added).

If anthropologists occasionally neglect market devices and conjure financial markets as the virtual backdrop against which value transformations play out around particular mineral extraction sites, SSF scholars conducting

fieldwork in financial centers have also been guilty of operating with a geographical imagination that is far more circumscribed than that deployed by anthropologists working on an “awkward scale.” In spite of Latour’s (2005, 179) injunction to focus on neither capitalism nor “the screen of the trading room either,” scholars indebted to his material sociology have been deliberately selective in their attention to calculative arrangements within funds’ offices, even when those funds trade in the currencies of “far-flung countries” (Hardie and MacKenzie 2009, 66; Beunza et al. 2006). In the terms of critics like Roberts (2012, 42), excessive attention to the “empirical plane of organization” leads to a neglect of “immanent *capitalist* processes.” However, by switching attention away from calculative market devices that facilitate the value and exchange of commodities, and toward the capitalization devices (Doganova and Muniesa 2015) through which *assets* are made valuable in light of their earning potential, it is possible to remain attentive to the political controversies embedded in socio-technical devices while also appreciating them as explicitly capitalist forms of calculation that “connect distant situations and configure large social realities” (Muniesa et al. 2017, 17).

The ethnography of capitalization presented below begins from the assumption that “formulating reality in capitalist terms might, in some circumstances, transform the formulated reality” (Muniesa 2014, 35). In other words, the techno-economic operations through which things such as mineral deposits are turned into assets, capitalized as a source of (expected) future revenue, are fundamental to the operation of extractive industry techno-capitalism. The political economists Jonathan Nitzan and Shimshon Bichler have argued forcefully that the study of capitalist realities must begin with the “ritual of capitalization” through which the net present value of an asset is calculated (Nitzan and Bichler 2009, 17–19; Nitzan 1998). This, they argue, is because capitalists themselves approach capital as capitalized earning capacity, and *not* as actual physical and material infrastructure or inventory. For followers of Nitzan and Bichler, what is being capitalized in the calculation of net present value is “the *power* of governments or corporations to shape and reshape the terrain of social reproduction in their favor *relative* to other organizations attempting to do the same thing” (Di Muzio 2012, 371). But attempts to literally “quantify the valuation-qua-capitalization of class power” (Park and Doucette 2016, 545)⁴ forego consideration of the careful socio-technical arrangements, narratives, and legal

foundations through which the world that is to be capitalized comes to be configured (Muniesa et al. 2017; also Knafo et al. 2014).

In the next section, I examine those socio-technical arrangements—through which mineral deposits become valued in terms of discounted future earnings. I highlight the tensions that arise between miners who conceive of a resources value in terms of sheer tonnage of rock or good community relations, and those who evaluate mineral deposits only in light of their “asset condition” (Muniesa et al. 2017, 32). Specifically, I focus on the models that mineral exploration firms and their investors use to adjust mine plans (including labor contracting, waste management protocols, and the cut-off grade below which extracting rock is seen as unprofitable) with a view to maximizing their net present value.

Afterward, I examine the discursive formations which nourish attempts to capitalize on mineral deposits. To value an asset in light of the future revenue it will produce, investors must have confidence in the *stability* of their mineral claim, and the contractual arrangements that pertain between mineral exploration firms, host states, and mine-area communities. During 2012–2014, mining analysts and investors in the City of London were particularly concerned about the political risk posed by a putatively global tide of “resource nationalism,” that was said to be a response to a prolonged mining and metals commodity price boom (or supercycle). The central risk preoccupying explorers, investors, and analysts during this time was the risk of contract review (Gilbert 2020), and the possibility that mining companies may be asked to pay higher royalty and taxation rates on the revenue that their assets produced in response to the commodity price boom. While the putative threat of resource nationalism encouraged some analysts and investors to heavily discount the net present value of their mineral assets, the resource nationalism narrative, in tandem with the capitalization devices used to value and optimize mine plans, has the effect of justifying rapid extraction of a mineral resource, regardless of the consequences for host communities and states.

Finally, I focus on the legal foundations which make the *promise* of capitalization feasible: capitalization devices that render mineral deposits value in terms of their earning potential, and a set of discourses according to which the “viability of all things resides, primarily, in the asset condition” (Muniesa et al. 2017, 52), are not in themselves sufficient to buttress the operations of mineral exploration firms seeking out new resource frontiers.

Investors must be able to point to durable legal configurations that provide confidence in their ability to realize contracted revenue streams in the future. Drawing briefly on a case study from Bangladesh, an emerging extractive industry frontier, I focus on the norms of international investment law and the protection afforded by investor-state arbitration tribunals to extractive industry firms who feel their “legitimate expectations” have been violated by acts of resource nationalism (which may include renegotiated royalty and taxation rates). The Bangladesh case study shows that the norms of investor-state arbitration allow not only mineral deposits but legitimate expectations themselves to be configured as assets. In the conclusion, I reflect on the implications of a highly contagious “capitalization syndrome” (Muniesa et al. 2017) for the ability of host states and communities to pursue alternative models of resource extraction.

Capitalization Devices: Real Options and Mineral Prospects

A concern with the economic ends to which mineral deposits might be put has long animated the discipline of geology (Braun 2000). Geologists are, however, frequently at pains to point out that a mineral deposit is not a resource if it cannot be “brought to book,” and that socio-political factors play as much of a part in transforming a mineral deposit into a valuable resource as geology itself (e.g., Edwards and Atkinson 1986; Njowa et al. 2014; Ténrière 2015). As Pete, an economic geologist (and officially recognized “Competent Person” authorized to sign off on the disclosures made by exploration firms seeking to list on London’s Alternative Investment Market) put it to me in early 2014: “A resource is made up of tonnage and political and economic factors.” As such, many geologists and mining analysts preempt through their practice the critique that Richardson and Weszkalnys (2014, 7–15) level at “capitalist forms of resource extraction” which allegedly cast resources as dead matter or inert substances in nature waiting to be discovered. It is certain that consulting economic geologists and mining analysts are aware of the painstaking calculative work and delicate political settlements that must be in place before a resource can be valued and made valuable. Bringing a mineral deposit to book means explicitly bringing it under the capitalizing gaze and coming to appreciate the deposit in terms of the discounted revenue streams it will produce. But this process of transforming invisible—and in the early phases of exploration, merely hypothesized—resources into

owned and tradable mineral deposits is first and foremost a techno-economic concern. The generation of contemporary extractive capitalism hinges on the successful deployment of a specific set of calculative practices: mineral deposit classification using specific geostatistical techniques and the valuation of variously classified mineral deposits through discounted cash flow (DCF) or real options (RO) capitalization models.

Here, I outline the technical procedures through which geological expertise is harnessed to the “release of value” (Buchanan 2016, 5) for mineral exploration firms and their investors. Of particular concern in this section is the use of net present value (NPV) calculations—derived either from DCF or RO analysis—to reformat pit plans, the planned life of a mine, and the cut-off grades beyond which extracting ore is not seen as viable. Conflicts arise when the capitalizing gaze—and the maximization of NPV—is prioritized over socio-political and environmental concerns around a given mine site.

To capitalize upon a mineral deposit and turn it into an asset that is valued in terms of discounted future cash flows, an exploration firm must first carry out drilling operations on their mineral property (which will require some form of prospecting or exploration license, depending on the jurisdiction). The samples extracted from the drill-cores are used to map strata and ore grade. Using geostatistical techniques introduced by South African mining engineers in the mid-twentieth century and refined at the *École des Mines* and Royal School of Mines, a resource block model is developed, where drilling samples are used to estimate the grades within given blocks. The key geostatistical innovation which enables reliable resource block models to be generated—and which underpins the valuation techniques outlined below—is known as kriging, after Danie Krige, a South African engineer whose master’s thesis (Krige 1951) introduced a series of refinements to the then-standard practice in the Witwatersrand of determining whether or not it would pay to mine a sampled block (or “selective mining unit”) by simply calculating the arithmetic mean of the ore grade recorded across a series of samples. Noting the possible presence of high-grade values in a low-grade block of ore, Krige developed a method for explaining variation in samples in terms of a correlation derived from mapping the distance between each sample in a given block.

For contemporary mining engineers and geostatisticians, determining whether it is economic to mine a given block—or what the ore/waste ratio will be in a given block—remains a primary concern (Assibey-Bonsu and

Krige 1999; Rossi and Deutsch 2013). Since the determination of whether it pays to mine a given block is not based on geostatistical modeling alone but also on a set of economic considerations and forecasts, there is a dynamic relationship between the valuation of a mineral asset and the application of geostatistical techniques to generate information about largely invisible mineral deposits. Indeed, the determination of cut-off grades, the levels at which it is economic to mine a given block, changes as mining proceeds and new information emerges (Peattie and Dimitrakopoulos 2013); this aspect of the mining process appears to have rendered mineral assets especially well-suited to RO-based valuation (see below). Confidence intervals around drill-core samples and geostatistical models of resource blocks also have implications for the classification of deposits under various financial reporting or disclosure codes. As such, it is not unheard of among mining analysts in the City of London for small exploration firms to simply flip mineral properties by carrying out some additional drilling, increasing the statistical likelihood that their deposit is a high-quality resource, and so elevating the mineral asset's NPV. As the convener of the Mining for Bankers training courses at Imperial College puts it, there is "a direct correlation between expenditure on drilling and enhancing the valuation of the project" (Buchanan 2016, 125).

The principal codes through which drilling data is translated into estimates of value (and ultimately NPV) are the Australian Joint Ore Reserves Committee (JORC) reporting code and Canadian NI 43-101 mineral disclosure code. The JORC code, inaugurated in the late 1980s, standardized the criteria for reporting measured, possible, probable, and ore in sight mineral deposits. The NI 43-101 code was introduced by the Canadian Securities Administrators as a direct response to the Bre-X scandal, which involved a speculative bubble built up around a Canadian exploration firm which had fraudulently reported on a 70- to 200-million-ounce gold find in Indonesia (see Tsing 2001). The NI 43-101 code requires that mineral prospects are reported as either resources (broken down by increasing degree of confidence into inferred, indicated, and measured) and reserves (broken down into probable and proven). Due to the legal requirement that the code be used by exploration firms seeking to list on Toronto's TSX-V (home to the largest number of exploration firms in the world), and its use as a de facto standard on the London Stock Exchange and its Alternative Investment Market, the code works as a translation device which reformats drilling

data and geostatistical models into estimates of a resource's viability that can be capitalized upon. As to what transforms speculative resources into asset-like reserves, the TSX-V is clear: the provision of infrastructure, initial test-mining, and "legal, environmental, social and governmental factors" (Ténière 2015, 37).

Evidently, turning mineral deposits into assets does not only rely upon geostatistical calculation. Resource or reserve estimates are but one input for the capitalization devices (Doganova and Muniesa 2015) through which mineral deposits come to be valued for their earning power. Also of concern are mineral price forecasts, the costs and availability of infrastructure, the acquisition of appropriate permits, the "social license to operate" and the presence of "political risk." The latter two factors, being less amenable to quantification, are folded into the capitalization calculation through the discount rate (see next section). There is also dispute among mineral economists working as consultants in the extractive industries over the appropriate form of capitalization device to deploy: discounted cash flow (DCF) or real options (RO) models. While some influential mineral economists (Buchanan 2016, 9–34) favor the DCF method, others reject it on the grounds that it utilizes a *single* discount rate, applied to all future cash flows, in order to facilitate a "now or never" analysis of the attractiveness of an asset. To its critics, DCF modeling is not capable of accounting for geological risk or the wide range of uncertainties faced by mineral assets exposed to price, labor, taxation, and royalty rate alterations—but RO analysis is (Samis et al. 2006).

RO analysis, introduced as a tool for making capital allocation decisions by Stewart Myers in the late 1970s and adopted more widely by financial analysts in the late 1990s, allows managers to capitalize on emerging opportunities in a way that DCF—which involves a constant discount factor and a cash flow structure known at the outset—does not (Schulmerich 2010). Although mining executives and analysts were originally slow to adopt RO analysis and many junior miners continue to make decisions based on DCF (Ajak et al. 2018), mining investments do appear particularly amenable to RO analysis—or analysis as if they were a series of financial options contracts. Mining investments are largely irreversible and proceed as a series of options: purchasing a property and a license gives the option to explore, exploration gives the option to develop, and development of a mineral prospect gives the option to extract (Slade 2001). Analyzing them as such allows for decision makers to react to changing market conditions

and exercise a series of options, should cost and profit considerations require that this be done (see Schulmerich 2010, 24). These options could include the option to alter cut-off grades, to alter the pathway of progression through a planned pit, or even closing and reopening a mine in response to changing mineral commodity prices and their effect on cut-off grades (Ajak et al. 2018).

RO analysis thus allows each individual source of cash flow (or cost) to be discounted for uncertainty individually. As a result, the likely effects on future cash flow of price rises (or falls), labor cost changes, and the possibility of encountering particularly low (or high) quality ore in a given year can be accounted for. One significant result of the application of RO analysis to mineral asset valuation is the emergence of pit optimization models, which use price forecasts to determine cut-off grades—and thus the organization of a pit, the life of a mine, and the required flexibility of a mine workforce (Asad and Dimitrakopoulos 2012; Dimitrakopoulos et al. 2002; Evatt et al. 2011). Pit optimization models predate the use of RO analysis in mineral economics. Building on the geostatistical block models outlined above, pit optimization consultancies expanded rapidly in the early 1990s when computational advances allowed the easy calculation of an optimal pit outline (Whittle 1990). Optimal pit outlines could be determined as the point at which the value of ore in a given series of blocks (available ore multiplied by ore value), minus the cost of waste removal for those blocks, was maximal. While early pit optimization models used DCF approaches to calculate the dollar value of each feasible pit outline (Whittle 1990, 471), it is perhaps unsurprising that pit optimization has been married to RO analysis since its dissemination among financial analysts in the late 1990s. Not only does information about ore grade itself change as mining proceeds and provides more data points for geostatistical block models, but the scheduling of pit outlines with a view to maximizing a mineral's asset value must by necessity respond to a series of contingencies, from commodity price changes to labor costs, and taxation or royalty rates.

If not explicitly performative, pit optimization models certainly have the capacity to “format” the relationship between extractive industries and host polities (cf. Crosby and Hennebery 2016, 1435). Indeed, as Bowman and Moskowitz (2001) show, the use of RO-based valuation has encouraged executives to take a more experimental approach, and consider proposed capital allocation decisions as a series of options. Below, I illustrate the potential for conflicts to arise when the asset logic of RO models produces

recommendations for mine length, cut-off grades, and mine planning that are subordinated to, and arise from, the desire to maximize NPV. To do so, I draw on ethnographic material from seminars run for mining analysts and executives between 2013 and 2015 by a pit optimization modeling company, which I will call ExtractCo.

The modelers at ExtractCo, having convinced heavyweight natural resource fund managers in the City of London to use their RO-based optimization approach to assess possible investments, were now seeking out mining analysts, managers and investors to convert to their approach. As one of their executives put it at a 2014 briefing, “There is a disconnect between what mining investors want and what miners want. Bankers want the ‘magic number,’ the NPV. Miners don’t, they want ounces.” For ExtractCo, seeking to persuade others to use their models, mining executives and analysts are too concerned with proxies for productivity like ounces and tonnage of ore, mine length, and the cost of leaving equipment idle—without thinking sufficiently about time. In an effort to convince analysts and executives attending a 2013 training session of the infallibility of the capitalizing gaze, one ExtractCo modeler emphasized the importance of flexible labor and equipment management in order to deal with a brief dip in ore grades as mining might progress through a particular layer: “Don’t buy the trucks, hire them. When you don’t need them, let them go. You pay extra, but it’s going to reduce operating expenditure over ten years.”

As discussion turned to a then high-profile (now amended) plan for a “jobless” automated mine on South Africa’s platinum belt, some analysts and brokers in attendance expressed concern that this would be viewed as hostile and alienating, given the character of labor politics in the region. The ExtractCo modeler jovially responded that they knew what the optimizer would say: less employment means less cost, means higher NPV—to less than universal approval from the audience. A follow-up question was then asked by a prominent mining broker about the model’s capacity to deal with environmental liability, since “only going for the high grade and throwing away the rest of the rock [in an effort to maximize NPV] makes a nasty stockpile.” The response from ExtractCo reveals a great deal about the temporal politics of the asset condition:

Well, “nasty” stockpile, I don’t look at it as “nasty”—it’s *money*. Environmental restoration is a cost, so is CSR [Corporate Social Responsibility]. If you’ve got to move a village, if the pit is under a village—and it usually is—the CSR has to be

paid for, so you have to find cash to move the village. If you have cash, you can do CSR and sustainability, *and* give to shareholders. So get the cash first! Recently an African mining minister said to me, “We want *long term*.” We said, “Wait a minute, you got a depleting resource, your roads don’t work, hospitals don’t work, there is high AIDS—do you want that now or in five to ten years? I think now!” Whether it gets there or not [laughter]—you can’t model corruption! So make as much as you can now and *then* invest in CSR or sustainability.

To most in attendance, this was a relatively satisfactory response. The flip-pant regard shown for generic African mining ministers aside, ExtractCo’s response reveals the capitalizing gaze according to which the viability of all things lies in the asset condition (Muniesa et al. 2017). But it also points toward the social, environmental, and distributional conflicts over the course of resource developments that are themselves formatted (and exacerbated) by capitalization devices that place a discount on political uncertainty (see Gilbert 2020), and send their devotees a clear message: cash first, politics later. I return to the temporal politics that surround the distribution of mineral wealth in the conclusion. Next, however, I introduce the discourse of resource nationalism which worked in tandem with capitalization devices and calculations of cut-off grades to present any attempt to raise royalty and taxation rates as harmful to *everyone* implicated in the future of a mineral asset, host communities and states included.

Narrative Plots: Political Risk, Resource Nationalism, and the Supercycle

Turning things into assets rests not only on calculative capitalization devices. It also relies on the operation of a capitalizing gaze that is activated and sustained by a particular narrative plot, according to which valuing objects in terms of their earning capacity becomes sensible (Muniesa et al. 2017). Previously, I outlined the mineral reporting codes, geostatistical methods, and real options (RO) analyses through which mineral deposits come to occupy the asset condition. For a mineral deposit to become a capitalized mineral reserve, valued in terms of its earning potential, certain legal, environmental, social, and governmental factors also need to be in place. Turning a mineral deposit into asset requires convincing investors that these revenue streams will be stable and securely contracted, and that a prospective project still produces a positive NPV even when discounted for political risk.

Between 2012 and 2014, as mineral exploration firms and investors in the City of London sought new extractive opportunities in what one fund manager termed the “farther reaches” (see Gilbert 2019), analysts were particularly concerned about the political risk posed by resource nationalism and its apparent relationship with a commodity price supercycle. The mining market’s conception of resource nationalism is expansive, but analysts typically saw the risk of contract review (including renegotiation of taxation and royalty rates) as the preeminent political risk. In other words, political risks are those that interrupt the certainty that an asset’s capitalized earning capacity will hold forth on its promise. Here, I outline the contours of the resource nationalism narrative prominent in the City of London during 2012–2014. I examine the way that the asset condition itself is used as grounds to challenge a diverse set of regulatory measures (including tighter environmental codes, and raised royalty and taxation rates) as aggressive resource nationalism. Higher taxation and higher royalty rates have the effect of raising costs and raising the cut-off grade in mining projects that have been planned with the RO analysis and pit optimization techniques discussed above.

In their survey of executives’ and investors’ concerns for 2012–2013, Ernst & Young (2012, 7–14) identified resource nationalism as a key political risk facing mining and metals exploration firms. Their conception of resource nationalism was expansive, incorporating moratoria on investment licenses (Mongolia), plans to tax coal based on market prices rather than volume (China), enforcement of higher royalty payments by an anti-corruption commission (Indonesia), as well as moves to legalize nationalization of mineral assets (South Africa) (see Ernst & Young 2014). This all-encompassing approach to classifying nonbeneficial regulatory acts as resource nationalism was shared by many analysts in the City of London, as well as by international investment lawyers providing advisory services to exploration firms (see Gilbert 2020).

Analysts, investors, and prominent political risk consultants like Ian Bremmer also shared an understanding of resource nationalism as a *global* phenomenon linked to an upswing (or supercycle) in commodities prices, and a desire for resource-rich states to secure a greater share of ‘rent’ for themselves—even if local “social or political upheaval” conditioned the particular form taken by that resource nationalism (Bremmer and Johnston 2009, 151; see also Gayi and Nkurunziza 2017). Resource nationalism itself

is thus depicted as cyclical by many consulting mineral economists, seen to arise in response to long-term economic fluctuations (e.g., Joffé et al. 2009). The notion that the metals and mineral price boom beginning in the late 2000s was a supercycle rather than a normal business cycle is often credited to a Citigroup note (Heap 2005) which attributes the price boom to demand from a growing China. What makes it a putative supercycle is the increasing cost of exploration that prevents the increased capital investment required to restore a putative economic balance (cf. Radetzki 2013, 86)—hence the search for new frontier jurisdictions in the “farther reaches” of mining investors’ geographical imaginations.

Because the time from exploration to exploitation may be two decades or more, the renegotiation of taxation and royalty rates up from levels agreed with host governments prior to the supercycle was the primary source of political risk in most resource nationalism narratives (Cuddington and Jerret 2008). The mining market’s attention was thus captured throughout 2012–2014 by various reports that claimed to announce the end, peak, or persistence of what analysts depicted as anything from a ten-year to thirty-five-year supercycle.⁵ During this period, the resource nationalism narrative was fundamental to the activation of the capitalizing gaze. Rumors that the supercycle was about to end could provide a powerful negotiating position for exploration firms, as one editor of industry news source *mining.com* put it: “Executives have the power to cherry pick which combination of country and project offers the best returns. ... The threat of a cancellation—or long delays—could be a powerful incentive for politicians to offer better terms to companies, executives mutter” (Els 2012).

Challenges to the royalty and taxation rate increases proposed or implemented by a range of resource-rich countries were aided by claims that the supercycle, as a historically unusual fluctuation, was a deviation from the normal, lower prices on which explorers and investors hoped to base tax and royalty calculations. This narrative was put to me explicitly by Colin, a geologist-turned-executive who had established a number of exploration firms in Latin America, the Middle East, and North Africa (as well as consulting on mineral code reform for the World Bank in several of those same jurisdictions). After meeting in 2013 at an event hosted by a professional society for economic geologists (all geologists who sign off on the resource or reserve estimates of listing companies must have professional recognition), Colin invited me to his serviced offices in Mayfair, and subsequently

to a Pall Mall club at which he was a member, to explain resource nationalism and the supercycle.

At one of our meetings, Colin related how during the 1990s, “London was the fountain of all knowledge on privatization. All countries were realizing government should never be involved in business. I mean, look at Venezuela!” This treatment of any putative acts of resource nationalism as evidence that a jurisdiction was lined up to be the next Venezuela was a common refrain among analysts during 2012–2014. (see Bremmer and Johnston 2009). Colin then reached for a sheet of paper and began to draw. First, he sketched the axes of a graph, and then a flat horizontal line: the expected annual revenue a mine would produce over its life. Then he superimposed a large parabolic curve toward the end of the time series on the graph. “You see, the private sector brings the cost down. Then the price [of the mineral] goes up, and the government says, ‘Wait a minute, you’re making a lot of money, and we want to take this off you. Oh well, we will nationalize you.’ And of course, it doesn’t work, because their objective is to make jobs, and there is no reinvestment. In twenty years, you have to privatize again.” As crude as this narrative—of which Colin’s rendering is not atypical—may be, it plays an important role in the capitalization process. It is brought into relation with the capitalization devices discussed above primarily through references to cut-off grades.

As noted above, real options (RO) approaches allow for mine plans (including the length of mine, flexibility of labor, and environmental impacts) to be manipulated such that the net present value (NPV) of a mineral asset is maximized, thereby formatting relationships between the extractive industries and host communities through the capitalization device. Mineral prices are, obviously, one of the many sources of revenue that can be discounted and incorporated into RO calculations, with higher prices (alongside the costs of extraction and processing) affecting cut-off grades, and the desirability of maintaining stockpiles to be processed at a later date, in mine plans optimized for NPV (Abubakary et al. 2015; Asad et al. 2016). In an email exchange that took place in 2013 with Simon, an influential mineral economist and consulting geologist in the City of London, I asked about the impact of the supercycle on mineral exploration. The response was that “high government royalties, as advocated by IFC/World Bank, are highly counterproductive, as they are simply costs. They effectively raise cut-off grades, and hence reduce the effective exploitation

of, and long-term economic benefit for the host from, the mineral deposit (shorter life, effect on community, etc.).”

The extent to which the World Bank Group advocates higher royalties is certainly subject to contestation, and some brokers and analysts describe the political risk guarantees and co-financing provided by the IFC as a saving grace when attempting to develop projects in high-taxation jurisdictions.⁶ However, the email exchange cited above reveals the extent to which the resource nationalism narrative works together with the capitalization device of RO-based mine optimization to challenge the diverse attempts that host jurisdictions make to renegotiate royalty rates. By treating mineral deposits as assets valued for their capacity to produce future revenue, royalty and taxation rates appear necessarily as costs, curtailing the life of a mine, necessitating rapid extraction and potentially undermining host communities’ attempts to build themselves a durable economic future.⁷ Similarly, assimilating all attempts to renegotiate royalty and taxation rates to an unprecedented supercycle works rhetorically such that it is “through emphasis on excess that the normal is able to emerge” (De Goede 2005, 81). Effectively, the resource nationalism/supercycle narrative allows a range of public policy decisions in diverse resource-rich jurisdictions to be treated as deviations that impede upon the legitimate expectations of those who would transform mineral deposits into assets.

In the final section, I review the relatively recent emergence of this notion of legitimate expectations, and its codification in international investment law. The norms of international investment law and investor-state arbitration that have emerged over the past four decades form the durable legal foundations that, in the final instance, allow for the assetization of legitimate expectations themselves.

Durable Foundations: Capitalizing on Legitimate Expectations

The resource nationalism/supercycle narrative has the effect of normalizing low royalty and taxation rates negotiated with resource-rich states at the bottom of commodity price cycles. But the cyclical temporality of this narrative, which attributes an internal logic to the oscillations of the market, rests on an erasure of the efforts that postcolonial states made to assert sovereignty over their natural resources during the mid-twentieth century. Equally, it naturalizes the curious and contested emergence of investors’ legitimate

expectations as a salient legal category that can itself come to inhabit the asset condition. Opposition to previously colonized resource-rich states being beholden to royalty and taxation regimes established by colonizing powers (who tended to treat domestic extractive industry corporations operating in the colonies favorably) was crystallized in the Third World jurists or Third World Approach to International Law (TWAAIL) movement in the 1970s and 1980s (Anghie 2007). The arguments put forward by these jurists—that it was entirely unjust for corporations to benefit from concessions or taxation rates agreed with pre-independence administrations when resource prices were historically low—is a direct inversion of the arguments put forward by analysts, mineral economists, and consulting geologists in the contemporary City of London. Where contemporary mining analysts and investors find their rhetorical purpose served by naturalizing *low* points in mineral price cycles, the reverse was true for the Third World jurists' project.

Permanent sovereignty over natural resources was touted as a response to the inequity of colonial concessions, that would allow for renegotiation of taxation and royalty rates—or implementation of a windfall tax—if resource prices boomed (Hossain 1983). Despite UN resolutions recognizing and declaring permanent sovereignty over natural resources during the 1960s and 1970s, the broader project to institute a New International Economic Order of which these efforts were a part crumbled during the 1980s (Bair 2003). At the same time, bilateral investment treaties (BITs), which provided for arbitration between host states (as one party to the treaty) and foreign corporations (domiciled in the state that forms the other party), proliferated, and the number of investor-state arbitrations taking place in the World Bank's International Court for the Settlement of Investment Disputes (ICSID) skyrocketed (Parra 2012). BITs, according to their advocates, provide the confidence required by foreign investors in capital exporting countries, and are thus putatively beneficial to the populace of capital importing countries. Layers operating in the TWAAIL tradition, however, view BITs as sustaining an imperial system of investment law, according to which transnational corporations' freedom to contract is given priority over the rights of postcolonial nations, who may be sued for legislative decisions taken in the public interest, or attempts to exert sovereignty over their natural resources (Anghie 2007; Gilbert 2018; Sornarajah 2016).

As more and more investor-state arbitral decisions have been made public, a number of prominent critics have voiced their concern about

the expansive interpretation of terms like expropriation, investment, and legitimate expectations (e.g., Prieto-Rios 2015). Of particular concern to critics of international investment law is the extent to which investors may be compensated for loss of future revenue based on the treatment of a regulatory decision as an act of “creeping expropriation.” I now want to review the debates that have taken place among scholar-practitioners who work as lawyers or valuation consultants in investor-state arbitrations, regarding the appropriate standards for valuing and compensating for a violation of legitimate expectations. I do this in order to show that a discourse of resource nationalism parallel to that outlined above enables the treatment of legitimate expectations as an asset, such that compensation can be offered for the loss of earnings that might be expected in a favorable investment climate.

In a recent review of the notion of indirect expropriation, international arbitrator Mark Kantor adopts the definition included in the US’s Model Bilateral Investment Treaty, whereby indirect expropriation is “the extent to which the government action interferes with distinct, reasonable investment-backed decisions” (Kantor 2015, 173). Other scholar-practitioners define legitimate expectations as the entitlement to protection from harm caused by the retraction of a publicly taken position by an authority, or locate legitimate expectations in the rule of law and the putative necessity for individuals to be able to foresee the consequences of their actions in order to carry out rational capitalist enterprise (Potesta 2013, 7; Schultz 2015; cf. Smith 2011). A particularly troubling area for many arbitral lawyers is the emergent concept of creeping regulatory expropriation whereby no single act constitutes expropriation, but apparently “expropriatory” taxation rates may do so (Kantor 2015, 179). It is precisely the malleable nature of the concept of legitimate expectations that means it has become tribunals’ “preferred way of providing protection to claimants in situations where the tests for ‘regulatory taking’ appear to difficult, complex and too easily assailable” (Potesta 2013, 7). It is perhaps unsurprising that City of London lawyers advising on mineral exploration frequently warned against creeping expropriation as an aspect of resource nationalism. Such creeping expropriation—or impingement on legitimate expectations—could, extractive industry lawyers argued, begin with stringent environmental regulations or the kinds of windfall tax promoted by Third World jurists (see Gilbert 2020).

If a corporation successfully sues a resource nationalist state in an arbitral court for violating its legitimate expectations or for creeping expropriation,

compensation may be paid. Compensation for the violation of legitimate expectations rests upon the habit of capitalization but is fraught with difficulty. For instance, if legitimate expectations are violated by a resource nationalist government, how should political risk be incorporated into the valuation of the mineral asset that has been expropriated (and the future earnings that have been lost)? Should firms have already discounted their expected cash flows for a high level of political risk, perhaps as measured by the International Country Risk Guide (Chinen 2016)? Or can (retrospectively) mistaken calculations of NPV based on a *lower* political risk environment be upheld (Joffé et al. 2009; Kantor 2009)? The speculative nature of compensation for expropriation and violation of legitimate expectations continues to trouble arbitrators, and several attempts have been made to develop more rigorous or scientific standards for compensation calculation (Pan 2014; Simmons 2012).⁸

The challenges posed by terms like legitimate expectations and definitions of creeping expropriation exceed these questions of how to refine capitalization devices used in compensation calculations. It is the same narratives about resource nationalism outlined above, and the treatment of supercycles as deviations from normal price levels (thus erasing attempts by Third World jurists to treat light-touch taxation and royalty regimes as the product of artificially low prices) which renders the assetization of mineral deposits durable. Host states' attempts to present their natural resources as destroyed or expropriated national assets have typically failed—a recent attempt is exemplified by Bangladesh suing Canadian exploration firm Niko at ICSID for the future value of gas lost in a blowout putatively due to negligence (see Gilbert 2017). After blowouts took place at one of Niko's concessions in the Chhatak district during 2005, the government of Bangladesh filed suit against them in 2008, demanding compensation for destroyed national assets, and the effective incineration of a portion of the nation's energy future. The legality of the Niko concession had in fact been challenged in court in 2005 by the Bangladesh Environmental Lawyers' Association (BELA) who argued that incorrect classification of the Chhatak field (as a "marginal" resource rather than "abandoned" reserve) had resulted in undue calculation of this asset's earning capacity (and so an excessively lenient royalty and taxation regime). In both cases, the government and BELA invoked Bangladesh's sovereignty over natural resources (enshrined in the constitution), giving credence to Sornarajah's (2016, 1976) claim that the Third World jurists project has not been entirely overwritten.

While attempts to sue resource extraction firms for the destruction of national assets and the erosion of national energy futures have been unsuccessful, attempts by firms like Niko to sue host states for payments withheld as a result of environmental damage they may themselves be liable for have been upheld by ICSID.⁹ The extent to which the legitimate expectations of resource extraction firms themselves become assets, underwritten by the durable legal foundations of international investment law, is made even more explicit by yet another ICSID arbitration to which Bangladesh has been party. In the *Saipem v. Bangladesh* (2007) arbitration, arbitrators ruled that the refusal of the Bangladeshi government to pay compensation to a gas company (Saipem) whose project was interrupted by local opposition was itself an act of expropriation. Saipem's legitimate expectations that their capitalized earnings would materialize were buttressed by the conventions of international arbitration despite Bangladeshi courts ruling that they were not eligible for compensation (see Goldhaber 2013). In the final instance, the expectation that future cash flows will materialize, unimpeded by putative acts of resource nationalism and regulatory expropriation, is enabled by norms of international investment law that allow legitimate expectations themselves to be treated as revenue-generating assets.

Conclusion

In this chapter, I have argued that attending to the techno-economic rituals of capitalization allows for an ethnographic perspective that connects political contestation over socio-technical devices to the broader social realities that they configure on a range of awkward geographical scales. The capitalization devices which translate real options valuation of mineral deposits to mine plan optimization models have clear political effects. In the pursuit of the "magic number," NPV, they format labor relations, environmental hazards, and the temporal distribution of revenue among mine-area communities and host states. Several anthropologists have called attention to the disruptive temporal politics that ensue when extractive industry firms attempt to transform mineral deposits into cash up front and do politics later. The ability for mine-area communities to build durable futures is rapidly undermined—just as it is when mine closure plans are constantly deferred when changes to commodity price forecasts alter cut-off grades and render previously worthless blocks valuable (see Gilbert 2012; Gilberthorpe 2008; Kirsch 2014).

I have also argued, after Muniesa et al. (2017), for the significance of discursive formations and narrative plots in sustaining and nourishing the rituals of capitalization. Du Castel and Anseeuw (2017) and Visser (2017) have called attention to the discursive dimensions of land assetization: investors must be convinced of the stability (and scarcity) of land for it to become an asset valued in terms of the revenue it is expected to produce. Similarly, investors in mineral exploration must be convinced of the stability of the contractual arrangements that help to transform mineral deposits into assets, and the absence of political risks including resource nationalism. Any increase in royalty and taxation rates is assimilated to a discourse of resource nationalism, and presented as deviant behavior that simply responds to a rare and artificial mining price supercycle. As I have shown, resource nationalism narratives can be paired with the capitalization device to argue that increasing royalty and taxation rates is *bad* for host communities and states. Real options valuation and pit optimization models can be used to undergird a rhetorical ploy whereby increasing royalty and taxation rates is seen to force miners to shorten the life of a mine—in contravention of technocratic guidelines for the long-term management of resource revenue by states in the Global South (Humphreys et al. 2007).

To this extent, the capitalization device wrests efforts to determine the optimal rate of resource extraction away from indigenous communities (Kirsch 2014), social movements, and social-democratic states (McNeish and Logan 2012). But it would be a mistake to locate the politics of mineral assets in terms of calculative or capitalization devices alone. The “capitalization syndrome” outlined by Muniesa et al. (2017) is able to exert its influence on mineral exploration—and conflicts between mineral extraction companies and host states or communities—in large part because of the durable legal foundations through which the promise of future revenue streams is made to appear feasible. It is the norms of international arbitration, together with the discourse of resource nationalism and political risk, that allow mineral exploration firms and their investors to capitalize on legitimate expectations. It is the putative legitimacy of these expectations that must be punctured if host communities and states are to regain control of the temporal politics of mineral asset management.

Notes

1. Ferry (2005) situates her work in relation to Nancy Munn's (1977) approach to value transformation, on which Appadurai (1986) also drew.
2. On the idea of a "world" price (for cotton), and the many transformations and derivations through which it is produced, see Çalışkan (2010).
3. It is certainly true that "capital" and "capitalism" can figure as a causal or explanatory force that is prominent and yet analytically absent—or at least under-theorized—in much anthropological work on mineral extraction (e.g., Sawyer 2002; also Smith 2011; Walsh 2004). This is not to say that anthropologists are guilty of the totalizing abandonments of agency toward which Callon and Beunza direct their critiques. For instance, James Ferguson's (2005, 379) observation that capital does not "flow" from financial centers to distant sites of extraction, but "hops" between appropriately configured "mineral-extraction enclaves" has been highly influential (e.g., Gardner 2012; Welker 2014).
4. By measuring a rising capital share of income and "non-negative rate of differential accumulation by the dominant capital group" (Park and Doucette 2016, 547).
5. The following examples are all drawn from www.mining.com, a leading industry news site: Anthony Hallie, March 7, 2013, "Commodities 'supercycle' will last another 15 years: JP Morgan"—a view taken on the basis that India will need to build 900 million square meters of residential and commercial space and 400 kilometers of subway annually to account for fifteen forecasted years of urbanization (<http://www.mining.com/commodities-supercycle-will-last-another-15-years-jp-morgan-85593/>); Cecilia Jasmamie, May 12, 2013, "Commodity supercycle is essentially over: Citigroup"—a claim based on growth slowing in China (<http://www.mining.com/commodity-supercycle-is-essentially-over-citigroup-73028/>); Anna Komnencic, September 26, 2013, "Rumours of supercycle's death are greatly exaggerated: McKinsey"—based on the idea that future demand from China and, intriguingly, the potential future incorporation of environmental costs into metal prices (<http://www.mining.com/rumours-of-the-supercycles-death-are-greatly-exaggerated-mckinsey-48435/>).
6. One broker based in a prominent City of London mining investment and advisory firm (interviewed in 2012) explained resource nationalism to me in terms of the difference between Burkina Faso with 25 percent taxation and 2 percent royalty, and Ethiopia with "something like 35 percent and 8 percent." In the case of the latter it is "just *impossible*, unless you bring in the World Bank and the IFC. They look after the projects."
7. Though the assessment of who benefits from rapid extraction made by Simon and the ExtracCo modelers may differ, they do share the same commitment to the capitalizing gaze. For an analysis of the impact of royalties on cut-off grades where

royalties are treated as costs (but taxation is not, because cut-off grades are determined on the basis of pre-tax profits) see Lilford (2017).

8. It should be noted that most discussions of valuation in relation to the protection of legitimate expectations do in fact use DCF models, rather than Real Options analysis—perhaps surprising given the focus of Real Options analysis on the ability to respond to emerging contingencies.

9. See the ICSID cases ARB/10/11 and ARB/10/18.

References

- Abubakary, S., Nehring, M., and Greberg, J. 2015. Evaluation of the Impact of Commodity Price Change on Mine Plan of Underground Mining. *International Journal of Mining Science and Technology* 25 (3): 375–382.
- Ajak, A. D., Lilford, E., and Topal, E. 2018. Valuing the Unknown: Could the Real Options Have Redeemed the Ailing Western Australian Junior Iron Ore Operations in 2013–2016 Iron Price Crash? *International Journal of Mining, Reclamation and Environment* 33 (8): 1–24.
- Anghie, A. 2007. *Imperialism, Sovereignty and the Making of International Law*. Cambridge: Cambridge University Press.
- Appadurai, A. 1986. Introduction: Commodities and the Politics of Value. In *The Social Life of Things: Commodities in Cultural Perspective*, edited by Arjun Appadurai, 3–63. Cambridge: Cambridge University Press.
- Asad, M., and Dimitrakopoulos, R. 2012. Optimal Production Scale of Open Pit Mining Operations with Uncertain Metal Supply and Long-Term Stockpiles. *Resources Policy* 37 (March): 81–89.
- Asad, M., Qureshi, M., and Hyongdoo, J. 2016. A Review of Cut-Off Grade Policy Models for Open Pit Mining Operations. *Resources Policy* 49 (September): 142–152.
- Assibey-Bonsu, W., and Krige, D. 1999. Practical Problems in the Estimate of Recoverable Reserves When Using Kriging or Simulation Techniques. *International Symposium on Geostatistical Simulation in Mining*, Perth Australia, October.
- Bair, J. 2003. Taking Aim at the New International Economic Order. In *The Road from Mont Pélerin: The Making of the Neoliberal Thought Collective*, edited by P. Mirowski and D. Plehwe, 347–385. Cambridge, MA: Harvard University Press.
- Barry, A., and Slater, D. 2002. Technology, Politics and the Market: An Interview with Michel Callon. *Economy and Society* 31 (2): 285–306.
- Beunza, D. 2010. Political Economists Denounce Social Studies of Finance for Overlooking the Political, <https://socfinance.wordpress.com/2010/05/21/political-economists-denounce-social-studies-of-finance-for-overlooking-the-political/>.

- Beunza, D., and Garud, R. 2007. Calculators, Lemmings or Frame-Makers? The Intermediary Role of Securities Analysts. *Sociological Review* 55 (S2): 13–39.
- Beunza, D., Hardie, I., and MacKenzie, D. 2006. A Price Is a Social Thing: Towards a Material Sociology of Arbitrage. *Organization Studies* 27 (5): 721–745.
- Bowman, E., and Moskowitz, G. 2001. Real Options Analysis and Strategic Decision Making. *Organization Science* 12 (6): 772–777.
- Braun, B. 2000. Producing Vertical Territory: Geology and Governmentality in Late Victorian Canada. *Ecumene* 7 (1): 7–46.
- Bremmer, I., and Johnston, I. 2009. The Rise and Fall of Resource Nationalism. *Survival* 51 (2): 149–158.
- Buchanan, D. 2016. *Metals and Energy Finance: Advanced Textbook on the Evaluation of Mineral and Energy Projects*. London: Imperial College Press.
- Çalışkan, K. 2010. *Market Threads: How Cotton Farmers and Traders Create a Global Commodity*. Princeton, NJ: Princeton University Press.
- Callon, M. 1998. Introduction: The Embeddedness of Economic Markets in Economics. *Sociological Review* 46 (S1): 1–57.
- Callon, M. 2005. Why Virtualism Paves the Way to Political Impotence: A Reply to Daniel Miller's Critique of *The Laws of the Market*. *Economic Sociology* 6 (2): 3–20.
- Callon, M., and Latour, B. 1997. Tu ne calculeras pas!—ou comment symétriser le done et le capital. *Revue du MAUSS* 9: 45–70.
- Callon, M., Méadel, C., and Rabeharisoa, V. 2002. The Economy of Qualities. *Economy and Society* 31 (2): 194–217.
- Callon, M., and Muniesa, F. 2005. Economic Markets as Calculative Collective Devices. *Organization Studies* 26 (8) 1229–1250.
- Chinen, M. 2016. The Standard of Compensation for Takings. *Minnesota Journal of International Law* 25 (2): 335–380.
- Comaroff, J., and Comaroff, J. 2003. Ethnography of an Awkward Scale: Postcolonial Anthropology and the Violence of Abstraction. *Ethnography* 4 (2): 147–179.
- Coombs, N. 2016. What's an Algorithm? Financial Regulation in the Era of High-Frequency Trading. *Economy and Society* 45 (2): 278–301.
- Crosby, N., and Hennebery, J. 2016. Financialization, the Valuation of Investment Property and the Urban Built Environment in the UK. *Urban Studies* 53 (7): 1424–1441.
- Cuddington, J., and Jerett, D. 2008. Super Cycles in Real Metals Prices? *IMF Staff Papers* 55 (4): 541–565.

De Goede, M. 2005. *Virtue, Fortune, and Faith: A Genealogy of Finance*. Minneapolis: University of Minnesota Press.

Dimitrakopoulos, R., Farrelly, C., and Godoy, M. 2002. Moving Forward from Traditional Optimization: Grade Uncertainty and Risk Effects in Open-Pit Design. *Transactions of the Institution of Mining and Metallurgy*, 111 (1): 82–88.

Doganova, L., and Muniesa, F. 2015 Capitalization Devices: Business Models and the Renewal of Markets. In *Making Things Valuable*, edited by M. Kornberger, L. Justesen, A. K. Madsen, and J. Mouritsen, 109–125. Oxford: Oxford University Press.

Ducastel, A., and Anseeuw, W. 2017. Agriculture as an Asset Class: Reshaping the South African Farming Sector. *Agriculture and Human Values* 34 (1): 199–209.

Els, F. 2012. End of the Supercycle Is Also Spelling the End of Radical Resource Nationalism, <http://www.mining.com/end-of-the-supercycle-is-also-spelling-the-end-of-radical-resource-nationalism/>.

Ernst & Young. 2012. *Business Risks Facing Mining & Metals 2012–2013*. London: Ernst & Young.

Ernst & Young. 2014. *Mining & Metals—Resource Nationalism Update*. London: Ernst & Young.

Evatt, G., Johnson, P., Morarity, J., Duck, P., Howell, S., and Tonkin, C. 2011. The Resource Valuation and Optimisation Model—Real Impact from Real Options. *353rd APCOM Symposium, Wollongong*, September 30.

Ferguson, J. 2005. Seeing like an Oil Company: Space, Security and Global Capital in Neoliberal Africa. *American Anthropologist* 107 (3): 377–382.

Ferry, E. 2002. Inalienable Commodities: The Production and Circulation of Silver and Patrimony in a Mexican Mining Cooperative. *Cultural Anthropology* 17 (3): 331–358.

Ferry, E. 2005. Geologies of Power: Value Transformations and Mexican Mineral Specimens. *American Ethnologist* 32 (3): 420–436.

Froud, J., Moran, M., Milsson, A., and Williams, K. 2011. Opportunity Lost: Mystification, Elite Politics and Financial Reform in the UK. *Socialist Register* 47: 98–119.

Gardner, K. 2012. *Discordant Development: Global Capitalism and the Struggle for Connection in Bangladesh*. London: Pluto.

Gayi, S., and Nkurunziza, J. 2017. Trends in Minerals, Ores and Metals Prices. In *The Political Economy of Natural Resources and Development: From Neoliberalism to Resource Nationalism*, edited by P. Haslam and P. Heidrich, 35–52. London: Routledge.

Gilbert, P. 2012. The Development of Difference: Social Change around the Ok Tedi Copper and Gold Mine, Papua New Guinea. *Durham Anthropology Journal* 18 (1): 61–114.

Gilbert, P. 2017. Social Blowouts: Practicing Comparison and Locating Expertise in Bangladesh's Extractive Industries. *Paper Presented at the London School of Economics and Political Science, Department of Anthropology*, March 10.

Gilbert, P. 2018. Sovereignty and Tragedy in Contemporary Critiques of Investor-State Dispute Settlement. *London Review of International Law* 6 (2): 211–231.

Gilbert, P. 2020. Speculating on Sovereignty: “Money Mining” and Corporate Foreign Policy at the Extractive Industry Frontier. *Economy and Society* 1 (49), <https://doi.org/10.1080/03085147.2019.1690255>.

Gilberthorpe, E. 2014. The Money Rain Phenomenon: Papua New Guinea Oil and the Resource Curse. In *Natural Resource Extraction and Indigenous Livelihoods: Development Challenges in an Era of Globalization*, edited by E. Gilberthorpe and G. Hilson, 75–92. Farnham, UK: Ashgate.

Goldhaber, M. D. 2013. The Rise of Arbitral Power over Domestic Courts. *Stanford Journal of Complex Litigation* 1 (2): 373–416.

Hardie, I., and MacKenzie, D. 2007. Assembling an Economic Actor: The Agencement of a Hedge Fund. *Sociological Review* 55 (1): 57–80.

Heap, A. 2005. China—The Engine of a Commodities Super Cycle. *Citigroup Global Markets, Paper Presented at Mineral Economics and Management Society Annual Conference*, Washington, April.

Hossain, K. 1983. Introduction. In *Permanent Sovereignty over Natural Resources in International Law*, edited by K. Hossain and S. R. Chowdhury, ix–xx. London: Frances Pinter.

Humphreys, M., Sachs, J., and Stiglitz, J. 2007. Future Directions for the Management of Natural Resources. In *Escaping the Resource Curse*, edited by M. Humphreys, J. Sachs, and J. Stiglitz, 322–336. New York: Columbia University Press.

Joffé, G., Stevens, P., George, T., Lux, J., and Searle, C. 2009. Expropriation of Oil and Gas Investments: Historical, Legal and Economic Perspectives in a New Age of Resource Nationalism. *Journal of World Energy Law and Business* 2 (1): 3–23.

Kantor, M. 2009. New Age Compensation for Expropriation. *Journal of World Energy Law and Business* 2 (2): 155–162.

Kantor, M. 2015. Indirect Expropriation and Political Risk Insurance for Energy Projects. *Journal of World Energy Law and Business* 8 (2): 173–198.

Kirsch, S. 2014. *Mining Capitalism: The Relationship between Corporations and Their Critics*. Berkeley: University of California Press.

Knafo, S., Hughes, M., and Wyn-Jones, S. 2014. Differential Accumulation and the Political Economy of Power. In *The Capitalist Mode of Power: Critical Engagements with the Power Theory of Value*, edited by T. Di Muzio, 134–151. London: Routledge.

Krige, D. 1951. A Statistical Approach to Some Basic Mine Valuation Problems on the Witwatersrand. *Journal of the Chemical, Metallurgical and Mining Society of South Africa* 52 (6): 119–139.

Latour, B. 2005. *Reassembling the Social: An Introduction to Actor–Network–Theory*. Oxford: Oxford University Press.

Lenglet, M. 2011. Conflicting Codes and Codings. *Theory, Culture & Society* 28 (6): 44–66.

Lepinay, V., and Callon, M. 2009. Sketch of Derivations in Wall Street and Atlantic Africa. In *Accounting, Organizations and Institutions: Essays in Honour of Anthony Hopwood*, edited by C. Chapman, D. Cooper, and P. Miller, 259–289. Oxford: Oxford University Press.

Lilford, E. 2017. Quantitative Impacts of Royalties on Mineral Projects. *Resources Policy* 53: 369–377.

MacKenzie, D. 2001. Physics and Finance: S-Terms and Modern Finance as a Topic for Science Studies. *Science, Technology & Human Values* 26 (2): 115–144.

MacKenzie, D. 2007. The Material Production of Virtuality: Innovation, Cultural Geography and Facticity in Derivatives Markets. *Economy and Society* 36 (3): 355–376.

MacKenzie, D. 2009. *Material Markets: How Economic Agents Are Constructed*. Oxford: Oxford University Press.

MacKenzie, D., Beunza, D., Millo, Y., and Pardo-Guerra, J. 2012. Drilling through the Allegheny Mountains: Liquidity, Materiality and High-Frequency Trading. *Journal of Cultural Economy* 5 (3): 279–296.

MacKenzie, D., and Spears, T. 2014. The Formula that Killed Wall Street: The Gaussian Copula and Modelling Practices in Investment Banking. *Social Studies of Science* 44 (3): 393–417.

Mantz, J. 2008. Improvisational Economies: Coltan Production in the Eastern Congo. *Social Anthropology* 16 (1): 34–50.

Mbembé, A. 2003. Necropolitics. *Public Culture* 15 (1): 11–40.

Muniesa, F., Doganova, L., Ortiz, H., Pina-Stranger, Á., Paterson, F., Bourgoin, A., Ehrenstein, V., Juven, P., Pontille, D., Saraç-Lesavre, B., and Yon, G. 2017. *Capitalization: A Cultural Guide*. Paris: Mines Paris Tech,

Munn, N. 1977. The Spatiotemporal Transformations of Gawan Canoes. *Journal de la Société des Oceanistes* 33 (54/55): 39–53.

Nitzan, J. 1998. Differential Accumulation: Towards a New Political Economy of Capital. *Review of International Political Economy* 5 (2): 169–216.

- Nitzan, J., and Bichler, S. 2009. *Capital as Power: A Study of Order and Creorder*. London: Routledge.
- Njowa, G., Clay, A., and Musingwini, C. 2014. A Perspective on Global Harmonization of Major National Mineral Asset Valuation Codes. *Resources Policy* 39 (March): 1–14.
- Ouma, S. 2015. *Assembling Export Markets: The Making and Unmaking of Global Food Connections in West Africa*. Oxford: Wiley Blackwell.
- Pan, J. 2014. Valuation Standards for Calculating ICSID Awards. *Pepperdine Dispute Resolution Law Journal* 14 (3): 355–374.
- Park, H., and Doucette, J. 2016. Financialization or Capitalization? Debating Capitalist Power in South Korea in the Context of Neoliberal Globalization. *Capital & Class* 40 (3): 533–554.
- Parra, A. 2012. *The History of ICSID*. Oxford: Oxford University Press.
- Peattie, R., and Dimitrakopoulos, R. 2013. Forecasting Recoverable Ore Reserves and Their Uncertainty at Morila Gold Deposit, Mali: An Efficient Simulation Approach and Future Grade Control Drilling. *Mathematical Geosciences* 45 (8): 1005–1020.
- Potesta, M. 2013. Legitimate Expectations in Investment Treaty Law: Understanding the Roots and the Limits of a Controversial Concept. *ICSID Review* 28 (1): 88–122.
- Prieto-Rios, E. 2015. Neoliberal Market Rationality: The Driver of International Investment Law. *Birkbeck Law Review* 3 (1): 55–76.
- Radetzki, M. 2006. The Anatomy of Three Commodity Booms. *Resources Policy* 31 (1): 56–64.
- Radetzki, M. 2013. The Perseverance of the Ongoing Metal and Mineral Boom. *Mineral Economics* 25 (2-3): 83–88.
- Richardson, T., and Weszkalnys, G. 2014. Introduction: Resource Materialities. *Anthropological Quarterly* 87 (1): 5–30.
- Roberts, J. 2012. Poststructuralism against Poststructuralism: Actor-Network Theory, Organizations and Economic Markets. *European Journal of Social Theory* 15 (1): 35–53.
- Samis, M, Davis, G., Laughton, D., and Poulin, R. 2006. Valuing Uncertain Asset Cash Flows When There Are No Options: A Real Options Approach. *Resources Policy* 30 (4): 285–298.
- Sawyer, S. 2002. *Bobbitizing Texaco: Dis-membering Corporate Capital and Remembering the Nation in Ecuador*. *Cultural Anthropology* 17 (2): 150–180.
- Schulmerich, M. 2010. *Real Options Valuation: The Importance of Interest Rate Modeling in Theory and Practice*. Berlin: Springer-Verlag.

- Schultz, Thomas. 2015. *Transnational Legality: Stateless Law and International Arbitration*. Oxford: Oxford University Press.
- Simmons, J. 2012. Valuation in Investor-State Arbitration: Toward a More Exact Science. *Berkeley Journal of International Law* 30 (1): 196.
- Slade, M. 2001. Valuing Managerial Flexibility: An Application of Real-Option Theory to Mining Investments. *Journal of Environmental Economics and Management* 41 (2): 193–233.
- Smith, J. 2011. Tantalus in the Digital Age: Coltan Ore, Temporal Dispossession and “Movement” in the Eastern Democratic Republic of the Congo. *American Ethnologist* 38 (1): 17–35.
- Sornarajah, M. 2016. On Fighting for Global Justice: The Role of a Third World International Lawyer. *Third World Quarterly* 37 (11): 1972–1989.
- Ténière, P. 2015. Technical Disclosure Best Practices and Useful Guidance for Exploration and Mining Companies. *Paper Presented at PDAC*, Toronto, March 4.
- Tsing, A. 2000. Inside the Economy of Appearances. *Public Culture* 12 (1): 115–144.
- Visser, O. 2017. Running Out of Farmland? Investment Discourses, Unstable Land Values and the Sluggishness of Asset Making. *Agriculture and Human Values* 34 (1): 185–198.
- Walsh, A. 2004. In the Wake of Things: Speculating in and about Sapphires in Northern Madagascar. *American Anthropologist* 106 (2): 225–237.
- Walsh, A. 2010. The Commodification of Fetishes: Telling the Difference between Natural and Synthetic Sapphires. *American Ethnologist* 37 (1): 98–114.
- Welker, M. 2014. *Enacting the Corporation: An American Mining Firm in Post-Authoritarian Indonesia*. Berkeley: University of California Press.
- Whittle, J. 1990. Open Pit Optimization. In *Surface Mining*, edited by Bruce Kennedy, 470–477. Littleton, CO: Society for Mining, Metallurgy and Exploration.

