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8 From Commodity to Asset and Back Again: Property in the Capitalism of Varieties

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Introduction

What does it mean to turn something into an asset—not just conceptually, but also in terms of the good itself? And what are the implications for doing business with others through assets? These are crucial questions as they connect the nature of a good to the issue of what role we want business and economic matters to play in our lives. If Birch (2017a) is correct in his observation that certain industries like biotechnology have abandoned the market and its principles in favor of capitalizing on their assets instead of selling them, and if Muniesa et al. (2017) are right about connecting assets to what is commonly called "capitalism" (as opposed to "market economy"), we need to inquire into the relationship between the nature of a good, including its economic and wider social effects. But how to approach things as elusive as assets?

Birch (2017a, 462) argues that (contrary to many STS approaches to economic matters) the answer is best sought not in the materiality of goods but in the way these goods are valuated through specific forms of calculation and assessment. This is a compelling argument: after all, Tesla's net income from selling electric cars has been consistently negative until recently while Amazon barely makes any profits from its online sales, yet both companies continue to soar at the stock markets, being valued at several billion USD each. If we want to understand the gap between the market value of companies and the market value of the goods they produce, it is not enough to simply look at the latter, Birch rightly concludes—we rather need to look at how they are produced as something valuable. This conclusion, however, also comes with several drawbacks. Firstly, it poses the danger of falsely reifying commodities: who's to say that a commodity's market value is any

more abstract, concrete, simple, or complex than that of an asset? Secondly, it solely defines an asset in opposition to a commodity, neglecting other possible contrasts (like commodity–gift or asset–liability). Thirdly, by excluding materiality from the outset, we might deprive ourselves of anything to be found there in spite of Birch's confidence that there will not be all that much. In any case, the argument does not locate the asset in a good itself but outside, in the calculations and conventions of calculative devices and agencies (Callon and Muniesa 2005; Hardie and MacKenzie 2007). In somewhat exaggerated terms, such assets are socially but not materially constructed.

Slightly deviating from Birch's agenda while at the same time taking seriously his call and arguments, I would like to propose a supplementary approach. My interest lies in the question of whether anything can be turned into an asset. If so, could it also be a commodity? If the answer is no, are the reasons to be sought merely in "trials of strength" (Latour 1993) between agents and agencies or does the good itself also have a say in its assetization? To answer this question, I will turn to a controversy between German wheat breeders and farmers over the nature of the seed sold from the former to the latter: should it be treated as a commodity or as an asset—and if so, whose?[1] The answers offered by the involved parties do not only imply different forms of valuation, but also diverging practices of using and shaping the good in question—wheat varieties—in very material ways. What I will be looking at are their specific articulations in order to understand the relationship between assetization and commodification in wheat.

Commodified Seed

For roughly a century now, wheat breeding in Germany has been the business of private companies. Wheat is bred commercially by medium-sized to large firms, many of which are family businesses or part of cooperatives. Unlike in the US (Brandl and Glenna 2017), Australia (Head et al. 2012), or other countries, public wheat breeding has long been confined to basic research and resistance breeding in Germany while breeding by farmers themselves is virtually nonexistent (Harwood 2012; Brandl 2017). Farmers receive breeding companies' seed through commercial distributors (who usually also provide them with other farm input) at around €52 a quintal, the breeder's share (i.e., their income stream) in the final price making up €7.00–13.25, or 13 to 25 percent (2017 prices; STV 2018).[2] Wheat seed

is produced for and distributed via anonymous markets: breeders do not know their customers in advance, nor are they aware of the latter's growing conditions. Through experimental crossing and subsequent selection, new varieties of wheat are developed and then evaluated on a large scale—first by the breeders themselves to gather data, at a later stage also by public assessment programs on a national and regional level which provide essential information for comparing and ranking varieties to breeders, farmers, and their respective contractors (Pallauf 2018). A finished plant variety will produce uniform plants which can be clearly distinguished from other varieties and whose agronomic performance will hardly differ over subsequent years. This is essential for farmers who will have to harvest all of their produce within a couple of days and for whom predictable and homogeneous quality matters.

What at first sight looks very much like a model for a market economy nevertheless comes with some major restrictions: only sufficiently standardized wheat varieties which outperform existing ones will be admitted to the market. Without approval by the Federal Variety Office (Bundessortenamt, BSA), breeders are not allowed to sell their seeds to farmers. This regulation is meant to safeguard steady progress in seeds as well as a neat market with no more varieties than farmers could realistically compare with each other. In return, the state grants breeders property rights for their varieties that basically amount to a temporary sales monopoly for twenty-five years. During that time, no one else is allowed to sell seeds of that variety on the market without the breeder's permission. This so-called plant variety protection (PVP) legislation is a unique intellectual property right for plant seeds. While it can also be found in many other member countries of the International Union for the Protection of New Varieties of Plants (UPOV), the legislations of Germany and other European countries exclude plant varieties from patentability, making PVP the only legal instrument to govern intellectual property in this field.

In Germany, seeds may legally only be commercialized in the form of varieties. This means that breeders have to "bring them into shape" before they can take them to the market. If varieties fulfill the criteria of homogeneity (uniform appearance), distinctiveness (phenotypic distinguishability), and stability (stable characteristics over several generation), PVP will legally protect them against "plagiarization" by third parties. This effectively forces breeders to commodify their products, shaping seed in a way that

allows market actors to make economically informed, rational decisions (Callon 1999). While some organic farmers and eco-activists openly oppose PVP as a threat to biodiversity and as catering to the needs of industrial agriculture (Aistara 2014; Demeulenaere 2014), it enables transregional seed markets of buyers and sellers who remain anonymous to each other. These markets are not only enabled by distributive and calculative infrastructures like agri-trade firms or technologically enhanced capacities for economic decisions: the strongly standardized nature of the plants themselves is a necessary condition for comparing and evaluating varieties, be it for assessment programs or individual farmers. Bred for context-independence and made "immutable" (Latour 1987), varieties largely work beyond the specific requirements of local soils, climates, and ecologies. Farmers do not need firsthand experience of a variety to assess its performance but can make up their mind by looking at numbers referring to quantifiable, distinguishable products.

That wheat seeds come as standardized, homogeneous, comparable, quantified, and stable objects traded on a market thus gives good reason to characterize them as commodities. As such, they can bridge the geographical, temporal, and social distance between sellers and buyers as well as their respective contexts (cf. Callon 1998). This requires that wheat seeds are thoroughly bred for several generations, evaluated with statistical methods across various climatic regions, and coated with chemicals that protect them from insects and fungi. All these activities are part of a process of commodification, not just semantically, but also materially turning seeds into things that can be sold on an anonymous market. That commodities function so smoothly in combination with markets allows buyers and sellers to be quits (Kopytoff 1986; Callon 1999; Callon and Latour 2011), as they require no complex dis- and re-entanglement, work without assistance or aftercare of the seller (Schubert et al. 2011), and thus give no reason for a prolonged economic or social exchange between transaction partners.

Commodities not only need to be alienable, as Don Slater (2002) has pointed out, they also need to be reappropriable without much effort. This is more than just a matter of access to intelligible and comparable quantified data such as prices, ingredients, and weights. It also involves a material commodification process without which they could not even be quantified in the first place. Commodities also have a social effect beyond alienation between producer and good or seller and buyer. Whereas in former times, farmer and breeder were one and the same person, they are now consumers

and producers of seeds, respectively. There is a division of labor along the seed value chain in which farmers turn the value produced by breeders into something else—grain—which in turn is ground to flour by millers a little further downstream, with a hungry consumer waiting at the end of the value chain to finally turn a loaf of bread into energy. In a classical production logic, these are instances of consumption (Graeber 2011): an initial stage of the good is fully exhausted, giving way to a new state of the product, which in turn will be fully used to bring forth yet another form of it. This material zero-sum game is mirrored in the alienation of property in a sales transaction: here, property in a good is fully exhausted on the one side of the transaction (Perzanowski and Schultz 2018, 25–28) and compensated by an equivalent flow of money in the opposite direction (Demsetz 1967; see also Kang, this volume). But if sellers and buyers do not stick to these zero-sum games, the state of seeds as a commodity becomes fragile.

Assets in the Wrong Hands

It is in the nature of seeds that they are able to multiply. A wheat seed sown in fall will yield fifty to sixty seeds in the next summer, provided it is adequately cared for. For breeders, this is a great advantage: they can start with a single cross between two parent plants to create a new variety that quickly scales up to thousands and millions of seeds within few generations. But it is also a threat to their business, as farmers may save a fraction of their harvest for resowing it—instead of buying new seeds from the breeder who initially created the variety. The product is then not fully exhausted in the production process; instead, a part of it remains and multiplies, expanding the material value of a wheat variety—but diminishing its economic worth on the breeder's side. Here we find one mechanism of accumulation (Birch and Muniesa, this volume): a fraction of the harvest does not follow the zero-sum game of consumption but the surplus laws of reproduction. In farming practice, the two differ only in a few details. In both cases farmers harvest their wheat fields mechanically and ship their grain to processing facilities. While in the case of commodification (i.e., consumption), these will be mills, breweries, or fodder producers, assetized (i.e., reproduced) seed ends up in seed treatment plants to be cleaned and chemically coated to be sown again. Both processes turn the harvest into objects of value. Valuation is not just a mathematical procedure here, though, but even more so a biological one—the material

contrast between flour and wheat seeds could not be more pronounced. Milled grain continues to flow down the value chain as a commodity; treated seed is held on to and continues to generate value on the farm. Ironically, it is seeds' commodified form (more precisely their standardized, immutable and context-independent nature) which makes it possible to multiply modern wheat seeds without much effort—and thereby to stray from the path of commodification set out for them by their breeders.

PVP, understanding seeds as something akin to intellectual property, was initially created to prevent "horizontal" plagiarism. Breeders were meant to be protected against competitors who would otherwise take their seed, multiply and sell it without having to bear the initial costs for creating a new variety (Sanderson 2017, 21–44). Historically, it therefore only gave a monopoly on commercialization to the breeder. Farmers consented to this restriction, primarily because they lacked the capacities for transregional distribution and sale anyway. For the longest time, the PVP framework in Germany and elsewhere thus implicitly granted a so-called farmers' exemption to them which allowed for saving and reusing seeds on-farm, as long as they did not reenter the market as seeds. This practice, however, became the source of a heated controversy between farmers and breeders from the 1990s on when EU laws rendered seed saving and on-farm reuse illegal if exercised on farms exceeding a few hectares.

In 1991, an amended version of the international UPOV convention on plant variety protection was passed and subsequently implemented in European law in 1994 and German legislation in 1997. Several developments coincided at that time: the wheat market had become more competitive due to increased breeding efforts and varieties lasted shorter on the market but longer on the fields, as phenotypic stability had increased. In earlier times, some varieties would bring in revenues for thirty years (interview with wheat breeder April 2015; Pallauf 2018). Today, farmers are buying less and less new wheat seed on the market (Kempf 2016). Meanwhile, modernization of agriculture had brought about a change of the economic landscape. In this sense, the motives for the move toward assetization of the plant variety business mirror those described by Milyaeva and Neyland (this volume) for the case of British higher education reform: the premises on which the original framework was built, such as the definition of goods and social roles, had shifted. Still, it is difficult to grasp why seed reuse suddenly became so big a problem for the breeding industry. As one breeder

puts it, "Well, farmers have always saved and resown. This farmers' exemption, it has always existed. Okay, I don't know if it's always been—I would say it has always had the same extents. Maybe it intensified a bit when [the former GDR] joined and those giant [farms] there resowed" (interview with wheat breeder, April 2015).

Seed reuse has always been a common practice, especially among smallholders who, after a bad harvest, did not have enough resources to purchase next year's seeds on the market. But the amendment was specifically aimed at big agricultural companies that relied on economies of scale and commercial varieties' ability of stable reproduction to save money. The scope of resowing is difficult to assess in that seed reuse fluctuates annually and farmers' activities are a private business. For the season of 2016–17, an estimated 44 percent of all wheat seed in Germany was farm-saved (Pallauf 2018, 1), which is much less than in Canada and the US with 70 percent, Spain with 85 percent, or Australia with 80–95 percent (Sanderson 2017, 232–233). Still, German wheat breeders are missing out on about half of their potential sales. Breeders, who discount their varieties because they expect revenues over several years in a row, feel that they are left out and demand compensation, while farmers regard seed reuse as one of their traditional privileges. The latter's attitude is aptly summarized in the following declaration by a lobby group:

> Sowing and harvesting, keeping a part of the harvest for resowing it next year—this ancient central principle of agriculture shall now no be longer possible without restrictions. Plant breeders do not only demand—legitimate—license fees when they sell new seeds to the farmers, but they also demand money for the following 25 to 30 years if the farmer is reusing a part of his harvest as seeds—so-called resowing. (IG Nachbau 2016, translated)

To resowing farmers, the nature of seeds is clear: they are an asset. Like a tractor, a harvester, or a plow, they are used for running the farm and not (like fertilizers) completely converted into a more valuable output. But the quote also frames the relationship between farmers and breeders in a particular fashion: while the latter have a legitimate claim to a single monetary compensation for their seeds, farmers consider themselves to be quits (Callon and Latour 1997) after this transaction. In their eyes, all contracts are fulfilled with the acquisition of the original seeds, and there is no need for a long-term relationship through continued license fees and declaration from the side of the farmers.

Resowing farmers thus understand seeds and plant varieties as an on-farm *asset*, where it becomes their lasting property, but as a *commodity* that is exhausted in the transaction at the moment of purchase on the market. They also regard themselves as producers with and owners of, not consumers and renters of seeds. Framing the issue with Slater (2002) as one of alienation, the problem is that too much is alienated when breeders sell their seeds: not just the possibility of using them for cultivation and harvesting but also the ability to multiply them. Since the knowledge necessary for this kind of "piracy" is inseparably built into the commodity itself, the farmer-consumer cannot be deprived of it, giving them an opportunity to become a farmer-reproducer (and, in the breeders' eyes, a bio-pirate). In turn, too little is returned to the breeders. What is compensated is only a portion of the variety paid for in an accordingly discounted single sales transaction. The variety's R&D costs, however, are meant to be covered over several years through recurring purchases, not within one single sales act. Costs of appropriating a new variety are spread across several thousand bags of seed, every single one bearing the potential to recreate the variety at a much smaller cost. In consequence, not all uses of seed are adequately compensated in the eyes of the breeders: those that turn seed into a means of production rather than consumption, they argue, touch upon their intellectual property. In other words, resowing farmers treat seed like a disentangled commodity on the market while breeders consider it an entangled asset of theirs (Muniesa 2008). On the farm, in contrast, farmers regard seed as their reproducible asset whereas breeders wanted them to subject it to consumption only.

The compromise eventually reached favored the breeders, at least on paper. While the right of reuse remained with the farmers (allowing them to resow without prior permission), breeders were granted the right to be included in the valuation of the seeds—independently of farmers' actual revenues. After years of hard-fought negotiations, the price for resowing a protected wheat variety was set at 50 percent of the original license, symbolically accounting for the costs of cleaning and treating the seeds which the farmers bore themselves. If farmers' understanding of varieties as their on-farm assets was acknowledged by the law, it simultaneously framed seeds as breeders' commercial assets that did not simply change hands on the market, but remained part of a larger system of claims and obligations. And yet, the breeders' victory should soon turn out to be a Pyrrhic one.

The Troubles of Doing Property

That breeders were meant to be included in the valuation processes in the fields also meant that the seed market was no longer enough for commercially interacting with the farmers. After the revision of German PVP laws in 1997, breeders needed an apparatus that allowed them to control sowing practices and to enforce their monetary claims. The seed trust administration (Saatguttreuhandverwaltung, STV), until then a barely known institution supported by the breeders, should monitor the use of seeds throughout Germany and collect resowing fees from farmers, if necessary, also by taking legal action. Even so, breeders encountered resistance early on. While resowing fees in wheat rose to around €8 million in the beginning, they soon dropped down to €4 million and are now back at about €9–10 million (interview with wheat breeder, December 2016). Compliance also differed regionally, with 97 percent of all farmers in the state of Thuringia filling out a resowing declaration compared to 23 percent in North Rhine-Westphalia (interview with industry representatives, September 2017). The system's loophole was the lack of identity of seeds: mature plants were readily distinguishable from each other, but once seeds were sacked and shipped, there was no way of telling which was which and, even worse, whose. Breeders' attempts to make farmers declare in questionnaires what, when, and where they had sown were soon stopped by courts. Only in case of reasonable suspicion could they demand information from a farmer.

It was not only farmers, though, who ignored legal boundaries of property. It was also the plants that did not discriminate between breeders and farmers, producers and consumers, asset and commodity. Provided they had been bred via selfing, they could theoretically work in both regimes, but here they sided with the farmers. While the legal boundaries of property were quite clear, a continuum existed in the material realm. Breeders tried to remedy this betrayal by stepping up their surveillance game. Seed processors and distributors were legally obliged to report suspicious batches of seed and, in case of reasonable suspicion, to take samples. Nonetheless, this did not turn out as a success either. First of all, because a lot of seed processors also sold pesticides and fertilizers to farmers and would rather turn a blind eye on undeclared resowing than to risk losing a customer for something they had no financial stakes in. Second, because many larger agricultural operations had their own in-house processing facilities and did not

rely on potentially untrustworthy third parties. Breeders' desperate efforts widened the trench between farmers and themselves. They consolidated the farmers' stance toward resowing fees as illegitimate and allowed them to win public sentiment for their side. Reframing property relations in ways that resembled a "refeudalisation" (Schubert et al. 2011) through financial obligations and supervision was met with disapproval in Germany. In 2005, the STV received the German Big Brother Award for its attempts to survey farmers and collect remuneration from them.

In retrospect, breeders admit that their approach back then was not a successful PR strategy. Today, they are attempting to approach the farmers and their representatives, making the argument of a shared interest in a thriving wheat breeding sector and highlighting the benefits farmers receive from buying new seed every year. Following the lesson of "verify but trust," wheat breeders and their associations are currently trying to bridge the gap that the battle over the legal shape of plant varieties has created. These attempts are, however, only partly successful. Revenues from resowing fees keep fluctuating; according to the breeders' calculations, about a third of all resowing farmers do not pay remuneration in cereals, equaling a missing €5–6 million out of a total of €14–15 million in 2014 (Würtenberger 2014, 119). With few legal means and hardly any information about how much resowing is taking place, breeders remain in a weak position. Although wheat breeders see revenues from resowing fees as essential for the future—the primary market alone is too small to sustain the existence of currently seventeen commercial wheat breeding programs—farmers question the economic precariousness of the seed producers. "On every breeder's yard, there's a new BMW and a new Fendt [tractor]; I doubt they're doing that badly," a farmer puts it in a conversation (interview with part-time farmer, March 2016). Faced with such attitudes, wheat breeders are not placing all their bets on the goodwill of farmers and policy makers. Some of them are envisaging a different strategy, hoping it can turn the tables between breeders and farmers.

Back to Commodities: Hybrid Breeding

Inbreeding through selfing has, for a long time, dominated as a breeding method in most crop species. There is a notable exception to this: as early on as the 1930s, corn was turned into a hybrid crop by US geneticists and breeders who could demonstrate the superiority of crosses between two inbred

lines over their parental varieties. Hybrid varieties came with considerably more yield, were more uniform in appearance, and promised a bright future for breeding (Fitzgerald 1990). They had another advantage for breeders, however, namely their lack of transgenerational stability. While first-generation (F_1) plants are more homogenous and have higher yields than their parents, subsequent generations exhibit Mendelian patterns, with recessive alleles being expressed, while yield approaches the parental average. This represented an effective biological technique for preventing farmers from resowing, not only because they would forgo yield but also because the plants would lose their commodity characteristics of stability, uniformity, and calculability. It would become harder and harder to predict when to sow and when to harvest, with some plants still being green and others ripe for harvesting. The more the harvest was replanted, the more varied plants would become, making resowing less and less attractive. As Kloppenburg (2004, 97) puts it, hybrid seed is not biologically but "economically sterile." Breeders, in contrast, could still reproduce hybrid varieties because they were in possession of the original parental lines. By being "consumed" over time, hybrid varieties turned into commodities on the farmers' end while remaining assets for the breeders. Where remuneration represents a move for extending the asset character of a breeder's variety to the farm by collecting revenues after the market, hybrid breeding is a move toward more commodification based on preventing assets to slip from the breeder's hands. Hybrid breeding decouples seed from grain (Kloppenburg 2004, 93), asset from commodity. The parental lines, which are held on to (Birch 2017a), not disclosed or handed to third parties, embody and reproduce the asset, while the F_1 seed that is sold to the farmers and can only be consumed represents the commodity.

Historically, hybrid breeding in corn was successful for several reasons. Higher yields allowed to turn hybrid varieties into a win-win scenario for both breeders and farmers; the gain in yields made farmers swallow their skepticism toward being deprived of the ability to resow; and, finally, hybrid breeding was simple in corn—since female and male flowers are separated and rather big, mechanical sterilization was cheap and simple (Fitzgerald 1990). The situation with many other crop species, especially wheat, is different. Wheat flowers are minuscule and delicate, with male and female flowers packed tightly together in the plant's spikelets, requiring skilled and patient work for removing the male parts. Since it is so time- and money-consuming, sterilization of flowers is only done for initial crosses between a

few hundred plants; manually producing seed on an industrial scale would be impossible (Whitford et al. 2013). Although so-called gametocides exist, which allow for a chemical sterilization of wheat plants, they are highly toxic, banned in Germany, and patented by a single firm, making their use unattractive (Becker 2011).

Since the 1980s, however, molecular techniques of hybrid breeding have gained ground (Acquaah 2012; Becker 2011). In rye, rapeseed, and barley, cross-fertilization of lines with specific cytoplasm combinations allows for controlled production of hybrids with only around 10 percent contamination by undesired pollen. While many crop species lack "hybrid vigor," the prospect of excluding farmers from resowing has made breeders go for hybrid varieties, despite their production costs being about twice those of conventional varieties (Nickl et al. 2014, 33). In many smaller crop species, breeding companies had an easier time of collectively shifting to hybrids and of simultaneously lobbying public authorities to loosen the thresholds for purity and stability of hybrid seed, as markets were already strongly consolidated. Although farmers were promised higher yields through hybrid vigor and increased breeding efforts funded by higher seed prices, comparisons with some of the still existing inbred varieties casts doubt on these claims (LfL Bayern 2014; Nickl et al. 2014, 2016).

Nevertheless, hybrid breeding remains attractive for wheat breeders. Many public research institutes consider hybrids the future of wheat breeding, citing the same arguments used by rapeseed and rye breeders a few decades ago. While many small and middle-sized companies seek a cheap and efficient method for producing hybrid varieties, they also fear the uncertainties of switching to a new breeding system. So far, the few hybrid wheat varieties on the market are not outperforming inbred ones, and collectively moving toward more expensive hybrid seed represents a challenge in the competitive wheat market. Still, many actors in the wheat breeding industry are optimistic and in favor of hybrid wheat. One breeder at a public research institute leading a program for the development of a hybrid system especially stressed the openness of such a system, which would be available to all companies without license fees, not only the big firms with their own R&D departments, and thus reconcile property protection with scale neutrality (interview with wheat breeder, April 2015).

That such scale neutrality is difficult to achieve was demonstrated a few months after that breeder made that statement. When asked for their

opinions, the private project partners who had come to observe the results and discuss the future of the hybrid program remained silent, until one among their ranks voiced his skepticism. Shortly before, the Swiss biotech company Syngenta had had to compensate farmers after one of its hybrid barley varieties had been found to be contaminated with foreign seed. Barley has only half the acreage of wheat in Germany (1.6 vs. 3.2 million hectares in 2017; Statista 2018). Still, the compensation paid by Syngenta was ten times his own company's total balance sheet, that breeder exclaimed. Even if the joint program were to yield a feasible and cheap method for producing hybrid seed, he could not possibly take the risk of going bankrupt over hybrid varieties. Consequently, the institute's hybrid program will fall dormant. Some basic research will probably still be conducted, but the development of a working technology is off the table for now. Elsewhere, though, public and private actors are still working on making hybrid wheat the future, especially within the plant science multinationals. To make up for its higher production costs and to compete with cheaper inbred seed, however, hybrid wheat varieties would need a stable yield advantage of around 6 percent. Since heterosis is so low in wheat, none of the existing varieties currently manages to come close to this (interview with wheat breeders, August 2018). Some industry experts are therefore pessimistic about the commercial prospects of the technology (interview with former biotech executive, June 2018).

At first glance, it seems like hybrid breeding could successfully combine the advantages of both asset- and commodity-shaped valuation processes. It would turn wheat varieties into assets on the breeders' side, securing them long-term revenues from selling seeds. In contrast, seed would only be consumed (and thereby commodified) on the farmers' side as they would be unable to recreate hybrid varieties. In spite of that, financial costs and risks of this technological solution are usually not discussed publicly. For small to medium-sized breeding companies, they are high enough to stick with traditional inbreeding, which is both cheaper and more secure. Bigger biotech-oriented firms that have only recently entered the German market still hope that, in the long run, hybrids will prevail, lead to higher revenues, and disentangle property relations between breeders and farmers. Currently, however, hybrid wheat is not economically convincing for any of the involved parties.

To Commodify or to Assetize?

The case of wheat seeds shows that telling assets from commodities is not that easy. That lawmakers think of plant varieties as a form of intellectual property and that breeders calculate their expenses against varieties as a lasting source of revenues commercialized at discounted rates does not mean that they do not also appear as commodities at other times or even simultaneously. Quite to the contrary: their valuation through markets requires a certain degree of commodification, both material and semiotic, channeling their value and allowing for an easy conversion to money. Varieties cannot do without certified, standardized bags of certified, standardized seed. There are, of course, also assets which are subject to less calculation and more speculation. Nevertheless, I would argue that the overwhelming majority of assets only work when coupled with some form of market where they can quickly and with little risk be converted into money through the exchange of commodities for money. In this sense, and contrary to Birch and Muniesa's (important) provocation in the introduction to this volume, commodification is not dead. It might, however, have taken on a different life.

The commodification of assets does, in turn, not imply that every aspect of them is subject to calculation and alienability. For example, although the costs of developing a new plant variety are usually estimated at around €/$1–2 million (Goodman 2002, 30), the specific costs for one particular variety cannot easily be assessed, simply because they escape straightforward zero-sum games of production and consumption:

> At the moment it is said that breeding a new variety costs 1.5 million, 1 to 1.5 million. And that's also relative. If I say, okay, we invest 700,000 per year or 800,000 here … yeah, maybe just 700,000 for wheat only. Barley, you'd have to subtract all of that, subtract [our barley breeder]. We invest 700,000 for the wheat program [here]. And you got three varieties admitted in a year, or maybe just one, then getting one variety admitted costs you between 300,000 and 700,000 euro. So that's really difficult to say. (interview with wheat breeder, April 2015)

Seed price is not simply the sum of cost factors. For the breeder quoted above, who licenses his seed at the upper end of the price range, it also carries a signaling function. Convinced that his varieties are of a higher quality and require less farming input than most others, he holds that a cheap product is a worthless product.

To "have a good variety" that will last a long time, enjoy popularity among wheat farmers, and yield considerable income which will not simply go into covering past expenses, but also future projects is important to breeders. But it is not only the breeders who decide whether seeds will be a commodity or an asset. Farmers, infrastructures, legislation, and not least the wheat plants themselves have a considerable say in that matter. Combining the advantages of assets—lasting rents instead of recurring labor efforts—with the convenience of commodities—easy, straightforward and almost automated commercialization—bears risk. Breeders cannot guarantee that their product will behave like the asset they want it to be once it changes hands. In wheat breeding, it is the mutability of biological beings which undermines the articulation of assetization and commodification. If varieties at the farmer's end of the valuation chain lose their commodity character, assets become a problem for the producers. While we take it for granted that commodities are consumed not only in consumption, but that they actually change hands as a whole on the market, customer complaints do not only make authorship and claims but also responsibility reemerge.

Hybrid breeding demonstrates why—somewhat contra Birch's (2017a) prompt—it is still important to look at the material dimension of goods. Theoretically, there are ways of separating asset and commodity, of dividing the world into producers who hold the former and consumers who have to acquire the latter again and again. In practice, the failure of wheat breeders to achieve this separation can be located in the fickle nature of wheat genomes, the delicate form of cereal flowers, and the very calculable limits of a medium-sized firm. On the other side of the spectrum, hybrid breeding in corn and other crop species has become an effective tool for extracting higher rents from farmers who pay a premium for seed they can no longer appropriate as an asset. This urges us to think about the specific articulation of goods through material, social, legal, and other techniques. Property plays an important (and, as I believe, so far largely neglected) role in this context: Which part of a good should actually be sold? What should be retained? What can be alienated, what can be appropriated by the other? How can legal, material, and social aspects be made to agree with each other, and what happens if they disagree?

That assets and commodities may be tightly interlinked along a value chain should also not distract us from noticing that turning varieties into assets is not an isolated event or idea. New forms of property are entering

the plant breeding sector, disrupting established social and economic relations. The 2010 Nagoya Protocol has made nation states and indigenous communities owners of their domestic biodiversity, previously subject to the public domain (Brand and Vadrot 2013). Biodiversity is now something to be managed—not just for conservation but also for economic reasons. For states like Mexico, Ecuador, or Namibia, it has become a national asset promising a bright economic future in the age of bioprospecting (Hayden 2003; Heeren 2016, 2017). Downstream the value chain, the protocol's implementation in Germany and other EU countries has led to concerns among breeders. The obligation to pay royalties for the use of foreign germplasm implies that such material as well as all other sources of genetic diversity used for breeding have to be minutely documented. If they do not comply, some national laws include heavy sanctions for breeders, from five-digit fees to imprisonment. Intended to foster exchange of genetic material and creating more legal certainty by turning states into owners of their biodiversity, Nagoya currently has the opposite effect.

Meanwhile, Europe has also seen a surge in plant patents granted by the European Patent Office (EPO) lately, especially in vegetables (Parthasarathy 2017). While patents are nothing new for the US seed sector, they have deliberately been kept out of European plant breeding by legislation until recently. In Europe, plant varieties are not eligible for patent protection, only for PVP. For both breeders and farmers, this is important since PVP is less restrictive than patent protection, giving them more freedoms in using foreign seed as a parent. Patents, in contrast, offer valuation channels very different from commodification, as Hyo Yoon Kang and Victor Roy show in their contributions to this volume. Critics argue they have become an outlet for turning science and technology into money without having to go through the troubles of production and consumption at all. At the same time, patents are often too complex and laden with transaction costs to be easily commodified. This is one of the factors suspected behind the rapid concentration of the US seed sector following the introduction of patents on genetically modified plants (Schenkelaars et al. 2011). In the same case, it has also led to the replacement of the commodity form—that is, disentangled goods and market transactions—with lasting contractual obligations between biotech firms and farmers, supplemented by an extensive socio-technical surveillance infrastructure (Schubert et al. 2011; Müller 2015).

Nevertheless, there are, also attempts at recommodifying plant patents. The Swiss biotech giant Syngenta, for example, introduced the platform *Traitability* in 2012, which offers access to the company's patented vegetable traits on simple, predefined, and purely monetary terms. Two years later, a cross-industry initiative spearheaded by Syngenta launched a patent clearinghouse for non-biotech patents on vegetables meant to reduce transaction costs and uncertainty around patents (Bjørnstad 2016). It is therefore still unclear what business vision companies connect to plant patents. After protests and an explicit disapproval by the EU commission, the EPO has backed down from its liberal position in granting patents (EPO 2017), a decision overruled shortly after by its own Enlarged Board of Appeals. The property question in European plant breeding is thus still open.

Conclusion

The examples discussed in this chapter point to a trend toward what can be aptly termed "assetization" of property, not just in plant breeding but also in other fields (Perzanowski and Schultz 2018). In the market economy, private property, with its extensive liberties, perfect alienation, and lack of lasting obligations, has traditionally been a necessary prerequisite for the exchange of goods as commodities. Unlike landed property and other forms of ownership centered around managing possessions and extracting value from them (see Nadaï and Cointe, this volume), the logic of private property on the market is fixated on alienation (Slater 2002), letting go of what you own and being adequately compensated in return (Appadurai 1986). Aside from the disruption this idea has historically caused (Polanyi 2001), one of its effects was a great liberty in property, allowing people to leave behind the constraints of their social context and dealing freely with strangers.

Understanding property as an asset, however, implies treating it not as something to be alienated (and, consequently, reappropriated), but something that can be let go of and yet returns to its owner. The specific articulation with commodities is crucial: it needs to provide all the advantages of commodity exchange—calculability, easy transport, scalability, straightforward appropriation—without what would be a disadvantage from an assets perspective—complete alienation and being quits. There are many ways of making goods, people and money return to the asset holder—from a legal-technological surveillance and sanction infrastructure to a more

concentrated product like hybrid seed which will obey the seller but not the buyer. This is why Birch's (2013) call to bring together STS and political economy is so important: we will only understand the differences between specific articulations of assets and commodities by looking closely at the political-economic effects a certain arrangement has. Through increasing yield and improving seed performance, hybridization can assetize varieties in corn and protect them from infringement. It is not suited, however, for protecting transgenes in the same varieties (Pottage 2011, 109f.)—the latter require an extensive apparatus of patents, snitch lines, technology use agreements and biomolecular detection techniques in order to work as assets (Schubert et al. 2011), making them socially and economically much more expensive. In the German wheat market, assetization of seed through a mixture of cooperation, dialogue, surveillance, and PR has been a moderate success in the last years, with currently some 70 percent of all seed-saving farmers paying remuneration (interview with wheat breeder November 2018; interview with industry representatives September 2017). The missing 30 percent of resowers point to the limits of assetization as a way of framing both economic calculations and economic exchange and of the control breeders can exert over "their" assets.

Assetization is neither a given nor something that is simply conceived, planned, and executed by economists, investors, managers, or multinationals. As a reaction to wheat varieties experiencing changes in their asset value and character through shifts in the economic landscape of farming and breeding, breeders attempted to reassetize their seed legally, biologically, and economically. But the success of such attempts depends on the compliance of consumers, laws, markets, competitors, genomes, and many other factors which all too often escape calculation or Latourian enrollment. Like commodification, assetization remains performative, leaving spaces and opportunities for intervention. A lot of things can be turned into assets and commodities, but commodities and assets can still be turned into other things—with or without the consent of their producers.

Notes

1. This chapter is based on participant observation, document analysis, and interviews with stakeholders in Germany, the Netherlands, and Switzerland between 2015 and 2018.

2. In 2017–2018, a rough estimate for the price composition of a quintal (100 kg) of certified winter wheat seed would be €20 for the base price or "consumption" (i.e., value as raw material for processing or fodder), €6.25 for the seed multiplier's share, €10 for processing and preparing (e.g., coating) of seed, €2 for the bag, €1,75 for distribution and sales, and €7–13.25 for the breeder's license (interview with wheat breeder, November 2018). Somewhat more precise but also more dated figures for a €39.80 bag of 2009/10 cereal seed (DLZ 2010) are €10.25 base price (26 percent), €10.10 for coating and bagging (25 percent), €6.30 for the multiplier's share (16 percent), €5.40 for sales and distribution (14 percent), and €7.30 for the breeder's license (19 percent).

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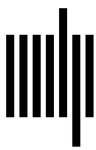

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