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# Going with the Flow: Moving Cells and Changing Values in Biomedical Practice

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**Abstract**

Science and technology studies have devoted considerable attention to the economic implications of biomedical technoscience. This article enriches these studies by offering a new reading of several strands of literature to explore how the valuation processes of gifts, commodities, and assets are intertwined in practice. We derive this approach from an empirical analysis of autologous blood donation in the case of a cell therapy called "extracorporeal photopheresis." Combining ethnographic fieldwork with semi-structured interviews, focus groups, and document analysis in a cell therapy laboratory at a Belgian university hospital, we followed cells in motion from their original donation to their reinjection into the body, observing the practices that constitute and shape their value. We find that the various qualifications as "gift," "commodity," or "asset" that cells acquire, accumulate, or relinquish, as well as the consequences of these qualifications, are accessible only by observing the valuation practices

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that configure living processes. Our analysis highlights the interrelations between the economic forms that living entities can take and rejects the idea of a watertight boundary between them. By emphasizing the entanglement of logics specific to donation, commodification, or assetization, we contribute to linking the value shifts observed at the level of the laboratory to broader capitalist transformations.

**Keywords**
bioeconomy, value, valuation, cell donation, commoditization, assetization

## Introduction

Turning compelling scientific findings into effective, safe and widely accessible therapeutic treatments are neither straightforward nor easy. Despite the success of simplistic metaphors such as the linear model of innovation, the process of getting from the bench to the patient's bedside is a real challenge for the actors involved, and the economic, scientific, and regulatory processes underlying these are uncertain. This is the case for researchers who are working on new cellular therapies and trying to make these accessible to the patients who need them.

During the development of a cell therapy, cells are attributed different forms of value (e.g., economic, therapeutic, epistemic) by different actors (e.g., clinicians, lab technicians, patients). How can we account for these forms of value and their relationships in, and through, biomedical research? Recently, much attention has been paid to a so-called shift in capitalist logic (i.e., from "commoditization" to "assetization," see below) that would require a "rethinking of value in the bioeconomy" (Birch 2017). Yet, there is still some way to go to capture the coexistence, rather than the confrontation, of multiple valuation practices in the bioeconomy. As will be shown in our section on the economic implications of biomedical technoscience, a review of the literature in science and technology studies (STS) reveals two main theoretical trends: some researchers consider that it is possible to derive value from body parts (cellular tissues and biological processes) and focus on notions of commodity production from biological gifts, commoditization, and materiality. Others look at recent developments in technoscientific capitalism and emphasize the political economic strategies of actors, with assetization becoming a key factor in relation to commoditization. Consequently, when we analyze the constant interplay between

techniques for controlling life processes and the economic forms under which living things circulate, we are often limited to an analytical choice between the attribution of one or the other category (relating to the gift, the commodity, or the asset economy). We return to the definition and the different economic logics ascribed to each form of exchange in the following section.

This limitation comes at a price. We end up looking at the economic processes in the life sciences solely from the perspective of the economic logic that seems to prevail, and we miss the more discrete changes that are evident when we observe actual valuation practices. To avoid this, it is necessary to move beyond the "static" categories of gift, commodity, asset, and instead consider these categories in light of the "mutability of economic things" (Braun, Brill, and Dobeson 2021) and the porous boundaries between different forms of exchange. In this paper, we do so by using autologous blood donation (i.e., a blood donation in which the donor and recipient are the same individual) as a case study of a therapy currently offered to certain transplant patients to explore the multiple valuation practices of clinicians, researchers, and laboratory technicians when handling blood cells outside of the body that needs to be treated. We address the following research questions: How do circulating blood cells shape and are shaped by medical, scientific, and regulatory practices? How do they move around within the hospital? How and when do they acquire value on the path to experimental treatment? What kind of value and for whom?

Concretely, we conducted a yearlong ethnography in a Belgian university hospital laboratory specialized in cell therapies (hereafter CTLab), combined with semi-structured interviews, focus group, and lab protocol analysis. In this article, we focus on the process of a cell therapy called "extracorporeal photopheresis" (ECP),[1] which we repeatedly observed. ECP therapy has been in select clinical use for more than three decades—since receiving approval from the US Food and Drug Administration in 1988—but is not yet commercialized[2] (Cho, Jantschitsch, and Knobler 2018). It is intended for patients chronically affected by graft-versus-host disease (GvHD), characterized by the attack of the host by the donor's stem cells or spinal cord. ECP provides a treatment that does not cure the disease but can alleviate symptoms and improve quality of life.

In Belgium, a clinical trial of ECP has been underway for several years. It is funded by various clinical departments and laboratories of the Belgian Society of Hematology, which have joined forces to limit the costs associated with this therapy, consolidate a study database and compensate for the lack of a treatment reimbursed by social security. Patients enrolled in the

clinical trial agree to come to the hospital twice a month to provide a blood sample from which a portion of the cells will be stimulated by exposure to a chemical that reacts with light, before being reinjected the same day.

Before describing each step of this cell therapy in detail and focusing on the tangle of valuation practices involved in handling the cells within the hospital, the next section situates our contribution within current debates on the economic implications of biomedical technoscience in STS. We then describe our abductive qualitative approach to a single in-depth case study and present our empirical data collection and analysis strategy. As we worked through the material, we proceeded to iterative feedback loops between empirical data and theoretical elements. The description of the case was based on our interpretation and synthesis of different lines of literature in valuation studies and STS that we derived from and stabilized through these iterations. We then describe our findings by emphasizing the interrelations between the economic forms that living entities can take, thus rejecting the idea of a watertight boundary between them. We conclude by taking stock of the analytical implications of recognizing the bifurcations and superimpositions of logics specific to donation, commoditization, or assetization when valuing living things and point to three avenues for further research.

## Theorizing the Economic Implications of Biomedical Technoscience

Drawing on the work of Foucault, Marx, or Weber, various strands of social science research have examined and theorized the economic implications of biomedical technoscience (see Helmreich [2008] for a very helpful timeline of that intellectual history). In STS, early conceptual work is often traced back to the contributions of medical sociologist Catherine Waldby (2000, 2002; see also Waldby and Mitchell 2006), who coined the term biovalue to highlight the yield of vitality of human cellular or molecular fragments produced by biotechnological reformulations of living processes. By questioning the constitution of biovalue in "tissue economies" of blood, organs, or cell lines, Waldby has contributed to a revival of studies that have examined the constitution and configuration of social relations around the circulation of biological gifts, such as Richard Titmuss's ([1971] 1997) seminal work on the social effects of blood donation.

Unlike Titmuss, for whom the opposition between gift and commodity was absolute and unsurpassable (Frow 1997), the work of Waldby or Rabinow (1999) has emphasized the porous boundary between gift and

commodity economies. Although focused on biological terrain, this approach was consistent with classical anthropological accounts (e.g., Mauss [1950] 1990; Appadurai 1986) that show capitalist value production requires and depends on the exploitation and transformation of noncapitalist social relations, such as the social obligations that accompany a gift, in order to transform things into commodities to be exchanged in a market (Tsing 2013). However, this process is neither obvious nor easy, and the value system of gifts often resurfaces in unexpected ways, like when Japanese consumers purchase matsutake mushrooms as a commercial product but still use them as a quintessential gift presented to reaffirm a relationship (Tsing 2015).

Exploring another facet of capitalist value production, scholars in the social and cultural studies of biology such as Rose (2001), Sunder Rajan (2006), and Cooper (2008) have suggested that in the age of biotechnology, as the substances and promises of biological materials (cells, genes, or tissues) are increasingly inserted into projects of product-making and profit-seeking, we are witnessing the rise of a new kind of capital: "biocapital." This term, which goes back to the Marxist critique of political economy, draws attention to the dynamics of labor and commoditization that characterize the production and marketing of living entities as industrial and pharmaceutical bioproducts (Helmreich 2008, 463-64; see also Hoeyer [2007] for a critique of the commoditization hypothesis).

Important debates about new forms of capitalism driven by biomedical technoscience have continued, particularly in the pages of this journal. For example, Birch and Tyfield (2013) provided a powerful critique of the many contributions found under the bioeconomy heading that tend to fetishize bio-concepts. In their view, these conceptualizations not only misappropriate political economy concepts such as value, capital, or surplus, but they also misrepresent modern bioscience and biotechnology by emphasizing the processes of commoditization and the so-called latent value in biological processes (Birch and Tyfield 2013, 313). Instead, they argued for placing other economic and financial processes at the heart of STS analysis of bioeconomies, paving the way for more political economy–oriented contributions that focus on rent-seeking and asset production (e.g., Birch and Tyfield 2013; Birch 2017; Birch and Muniesa 2020; Pinel 2021). According to these authors, the asset—meaning a tradable resource that an actor owns or controls with the expectation that it will provide a future benefit—has become the central tenet of technoscientific capitalism, imposing the speculative logic of investment and return as the key rationale and overtaking commoditization (Birch and Muniesa 2020).

However, classifying things as gifts, commodities, or assets is more difficult than it seems in contemporary (bio)economic life. Recent cultural economic analyses show that when living things such as seeds (Braun 2021), soybeans (Delvenne 2021), fish (Dobeson 2021), or cows (Turnbull and Barua 2023) are exchanged and valued, the analytical distinction between commodities, gifts, and assets, while clearly established in economic sociology or STS theory, is far from obvious in practice. This empirical statement opens the way to an original approach that does not focus solely on one or the other form of exchange or pit them against each other, as the abovementioned literature often tends to do. Rather, it is useful to consider how valued living things breach existing categories. For this reason, we propose to bring together the notions of gift, commodity, and asset within a single approach that recognizes the coexistence of different valuation practices of living things and related economic forms.

To this end, it is necessary to clarify and define the key concepts of gift, commodity, and asset and to specify where value lies in each form of exchange. First, a gift brings something personal to people who are connected beyond the exchange and whose relationship is difficult to set aside and overcome (Mauss 1990; Tsing 2013). Value in the gift system lies in social obligation, connection, and reciprocity. Second, a commodity is a thing intended for exchange under capitalist conditions (Marx [1887] 1971), which is the result of a successful alienation, that is, the separation of that thing from its producer and its context of production (Appadurai 1986; Tsing 2013). Value in the commodity system lies in the use and exchange of goods. Third, an asset is a thing that can be owned or controlled, traded, and capitalized as a revenue stream, often involving the valuation of discounted future earnings in the present (Birch and Muniesa 2020). Value in the asset system lies in investment and management practices (Birch 2017); unlike a commodity, an asset is a resource that can be used and exchanged but it also has value as property.

From this point of view, we assume that different types of value are formed in specific scientific and regulatory contexts and can compete with each other but also coexist in specific arrangements (Pinel 2021; Aarden 2022). The innovative nature of our approach is based on two ideas. First, the different qualifications as gift, commodity or asset that living entities receive, as well as the consequences of these qualifications, are only accessible by observing the valuation practices that configure living processes. Hence, we begin with the hypothesis that valuable living "things" may move in and out of the gift, commodity, or asset form several times and in different sequences over the course of their life cycle. Second,

characterizing these flows implies a much-needed shift of analytical attention from the distinct economic forms (such as gifts, commodities, and assets) that produce value to the rapid transformations and entanglements between forms of value (e.g., economic, therapeutic, epistemic). This shift is key to understanding contemporary capitalist value production in biomedical technoscience.

## Materials and Methods

To trace the circulation of cells and observe the valuation practices to which they were linked, we adopted Appadurai's methodological principle that "it is things in motion that illuminate their human, [economic] and social contexts" (Appadurai 1986, 5). This entailed following blood cells as they were transported from one infrastructure (i.e., clinic) to another (i.e., laboratory) and as they mobilized specific biomedical practices and financial and logistical resources. Going with the flow of cells and tracing their trajectories within the hospital also responded to the call by Braun, Brill, and Dobeson (2021, 272) to "understand their form[s] of exchange—that is, the mode[s] things circulate under and are evaluated in, as well as the corresponding economic assemblages they summon—as tied to their materiality rather than as a mere convention between human economic actors."

To do so, we used an abductive qualitative approach on a single in-depth case study in a Belgian university hospital specialized in cell therapies.[3] We combined four methods: prolonged observation, semi-structured interviews, focus group, and document analysis. The empirical fieldwork was conducted between November 2019 and March 2021. Regular participant observation was conducted during meetings of the hospital's transplant committee (composed of clinicians and a representative of the CTLab), weekly team meetings with all CTLab staff, and four cell donations. Ethnographic fieldwork in the laboratory also included ten observations of cell manipulations (when possible, of the entire process) and the participation in training sessions for CTLab staff, including a half-day online workshop on stem cell therapeutic procedures as well as regular training of laboratory technicians (e.g., on good manufacturing practices).

In parallel, we also conducted fifteen semi-structured interviews with lab executives ($n = 6$), laboratory technicians ($n = 5$), a maintenance staff worker, the director of the biobank, a member of the hospital ethics committee, and an industrial pharmacist, and we organized a focus group with CTLab executives on the evaluation of their practices by the Federal Agency for Medicines and Health Products. In addition, there were informal

interviews with four cell donors and everyday informal talks with the CTLab director, executives, or technicians.

Three key elements were followed and analyzed to track the trajectories of the cells. First, as participant observers (Soulé 2007), we regularly shadowed CTLab technicians and executives as they manipulated blood cells in the lab. We took photos and made many notes, which we recorded in a field journal that was regularly expanded to ensure a constant back-and-forth between impressions and details of the field. Questions for clarification were raised as they arose in informal discussions with CTLab members.

Second, we analyzed the CTLab's protocols (written and validated by the laboratory's managers according to current institutional and legal requirements), which organize and describe the conditions under which human bodily material can circulate and be handled within the hospital. Specific questions about these documents were asked during semi-structured interviews with the quality control managers of the CTLab to ensure our understanding of the documents.

Finally, in addition to allowing us to step back from situations experienced during routine laboratory manipulations, the interviews allowed us to trace the participants' career paths (i.e., their training and professional activities at the CTLab as they have unfolded to date) and relate them to the evolution of CTLab practices in the context of collaborations with public and private partners, scientific advances, and patient care needs.

Grounded in an interpretivist paradigm, our analysis first involved describing how the therapeutic and research protocols depicted the trajectories of the cells and the practices and discourses of the actors involved. We analyzed our interview and observational data, wrote a descriptive report, and asked the CTLab director to review it. This allowed us to observe, among other things, the recurring practices of the technicians, the importance of administrative work regardless of the cell therapy, the need for a dress code depending on the type of space in which the observations were made in the laboratory (e.g., clean room or not), and the measures taken to prevent cell contamination.

Based on these descriptions, which cover several cell therapies practiced at the CTLab, the strategy for writing this article was to take a thematic approach by focusing on the most practiced and frequently observed therapy, ECP.

This paper was written following a double movement of interdependence between the deductive movement of formulation and the inductive movement of verification, which allows each of the operations to be formed in

relation to the other. Methodologically, we have used "abductive analysis" (Thomas 2010; Tavory and Timmermans 2014; Thompson 2022), a process that consists in treating general propositions, which are formulations of modes of action, as hypotheses, instead of treating them as required or necessary. When there are discrepancies between the observed facts and what the hypothesis or theory requires, there is a good reason to modify the hypothesis (i.e., the watertight boundary between different forms of exchange or the tendency to approach the economic implications of biomedical technoscience only within the framework of a dominant economic logic). In our case, what was challenged in a double movement of theoretical and empirical considerations were fixed analytical categories of gift, commodity, and asset. These were chosen because they are economic forms that have received extensive scholarly attention in STS and anthropological analyses of bioeconomies.

In terms of contribution, this paper has a twofold objective: empirically, it provides a description of a cell therapy to understand a case study that is still relatively unexplored in the STS literature; theoretically, it demonstrates abductively the movements between cells' gift-commodity-asset status in order to account for the particular relations that support different economic logics in the configuration of living processes. Our findings confirm the need for an approach that shifts analytical attention from discrete forms of value to their rapid transformations and the entanglements of the relationships that sustain them. The next section aims to show this empirically with our case study.

## The Tangle of Valuation Practices in ECP

ECP is considered a safe and effective treatment for chronic GvHD which occurs when the donor's cells recognize the host organism as foreign. This condition usually appears "within three months post-transplant and the chronic form beyond hundred days" (CTLab executive, interview, March 5, 2021). Presented as the negative side of allografting (i.e., the transplant of an organ, tissue, or cells from one individual to another individual), this disease is a very common problem as an estimated 40-60 percent of allograft patients suffer from it (Servais et al. 2016). To treat these side effects, the patient's own cells are processed and returned to him or her.

From a technical point of view, ECP is defined by the CTLab as a therapeutic approach based on the combined effects of ultraviolet A (UVA) and the photosensitizing agent 8-methoxypsoralen (8-MOP), on mononuclear cells in a patient, usually by apheresis. From a regulatory perspective,

the therapy is not classified as a drug because the changes undergone by the cells are not considered "substantial." So far, the European Committee for Advanced Therapies decided to let national regulatory authorities choose how to classify ECP. Belgium, for now, continues not to consider cell modification as "substantial." However, as we shall see, this is a matter for debate. If this were to change, it would have concrete financial implications, as the cost of producing the treatment would be significantly higher because laboratory technicians would have to perform ECP to the pharmaceutical industry's higher standards (e.g., need for stricter monitoring of environmental contamination, additional equipment, and human resources).

At the CTLab, ECP therapy is performed more than fifteen times per week, which is more than any other cell therapy.

> The thing is that ECP is done on a long-term basis for a patient, who comes in for treatment two days every two weeks. One patient two days every two weeks is fine. But right now, we are dealing with four to five patients that need to be treated with ECP every day. (Technician, interview, December 9, 2020)

This clinical trial has been in place for some time and has become more and more present in the life of the laboratory:

> Interviewer: When did ECP start?
> Technician: Two or three years ago? Originally it was supposed to be temporary (laughs). It became temporary permanent. (Technician, interview, December 9, 2020)

This "temporary permanent" feature has consequences on the daily agenda of the technicians in charge of routine manipulations.

> [ECP] changed a lot of things! (laughs) Because it takes up all our lunch hours and all our days. . . . It's our daily life, this stuff, it's there every day, it's there all the time. (Technician, interview, February 25, 2021)

Despite the organizational difficulties and technicians' increased workload, CTLab executives consider it important to maintain this intensity of patient care in the absence of a therapeutic alternative for GvHD. They hope the clinical trial they have set up with the financial support of the Department of Hematology will build a strong-enough case for the therapy to be reimbursed by the Belgian social security system one day.

**Photo 1.** Photo of the bag retrieved from the dialysis unit before the start of the manipulation, September 9, 2020. *Source*: Photo taken by the authors during fieldwork.

In order to receive the therapy, strict legal and institutional procedures organize the collection and handling of the cells. Once patients are recruited, they must comply with a technical and legal mechanism, the informed consent,[4] which allows a bag of their blood cells to circulate within the hospital. Once the procedures are in order, the therapy begins like any other collection from circulating blood: using a dialysis machine, the patient's mononuclear cells are collected to keep only the cells with therapeutic value, plasma, and white blood cells. The red blood cells are reinfused directly into the patient.

When it is ready, the bag of cells to be treated is packaged and labeled, and the CTLab technician comes to a designated collection site and transports the harvested bag of cells to the benches in the laboratory where it will be processed (see Photo 1).

Initially, all cells follow the same path opened by autologous therapy based on a form of exchange that is a gift-with-consent model. As discussed in the second section, valuation through gifts rests on social relations and

**Photo 2.** Photos of the illumination device and of the bag specially designed for this manipulation, February 26, 2020.

obligations. In principle, and according to Belgian law,[5] cell harvesting is considered a donation and cannot be remunerated. However, in this case, reciprocity is achieved by trading an experimental medical treatment for two small cell samples that patients give to researchers for further use (more on this below). Gifts are also a matter of connection: apart from these donated samples, the link between patients and their cells is never broken, because it is the person's own bodily material that becomes the vehicle for treatment, which continues as follows.

Under the hood to prevent contamination, the technician adds a bag of 0.9 percent NaCl solution to the bag of cells. The sterile compress is unwrapped before disinfectant liquid is applied to the tips of the bags to disinfect them. Using scissors to control leakage, the two bags are combined into one, called a "special ECP bag." The chemical agent 8-MOP is then added to this bigger bag, which is weighed before being irradiated in the phototherapy light machine (see Photo 2). From one bag to another, each manipulation has a cost: some cells remain in the original bag and are therefore lost for the rest of the treatment. The irradiation process takes twelve to fifteen minutes. During this time, the technician continues to fill out the administrative form and performs a microbiology test to verify that the original bag is not contaminated.

The gift we are talking about here has a double dimension: patients agree to put their cells into circulation because they will benefit from the process (self-donation), but on the condition that they also give up ownership and control over a small part of them (their gift to researchers). This is where a bifurcation occurs, when a tiny fraction of the cells leaves the therapeutic pathway to enter the research and development pathway, which entails

**Photo 3.** Photo taken of extracorporeal photopheresis handling during sample collection, September 9, 2020.

different practices of valuation and gives the cells an economic form other than that of a gift.[6] In exchange for health value, patients agree to give a sample of their cells to biomedical researchers to feed the study database and improve the knowledge, expertise, and reputation of the CTLab, thus producing epistemic value. To proceed, the technician collects two samples (approximately 1.5-2 ml), which are sent to the biobank and frozen using cryopreservation techniques (see Photo 3).

In sum, the temporary separation of certain blood cells (i.e., the white blood cells and plasma) from their bodily context is organized as a partial donation of bodily material to which the patient consents and which is reciprocated by the benefit he or she receives from the cell therapy. Within the laboratory, a separation occurs between those cells that will continue their path as therapeutic products and the sampled cells stored in the biobank that will take a different path and be transformed into assets, that is, resources that scientists own and control and that will then be mobilized for future benefits, such as publications in academic peer-reviewed journals and credibility capital or the future acquisition of laboratory equipment.

Indeed, to carry out cell handling, technicians depend on specific, often very expensive machines. Sometimes, there are no alternatives to what a single supplier can offer, which places the latter in a dominant position vis-à-vis the laboratory.

> The CTLab buys most of its equipment at a premium, especially in cases where suppliers have a monopoly. (CTLab executive, interview, November 22, 2019)

In the case of ECP, at least two technical solutions exist, and the members of the Belgian Hematology Society involved in the current clinical trial are working hard to demonstrate that the cheaper machine is just as effective. The cell samples sent to the biobank are thus being used to consolidate a body of tangible evidence that will enable them to apply to the hospital for the purchase of additional equipment at a reasonable cost:

> We have already asked for two machines, but they wouldn't let us. Because the machine is expensive and . . . we don't have enough ECP patients to be able to have a second one. (Technician, interview, September 9, 2021)

> Our samples allow us to advance a clinical trial that will show the usefulness of a certain technical equipment that is in competition with another that charges insane prices, so as to advance the pawns for the day when there will eventually be reimbursement (by Belgian social security). (CTLab executive, interview, February 25, 2020).

Removed from bodies and detached from market transactions, whether they return to their host body or are cryopreserved, ECP-treated cells are treated during their time in the laboratory as "quasi-commodities" (Braun 2021). They are sufficiently removed to be manipulated and partially traded, but the vast majority will never be completely alienated from their donor. The donor retains the right to retrieve them because they are promised to return to the status of (autologous) donation.

As Pinel (2021) shows in her analysis of the production of knowledge and value in UK-based epigenetics research laboratories, the processes of value creation and extraction are deeply intertwined with processes of assetization. Indeed, our case study shows both the creation of therapeutic value (making an innovative cell therapy available to a series of patients) and epistemic value (completing the clinical trial database and publishing on cell therapy in academic journals). At the same time, knowledge and value are extracted from an increasing number of patients to strengthen

assets—tangible in the case of technical equipment and intangible in the case of international recognition and credibility for developing innovative cell therapies. Building and consolidating these assets is key to expanding the laboratory's portfolio of cell therapy projects and collaborations, including manufacturing other innovative products beyond ECP. In this sense, the process of asset consolidation at work with the ECP does not *directly* contribute to a "rentier regime of accumulation" in which assets are rented out outside the lab in exchange for a fee (Birch 2020). Instead, the process *indirectly* contributes to rent creation because it allows CTLab's executives to manage different Research and Development (R&D) lines as "alternative investment options" (Rushforth, Franssen, and de Rijcke 2019). The investment can be taken in an economic sense, but it should be emphasized that it is primarily a commitment to improve population health by addressing diseases in a credible, effective, and ethical manner, for which no economic return is expected or allowed by law.[7]

The coordination of the hospital infrastructures (dialysis department, CTLab, and biobank) and the actors involved (patients, nurses, and technicians), as well as technical and emotional investments and gestures that are precisely timed and executed, are extremely important to make these flows possible.

> You really have to live at the rhythm of the cells ( . . . ) you have to be able to manipulate them in time because they don't wait, they can lose quality. Cells don't wait. (Technician, interview, February 17, 2020)

To paraphrase Myers (2008), the "body-work" of the technicians who follow the protocol and manipulate the cells allows for the production of multiple forms of value that are already inherent in the technical gestures of the laboratory. While this "body-work" prepares the cells to fit into value categories for specialized connections, it does not prevent the development of corporeal and affective entanglements with cells whose anonymity, required for ethical reasons, is difficult to maintain, especially when patients have to undergo therapy over a long period of time. For the technicians, the patient's state of health is also an additional reason for concentration, commitment, and professionalism, since they know that their work is linked to a matter of life and death.

> I like what I do, I like my job, now it's true that it's exhausting in the sense that you have to be there all the time. I'm a stressful person by nature, I'm a stressful person in life, but I'm going to say that when I manipulate that stress

> goes away because I like what I do. And I'm not saying you're never sure of yourself, but everything you do has to be thought out and controlled. So, you can't make a mistake. A stupid mistake can have serious consequences . . . for routine products with patients behind. If you do four to five a day, at some point you can do it with your eyes closed. But you always have to be on your toes and control your actions, you must not touch your needle, you must not go over it, you must have a certain way of handling that must always be the same. (Technician, interview, October 16, 2020).

The final step in the therapeutic pathway of the cells begins when the technician leaves the lab with the bag of cells and goes to the dialysis unit where the patient is waiting. The technician takes the elevator and looks for the nearest station in the hospital to receive the bag. The performance of alienation that characterizes the commodity form of exchange is nevertheless repeated, since the technicians are careful not to come into direct contact with the patient. They then leave it to the nurses—to whom they hand the bag of irradiated cells—to take control of the final stage of autologous donation. In the patient's room, the irradiated cells are reinjected intravenously into the patient's body.

## Discussion

As they pass from hand to hand in the hospital, from collection to reinjection, blood cells bridge the clinic and the CTLab, participating in a tangle of valuation practices that build upon each other. By going with the flow of these cells as they leave the bodies they normally inhabit, we gained access to the issues and practices of a series of actors (patients, clinicians, nurses, and lab technicians) who gravitate around them in the consolidation process of an experimental therapy. In less than five hours, as the cells complete their journey, various economic forms are superimposed: a biological gift is both subjected to a quasi-commoditization logic and leads to the constitution and consolidation of various assets, without the vast majority of cells losing their quality of autologous donation. In our analysis, it is not one or the other economic form that prevails or fades away, but the three economic forms that are nested within each other and that mark and shape the stages of the cells' journey.

In other words, it is not a matter of deciding or prioritizing between different logics (e.g., donation, commoditization, or assetization) that would best characterize the new configuration of biomedical technoscience and capitalism. Rather than shifting the focus to a dominant form of

exchange, we benefit from an approach that allows for the multiple transformations of living things that acquire, accumulate, or relinquish the characteristics of the gift, commodity, or asset as they move and encounter actors driven by different, not necessarily conflicting, value logics. These results highlight the particular relations that support different, entangled, economic logics and reject the idea of a watertight boundary between different forms of exchange.

Consequently, it is important to combine STS approaches to biomedical technoscience that focus on biological materialities, with those that focus primarily on the political–economic strategies of actors. In our case, biological materiality was where we began to trace the movements of blood cells within the hospital, which led us not only to observe a process of quasi-commoditization that would interact with a gift economy but also to see different processes of assetization at work among the scientific actors involved. Once we move beyond the "static" categories of gift, commodity, and asset and go with the flow of cells to consider the different valuation practices they are subjected to, we refocus our analysis on the more or less rapid changes between different economic logics.[8] Rather than emphasizing the contrast between gift and commodity or asset economies, the analysis focuses on their overlap and their entanglement through valuation practices.

If things can become gifts, commodities, and assets over the course of their lives and in different sequences, different forms of value (e.g., economic, therapeutic, epistemic) are produced, and the understanding of what is valuable emerges along with the technical means to recognize and measure it. In our case study, the sorting of cells (e.g., choosing white blood cells over red blood cells, or diverting the therapeutic pathway to an R&D pathway by collecting samples for cryopreservation) is a crucial aspect of their valuation (see also Tsing 2013): assessing their quality, preparing them for different connections, using them as gift, commodity, or asset.

Yet a different arrangement of the economic logics guiding the flow of cells is conceivable. Just because decisions are made and the movement of cells is constrained by a strict legal and scientific framework does not mean things could not be otherwise. For example, if Belgian law allowed payment to human tissue donors, it is likely that the scarcity of certain cells with which to experiment would be less of a problem, and also that the market for human bodily material as a commodity would be much larger, like in other parts of the world. Similarly, if ECP therapy were reimbursed by the Belgian state, some of the processes of assetizing donated cells to justify the purchase of expensive laboratory equipment would be much less relevant. In other words, even if they seem hardly possible in the situation we have

described, changes in the characteristics of the present situation can be imagined, and these would have repercussions on the whole chain of actors and institutions involved as well as on their relationships.

The resulting "valuation constellation" (Waibel, Peetz, and Meier 2021) to be examined is therefore a precarious achievement, the study of which requires both an openness to value shifts (because things may lend themselves to different economic forms as they circulate), as well as situating the multiple valuation practices within the broader context that makes them possible. In the case of ECP, the context is notably characterized by taxonomic uncertainty, as regulatory authorities have not yet resolved doubts about the classification of cells processed by ECP. There is "ontological surgery" (Jasanoff 2011, 61) going on here, an effort to classify these ambiguous entities in scientific terms and to link them to moral conclusions. This work of classification is an integral part of a larger "ontological politics" (Mol 1999), a composite term we use here to suggest that the different valuations we analyzed are actively shaped by a set of practices (medical, scientific, and regulatory) that concern and go beyond how cells are treated and valued in the hospital.

At the moment, in direct relation to the valuation practices, we have observed in the laboratory, a struggle continues in regulatory arenas over how to view the biological materiality of the cells transformed by the therapy. This means that biological materiality is significant not only because it provides an entry point for observing situated, entangled valuation processes that would reveal the different strategies of biomedical actors but also because it makes valuation strategies possible. For the time being, the European Committee for Advanced Therapies has suggested that "irradiation, separation, concentration or purification of cells . . . should not be considered as substantial manipulation" (European Medicine Agency 2015, 5). However, this does not clarify the status of ECP-treated cells.

> There's a Committee that deals with all the cell and gene product issues and they were asked by a country and they said, "I would like to have this classified as ATMP" because their national agency had deemed that, and the Committee said, "No, we don't classify it as such." But they didn't classify it at all, anywhere. They didn't say, "It's a transfusion product" or whatever, they said, "No, we don't classify it." (CTLab executive, interview, March 5, 2021)

This lack of status (we know what the therapy is not, but we do not know what it is) is left to the competent authorities in each country, and no

country has yet decided to rule otherwise on the therapy. In Belgium, the Federal Agency for Medicines and Health Products (FAMHP) is still debating how to classify ECP. What is at stake for biomedical actors like those of the CTLab is to continue to convince their respective regulatory authorities that the ontology of the cell remains the same *after* the transformations it undergoes in the laboratory. The argument they and their European counterparts are currently defending is that UVA irradiation of cells is necessary to treat sick patients but is unlikely to alter the material biology of the cells in a "substantial" way. A routine inspection by the FAMHP, on which the laboratory's accreditation depends, could lead to a new decision that would classify the experimental treatment as a drug. The consequences of such a decision are feared by the members of the CTLab, as it would require the cells to be irradiated according to the higher standards applicable in the pharmaceutical industry. ECP would then have to be prepared in clean rooms with more stringent environmental contamination monitoring requirements, requiring expensive equipment and more personnel. This would also mean more work for technicians who are already struggling to keep up with the daily pace of care production to current standards.

Our analysis of entangled valuation practices in ECP therapy highlights the health, epistemic, and economic value production enabled by this space of taxonomic indeterminacy. If the balance of power at the Belgian or European regulatory level were to change, and leading regulators were to conclude that cell irradiation transforms human bodily material into a medicine, then for both practical and economic reasons, the current clinical trial should probably be halted, as well as the care provided to patients.[9]

When asked what principles should guide the classification of ECP and thus shape the valuation practices to which irradiated cells are subjected, CTLab executives raise patient interest and safety as goals to guide any future classification decisions:

> Irradiating cells certainly modifies, it modifies, but if we . . . what is the purpose of [requiring higher standards of production for a cell therapy]? The stated purpose is to ensure patient safety. But I'll tell you, the products here are handled in a closed circuit. What will applying stricter constraints to a photopheresis process do for patient safety? Nothing at all. So, it's an aberration. (CTLab executive, interview, March 5, 2021)

Currently, CTLab members are fighting to keep this borderline therapy out of a different classification scheme in order to benefit from greater freedom of action and to ensure they can treat patients with chronic diseases.

## Conclusion

STS scholars have made significant advances in analyzing how biotechnologies and new biological artifacts "disrupt the conventional boundaries and identities of biological forms . . . and allow multiple life forms to be created and given life, and perhaps, multiple lives" (Webster 2012, 1-2). They invite us to consider the plasticity of living matter: "Any live thing made of cells, after these interventions, becomes an object that can be stopped and started, suspended and accelerated" (Landecker 2010, 220). Such plasticity, however, has gone largely unnoticed in analyses of how living things are valued, successively and sometimes simultaneously.

In this article, we have discussed a therapy based on exposing blood cells to UVA radiation and related advances, made possible by new biotechnologies for controlling living matter. By following the circulation of cells between the clinic and the laboratory, we have observed multiple and intertwined valuation practices, including the technical process of the act of treatment by irradiation, the growing reputation of the laboratory that performs it, the ensuing epistemic developments for the scientific community, the use of scientific knowledge for the future purchase of laboratory equipment, and the therapeutic gain for patients afflicted by chronic diseases.

We can now ask how much of what we have said about the superimposition of economic processes and the entanglement of the relationships that sustain them is specific to ECP and the context of taxonomic indeterminacy we have described. The processes leading to the creation of multiple forms of value could be different if this therapy were classified as a substantial manipulation of cells. Once the therapy is approved as a drug, if it ever is, it is possible that the dynamics of transformation would lead to a more discrete classification of value if the exchanges took place entirely within the market. It will be up to future research to continue this analysis. Nevertheless, we believe that the approach developed in this paper can be productively applied to any other cell therapy.[10]

It remains for us to point out three possibilities for building on these results in order to further this research. First, there may be variation in the sequences in which moving cells take on different economic forms and thus participate in the creation of different forms of value. Studying the therapeutic process of ECP elsewhere, in a different sociocultural or socioeconomic context and/or laboratory, might reveal other economic superimpositions and other salient forms of value than those identified here. The position of the clinic and the biomedical researchers in the broader

political–economic and ethical context may matter to such flexibility in exchange and value production.

Second, our approach to the intertwining of economic processes in practice could be extended to other forms of exchange than those we described and observed (corresponding to the analytical categories of gift, commodity, and asset). Although these categories are most studied in STS literature about the bioeconomy, other economic forms (e.g., singularities, commodities with unique and incommensurable quality-based characteristics; Karpik 2010) could complement the contribution proposed here and lead to additional theoretical advances.

Third, it would be beneficial to use the approach proposed in this paper for ECP therapy and to compare with other cell therapies carried out in the same laboratory. This would make it possible to see whether the political–economic strategies of biomedical actors vary depending on the type of treatment proposed (is it a health product or not?), the state of regulation, the type of cells treated (mesenchymal stem cells, umbilical cord blood cells, and CAR-T cells), the type of donors (healthy or sick), and the type of recipients of the cells injected (autologous or allogeneic process).

Overall, our results show it is analytically imprecise to assume a priori that almost all cells at the heart of innovative therapies will follow the same valuation path and correspond to the same economic form. By tracing the movements of the cells, by going with their flow, we realize that the bifurcations and superimpositions of logics specific to donation, commoditization, or assetization are much closer to actual practices than a uniform shift toward a dominant economic logic that would best characterize the new configuration of biomedical technoscience and capitalism.

This gesture is also useful because it gives a grip to the critique of capitalism—that of the actors involved in the situations we describe and that of the STS scholars concerned with matters of concern, critique, and care (Latour 2004; Puig de la Bellacasa 2011)—from the entangled valuation practices to broader socioeconomic orderings. Describing the value constellations surrounding biomedical advances; their dynamics; and the fragile, random, and reversible flows on which they rest (as in this case where they depend largely on taxonomic indeterminacy) is key to describing the "rough edges of capitalism" (Tsing 2012, 39) as it appears in the field of cell therapies. As Braun, Brill, and Dobeson (2021, 275) point out, "mutability is not simply an inherent ability of things to change form. We can also think of it as a reaction to shifts in the wider topography of the economic world." These reactions and their effects should be studied more

systematically, linking the value changes observed at the level of the laboratory to broader capitalist transformations.

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## Notes

1. The terms “extracorporeal photopheresis” and “extracorporeal phototherapy” are both used in the biomedical literature and by the scientists and technicians we met. In this paper, we use extracorporeal photopheresis while also mobilizing their common acronym ECP.
2. As we will see in the Discussion section, this lack of commercialization has not prevented clinical practice to progress on the contrary. The context in which ECP therapy is currently performed is shaped by the ongoing debate among European regulatory authorities as to whether ultraviolet irradiation of cells constitutes a “substantial” modification of cells and the implications of this decision.

3. The CTLab was officially established in the early 2000s at one of the country's leading university hospitals. Its innovative activities and the prestige of its members have earned it institutional recognition over the years. Activity reports of the University Hospital highlight its scientific advances, related technological investments, numerous accreditations for cellular therapy, fundraising activities, and extensive collaborations with public and private partners. CTLab's members, especially its executives, are regularly invited to join international clinical and regenerative medicine associations, ensuring the continuity of the laboratory's reputation and CTLab's importance within these networks.
4. As a bioethical principle, informed consent protects the patient from exploitation and misconduct in biomedical research, but it also performs another function, that of regulating and formalizing the transfer of possession from a donor to recipient. Informed consent effectively acts as a "surrogate property contract" (Waldby and Mitchell 2006, 71-72).
5. Federal Parliament of Belgium, Law of December 19, 2008, on the procurement and use of human bodily material for human medical applications of scientific research.
6. If we broaden the focus beyond the cell flow we are observing here (from collection to reinjection into the patient), there is another dimension to the notion of gift that can be put into perspective by our observations and which points to a prior connection with the patient's donor. Indeed, in this case of ECP therapy, the gift of two small vials of cells to CTLab researchers can be seen as a second gift—after a first gift turned out to be a "cursed gift" because the stem cell or bone marrow transplant that patients received and which was of vital importance to them also backfired, when the donated cells began to attack the recipient's body, making the ECP necessary. The ensuing social obligations are fraught with consequences: to survive in the best possible conditions, patients are condemned to relive the sequence of their treatment twice a month, and to frequent the social world of the clinic for the rest of their lives. This logic of gifts that add up to one another, according to their own process and with their own consequences, would merit a work on its own and is beyond the scope of this paper.
7. The Belgian Law of December 19, 2008, on the procurement and use of human bodily material for human medical applications or scientific research purposes prohibit the commercialization of body parts. Only services related to cell harvesting may be invoiced, in cases where the CTLab supplies human bodily material to scientific or commercial actors, which is not the case for the ECP.
8. From our emphasis on flows and movements, the reader might assume that, in our view, only flows are linked to value. That is, for there to be value, there must be flows. In fact, however, circulation is not the only reason for valuation or

value shifts, as is clear from many science and technology studies works that argue value involves storage as much as flows, for example, storing biological materials in a biobank (Pinel and Sventsen 2021; Liburkina 2022; Aarden 2022). We do not deny that immobility is crucial for understanding valuation processes (Delvenne 2021), but we want to emphasize that to observe mutations between different economic forms and the creation and entanglement of multiple forms of value, it is necessary to consider flows that may include storage but go beyond it to take into account a larger part of the biographies of things.

9. This raises the question, beyond the scope of this article, about the relationship between the study of situated valuation practices and the exercise of critical judgment about these practices, and the contexts in which value is measured, established, maintained, negotiated, provoked, contested, and so on (see Doganova et al. 2014, 88).
10. For example, and although this case deserves an analysis of its own beyond the scope of this paper, using our observations of a therapy based on cord blood donation at the CTLab, we can highlight different possible pathways for cord blood units (CBUs) as they move from the clinic to the lab: cord blood biobanking, R&D, or waste. Diverting or slowing down the circulation of these other donated blood cells and turning them into different kinds of resources becomes a central issue here too. Laboratory analysis of CBUs for multiple parameters such as serology, human leukocyte antigen, cellularity level, or viability leads to different valuation practices: either the cells are suitable for medical therapy and can therefore be preserved using cryopreservation techniques or the quality criteria for biobanking cannot be met and the reuse of the CBU for R&D will generate epistemic (if used for scientific publications) and economic value (if services related to cell procurement are billed to private companies seeking human bodily material).

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