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# The annihilation of time by space: Pluri-temporal strategies of capitalist circulation

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**Abstract**

This paper contributes to thinking about the circulation of commodities across global supply chains by considering moments when circulation is intentionally slowed down for the purpose of capital accumulation. I examine oil tank farms at sites such as Cushing, OK, which act as a spatial fix allowing producers and speculators to place millions of barrels into storage during moments of overproduction. Oil storage is largely driven by futures markets. When prices are low, speculators store oil in order to derive higher profits by selling their product at a later date – a strategy that I describe as the annihilation of time by space. However, as tanks fill up, the crisis of overproduction begins to express itself as a shortage of storage capacity. In the absence of tank space, speculators have turned to supply chain infrastructures such as railcars and oil tankers as creative storage alternatives. Any empty space remaining in tanks becomes highly valued and traded or speculated upon as its own commodity. Ultimately, this paper offers a corrective to recent literature on global capitalist supply chains by demonstrating that capital accumulation relies not only on the speedy movement of commodities across global space; rather, capital employs pluri-temporal strategies of circulation.

**Keywords**

Supply chains, logistics, oil, pipelines, Marx, circulation

In October 2012, Musket Corporation announced the opening of a new rail terminal that would enable the movement of an additional 30,000 barrels of crude oil per day out of northern Colorado. Upon making the announcement, managing director J.P. Fjeld-Hansen stated that, 'We recognize a continued demand to move crude oil efficiently by rail, and now that we [...] have expanded our terminal and trucking network, we have further enhanced our well head to end user service capability' (Musket Corporation, 2012). Three years later, Fjeld-Hansen explained to *The Wall Street Journal* that since the new facility had opened, its function had changed: 'The focus has shifted from a loading terminal to an oil-storage and railcar-storage business' (Friedman and Tita, 2016).

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The railcars at Musket's terminal were filled to the brim with oil, but rather than moving this product efficiently from 'well head to end user' as the company had initially intended, the railcars remained stationary at the terminal, lined up along the tracks.

This article contributes to a growing literature on the circulation of commodities along the supply chain infrastructures of global capitalism. However, unlike much of the recent literature that tends to emphasize the capitalist imperative to accelerate the velocity with which commodities circulate, here my intention is to think carefully about moments where supply chain infrastructures are employed to perform the exact opposite function—where supply chains are used to relent the rate of circulation. At least since Marx, theorists of capitalist circulation have stressed the importance of moving commodities to markets quickly in order to hasten the rate of capital accumulation. Marxist theory typically suggests that the faster the turnover time of cycles of accumulation, the greater the number of cycles that can be completed, hence the more capital that can be generated (Danyluk, 2018; Harvey, 1999: 85–87, 377–380). In the late 1980s, Harvey (1989) argued that this tendency towards 'time-space compression' had intensified as the global economy shifted from Fordism to neoliberal models of capitalism (284–285, 293). Recent scholars of supply chain logistics have likewise taken up this emphasis on the imperative of speed for capitalist accumulation under conditions of neoliberal globalization (Cowen, 2014a; Danyluk, 2018).

Where contemporary scholars of supply chains address slowdowns or stoppages in circulation, they tend to explain these as either a type of unintentional bottleneck which occurs as a consequence of either design imperfections in the circulatory infrastructure or as social disruptions such as blockades or acts of sabotage (Chua, 2017a, 2017b; Cowen, 2014a, 2014b; Pasternak, 2017; Pasternak and Dafnos, 2018). These explanations assume that the interest of producers is to move products to market rapidly, and that slowdowns impair the generation of profit and accumulation. Moreover, it is implied that as soon as these unintentional or unforeseen impediments are ironed out or resolved, circulation will continue apace. These explanations for delays or gridlock in supply chains are not incorrect, but taken together what they miss are the instances in which slowing down circulation occurs intentionally and in the interest of capital accumulation. In other words, slow circulation is not always a result of accidents, oversights, or disruptions – rather, there are moments at which decelerating speed is an outcome consistent with the internal logic of capitalism. Careful attention to these moments can help expose the structural tensions and contradictions that are inherent to the capitalist mode of production.

In order to exemplify these points, I consider the example of Cushing, OK, where giant tank farms sprawl across the landscape, holding tens of millions of barrels of oil at a standstill. I argue that storage spaces such as these serve as a type of spatial fix for the oil industry, allowing excess oil to be temporarily taken out of circulation at moments when there is glut of cheap oil flooding the market and driving prices down. By storing oil, producers and other sellers of the commodity are able to avert a crisis in overproduction that would otherwise force producers to either sell low or scale back the rate of fossil fuel extraction. Much of the economics of oil storage is driven by speculation and futures markets. When the spread between the current market price of oil and futures market prices is greater than the cost of storage over that same period, there is an incentive to store now and sell later in order to maximize returns. So, whereas Marx described how capital can exploit price discrepancies between markets that are spatially distanced by accelerating the rate of circulation, which he referred to as the 'annihilation of space by time', here I want to think of the ways that capital exploits price discrepancies between markets that are temporally distanced by using spatial infrastructures to *decelerate* the rate of circulation, a practice that I argue can be thought of as the 'annihilation of time by space'.

As the incentive to store commodities increases, storage space becomes increasingly scarce and thus increasingly valued. At this point any empty space remaining in tanks becomes traded as its own coveted commodity. Here a situation arises where the absence of a commodity – specifically the absence of oil in tanks – becomes its own commodity. In recent years, available space in tanks became so highly valued that leases on empty tank space are now traded on their own futures markets, where speculators attempt to derive profits based on their predictions of what the value of this space will be later in time.

Ultimately, my argument is that while there are scenarios in which the rapid circulation of commodities serves the interest of capital accumulation as emphasized in much of the current literature, there are likewise other scenarios in which circulation slows down or grinds to a halt in order to avoid selling low and taking a loss. In other words, capitalism employs *pluri-temporal cycles* of circulation and accumulation. The multiple temporalities of circulation, and the role of futures markets and speculation in influencing these temporalities of circulation, have not been adequately considered in the existing literature on supply chains. Moreover, because this speculative activity requires the production of massive storage infrastructure such as the tank farms at Cushing, understanding the economics of storage can help us to think about the materiality of futures markets and speculative activity, and the ways that financial capital contributes to the production of space, time, and nature in ways that are unique from other forms of capital.

## Marxian theories of speedy circulation

In the *Grundrisse*, Marx identifies a fundamental tension between the demands of space and time within the capitalist mode of production which helps to explain the crucial role played by supply chain infrastructures in circulating global commodities. On the one hand, capital accumulation demands speed. If value is generated by completing cycles through which money is invested in a production process resulting in a commodity that is then sold and thereby 'retransformed' back into money plus surplus capital (M–C–M′), then the faster that this cycle can be completed the quicker surplus capital can be reinvested in further rounds of accumulation. This is to say that compressing the 'turnover time' of the cycle of accumulation enables more cycles to occur in a given period of time, and thus results in more value accrued (Danyluk, 2018; Harvey, 1989, 1999). On the other hand, capitalism requires continual spatial expansion. As a mode of production that prioritizes exchange value over use value, accumulation comes to rely on selling commodities to markets that are located at an ever-increasing distance. As Marx (1973) writes, 'this spatial moment is important in so far as the expansion of the market and the exchangeability of the product are connected with it' (534). Extending capitalism's reach spatially also offers the producer access to new sources of labour and raw materials, thereby reducing the cost of production (Harvey, 2003).

Marx considers that if a commodity were produced and sold in the same location, then the cycle of accumulation could theoretically be equal to the time of production alone – that is to say that no additional time would be required to move the commodity to another location before it is sold for profit. If the movement of the commodity 'proceeded as rapidly in reality as in the mind', then the 'repetition of the production process would be restricted only by the amount of time that it lasts, the amount of time which elapses during the transformation of raw material into product' (Marx, 1973: 538–539). But, herein lies the moment at which the demands of space and time collide. The further afield that capitalism reaches, and the greater the distance between sites of production and sites of consumption,

the more time is required for products to be transported to market. As Marx (1973) nicely sums up:

> capital must on the one hand strive to tear down every spatial barrier to intercourse, i.e. to exchange, and conquer the whole earth for its market, [while] it strives on the other side to [. . .] reduce to a minimum the time spent in motion from one place to another. (539)

For Marx, this 'time spent in motion' or circulation is a 'time of devaluation', meaning that the longer a product remains in circulation the less surplus value it can ultimately generate (539). Not only are there costs incurred by transportation that eat into profits, but circulation time also lengthens the overall turnover time of accumulation and therefore impedes the onset of subsequent rounds of investment, as noted above. As Marx describes in the *Grundrisse*,

> the velocity of circulation, the *time* in which it is accomplished, is a determinant of how many products can be produced in a given period of time; how often capital can be realized in a given period of time, how often it can *reproduce* and *multiply* its value. (538)

The need to circulate products through space therefore acts as a 'barrier' to the repetition of the production process (545). Minimizing circulation time therefore minimizes the devaluation of the product by ensuring greater profitability in the current cycle of accumulation and by enabling a greater overall number of cycles.

On Marx's account, space and time place limits upon one another, and these limits ultimately restrict the rate at which accumulation can occur. Space limits the speed of accumulation because the further commodities have to move, the more time it takes for them to get to market. Conversely, we could say that time places limits on space because the imperative of a rapid turnover time restricts the distance that commodities can travel while remaining profitable in exchange. In order to perfect the process of accumulation, capital must find a way to expand its reach spatially while also reducing the movement of commodities temporally. This is where Marx famously writes that the solution developed by capitalists is the 'annihilation of space by time'. The tension between the imperatives of space and time gives rise to the development of faster and faster transportation technologies that hasten the pace at which commodities move across space, thereby overcoming the distance of markets. Spatial distances become measured by the time it takes to move between two points, and this time is increasingly compressed. As Marx (1973) writes, 'even spatial distance reduces itself to time; the important thing is not the market's distance in space, but the speed – the amount of time – with which it can be reached' (538). As technological innovations move ever closer to eliminating circulation time altogether, they thereby obliterate the barrier that spatial distances pose to the accumulative process.

More recent scholars of supply chains have taken up and developed the theme of speed in processes of capital accumulation, emphasizing the increasing velocity of circulation under conditions of neoliberal globalization (Cowen, 2014a; Danyluk, 2018). As barriers to trade were dismantled worldwide, a consequence of the global economy's transition from Fordism to neoliberalism (Harvey, 1989), and as the production process itself has increasingly become decentralized and distributed across global space (Coe and Yeung, 2015), the demand for efficient and dependable circulatory systems has become more vital than ever, while the organizational challenges associated with this circulation have become ever more complex. Scholars of supply chains point to recent innovations in the technologies of transportation, such as the widespread adaptation of standardized intermodal shipping containers (see, for instance Chua, 2016; Cidell, 2012, Gregson, 2017; Levinson, 2016; Martin, 2014), as well as the recent 'revolution' in supply chain logistics (Chua et al., 2018; Cowen, 2014a). Logistical

sciences employ modelling technologies to carefully manage and orchestrate the flow of things over long distances to and from sites of production via networks of global distribution infrastructures that traverse continents, oceans, and geopolitical borders, ensuring just-in-time delivery. Scholars of these recent technological and managerial innovations in supply chains and global production networks tend to emphasize how they contribute to smoothing out the bumps and inefficiencies that impede the speedy flow of materials through this worldwide circulatory system of things.

In the following sections however, I think through these theories of capitalist speed and circulation in relation to the movement of oil, and by doing so I find that this case does not perfectly accord with the suggestion that capitalism places a premium on speed and acceleration. Thinking along the oil pipeline offers a different perspective on the circuitry of capital – one that is not only characterized by speed and smooth flows, but one that is at times also characterized by the sluggish movement of things. Here then, I want to consider how we might theorize or make sense of the spaces in which the circulation of 'capital in the commodity form' slows down or grinds to a halt.

## Understanding backlogs and bottlenecks

Visitors to Cushing, OK, are greeted by a sign constructed out of steel pipes that welcome them to the 'pipeline crossroads of the world' (Figure 1). This is the place where oil goes to rest. In this town of less than 8000 people, billions of dollars of oil – tens of millions of barrels – are held in oil tank farms that sprawl out across the landscape over hundreds of acres (Figure 2). According to the US Energy Information Administration (EIA), as of September 2017 approximately 61 million barrels of crude oil were being stored at Cushing, while across the United States a total of about 254 million barrels of crude sat idle in storage facilities awaiting further circulation.

If the imperative of capitalism is the speedy circulation of things, then how do we explain spaces such as these where commodities lie dormant? At Cushing, not only does the circulation


**Figure 1.** Sign welcoming people to Cushing, OK.
Source: Photo by Roy Luck. Licensed under Creative Commons Attribution 2.0 Generic (https://commons.wikimedia.org/wiki/File:Pipeline_monument,_Cushing_OK.jpg).

**Figure 2.** Aerial view of tank farms at Cushing, OK.
Source: Map data: Google 2018.

of the commodity grind to a halt, but the circulation of capital also becomes bound up in the investments required to build and maintain these storage facilities. If Marx and others are correct in theorizing that the logic of capitalism requires hastening the pace of accumulation, in part by circulating commodities from production to consumption as quickly as possible, then how do we make sense of these expansive infrastructures stationed here and elsewhere throughout the global oil assemblage where the flow of billions of gallons of oil reaches a standstill? If the purpose of supply chains is to facilitate the smooth and speedy delivery of commodities to markets, then how do we account for supply chain infrastructures that are specifically designed to slow down the pace of these movements?

In a landmark study of supply chain logistics, Deborah Cowen (2014a) notes that a 'more nuanced' account of supply chains would 'highlight the frequent disruptions' that include 'the everyday delays of bad weather, flat tires, failed engines, missed connections, traffic jams, and road closures' as well as more deliberate disruptions that include labour disputes or political actions (2). However, even where Cowen and other critical scholars of supply chains identify moments where circulation slows down, these moments are generally understood as either unintended or undesired impediments to capital's underlying interest in maintaining the fluid circulation of commodities. The supply chain literature identifies several different reasons that explain why blockages and backlogs occur, which I suggest can be broadly categorized as imperfections, accidents, and disruptions.

An imperfection is a deficiency or irrationality in supply chain design or management that has yet to be perfected by logistical sciences. These types of imperfections are commonly found at transfer points, or 'seam spaces' (Cowen, 2014a; Gregson et al., 2017), where two transportation modalities meet. For instance, Gregson et al. (2017) describe how 'freight cargo flows are heterogeneous', meaning that they arrive at different rates and volumes and consequently have to be consolidated or deconsolidated, thereby creating 'frictions' in circulation (384). In the case of oil, when existing pipeline capacity is insufficient or

unable to handle the volume of products that need to be moved at once, a backlog results and storage is temporarily required while excess volumes await their turn in the pipes. This need to increase capacity of circulation in order to avoid bottlenecks in delivery is one of the arguments that is frequently made by the oil industry in favour of new pipeline developments coming out of Alberta's tar sands. National borders constitute another seam in global flows that, from the perspective of logisticians, might be understood as a type of irrationality that might be overcome through the creative enactment of legislation, trade agreement provisions, or expedited border security procedures (Orenstein, 2018). Imperfections could also include wrinkles in logistical planning that have yet to be ironed out, such as scheduling inefficiencies. Gregson (2017) argues that inefficiencies and frictions of circulation within supply chain systems become more apparent through careful empirical investigation or ethnography of how the circulation of goods actually occurs in practice, or what she refers to as 'logistics at work' (see also Lawhon, 2013).[1] In sum, imperfections are frictions that are internal to the supply chain itself, but which can theoretically be fixed or vastly reduced with improved design, modelling or logistical management. They are treated as techno-managerial issues – areas of inefficiency where logistics have yet to smooth out the seams of circulation. But, the assumption remains that once these inefficiencies are improved or perfected by logistical sciences, commodities will be returned to constant rapid motion.

Accidents are a second explanation for backlogs that are identified in the literature. Accidents are problems that occur in the supply chain that tend to be accepted as somewhat unavoidable everyday issues but which inevitably delay deliveries such as flat tires or failed engines (Cowen, 2014a: 2). In the case of oil, pipelines invariably corrode, crack, split at the seams, and seep on a near daily basis. That spills invariably occur is known, but where and when they occur remains impossible to foresee. When spills do occur, lines must be shut down resulting in temporary bottlenecks and a need for storage. This was the case when the Keystone pipeline leaked in November 2017 near Amherst, SD, resulting in a pipeline shutdown for nearly two weeks. As a result, the 590,000 barrels per day that would have normally flowed through that line needed to be temporarily stored in tank farms in Hardisty and Edmonton, AB (Lewis, 2017). This pipeline leak is just one example of an accident, but taken as a whole they are relatively commonplace. Accidents tend to be the result of technological failings, but they can also be attributed to human error or unpredictable environmental circumstances. To some extent they could probably be mitigated by improving supply chain technologies and logistical planning, such as designing better tires, scheduling more regular maintenance of mechanical parts, or the improving traffic infrastructure. But they may also be the result of conditions that seem to be beyond the control of supply chain logicians, such as extreme weather conditions that can bear down upon infrastructures and reduce circulation to a crawl. Regardless, accidents typically result in only minor and temporary inconveniences or disturbances that may require temporary storage, but which the supply chain network as a whole can broadly absorb.

Disruptions are a third source of backlogs accounted for in the existing literature. Disruptions are interventions by human actors that deliberately attempt to impeded or inhibit the continued circulation of commodities (Cowen, 2014b). They are usually motivated by social, political, economic, or ecological objectives. Cowen (2014a) identifies labour actions, blockades, terrorist attacks, and pirate raids as examples of these 'deliberate interruptions' (2). As supply chains become increasingly vital to capital accumulation under conditions of neoliberal globalization, they equally become more vulnerable (Chua, 2017a: 264; Chua et al., 2018; Cowen, 2014a, 2014b). Consequently, we have increasingly witnessed political and economic struggles play out along these lines rather than at sites of production

where traditional Marxist accounts would tend to expect anti-capitalist mobilizations to be located (Chua, 2017a; Cowen, 2014a; Pasternak and Dafnos, 2018). Cowen (2014b) observes that 'one of the most potent forms of disruption to supply chains comes from logistics workers'. Chua (2017a, 2017b) raises questions about how solidarities can be built between workers who face unequal working conditions across uneven supply chain space. Supply chain disruptions have also been an effective tactic of Indigenous peoples in North America asserting jurisdiction or sovereignty in opposition to ongoing processes of colonization and resource extraction on their territories (Pasternak, 2017; Pasternak and Dafnos, 2018). Cowen (2017) additionally points to the occupation of expressways by Black Lives Matter as an example of supply chain disruption. Tsing (2009) argues that by thinking about the different ways people are positioned along supply chains offers an opportunity to 'imagine the ''bigness'' of global capitalism without abandoning attention to its heterogeneity' (150).

As with all categories, the lines which distinguish imperfections, accidents, and disruptions are blurry, and these categories could surely be delineated otherwise. One way that I differentiate these categories is according to the extent that they are internal or external to the management and governance of supply chain infrastructure. Imperfections can be seen as entirely a result of techno-managerial failings that are internal to supply chain design or governance, whereas social disruptions can be understood as the result of external actors who oppose these circulations. Accidents occupy the blurry middle ground between these categories insofar as they are often the consequence of unforeseen external events such as severe weather, but arguably could be accounted for with better logistical planning and infrastructure. The distinctions between these categories are nevertheless contingent upon where we draw our lines between the internal and the external, or in other words the extent to which we believe that the science of supply chain logistics can effectively manage, govern, or account for the entire vast field of socio-ecological unruliness. But regardless of how we distinguish imperfections, accidents, and disruptions, each of these explanations shares an understanding that the ultimate objective of capitalist circulation is the acceleration of the speed with which commodities move from sites of production to market.[2] Various different impediments may stand in the way of this objective, but it is generally agreed that the interest of global capital is to resolve any such obstructions as they arise so that the speedy circulation of things can resume, thereby minimizing the need for storage and stagnation.

But, while the dominant trend in the critical literature on supply chains typically assumes that commodities would remain in constant motion if the circulatory systems of capitalism were perfected and running smoothly, some scholars have gestured towards moments where capitalist actors can benefit from slowdowns. Paché (2007) considers the scenario of a high-cost energy future wherein the 'degradation of logistical performance will be the only possible way, and it will be necessary to justify this new deal to the consumer' (312). Under these circumstances, companies might attempt to gain market advantage by branding slowness as a more economical option for consumers. However, even in this scenario described by Paché, slower circulation is still assumed to be an involuntary consequence of 'conditions concerning the price of energy [that] will oblige companies to change strategy radically' (312).

Gregson et al. (2017) move beyond conceiving of supply chain slowdowns as always necessarily unintended and undesired by capitalist firms. They suggest that in some instances obstacles might be deliberately produced and leveraged as a strategy or tactic by competing firms 'wrestling to exercise control and capture value' along the supply chain (384). The authors discuss how some logistical actors offer preferential or prioritized sequencing for more powerful clients at transfer points thereby forcing smaller clients to endure slower service (393). Chua (2017b) makes a similar point, providing the example of

the Pacific Maritime Association deliberately slowing down transactions at ports on the west coast of the US in 2014 with the intention of undermining longshore workers and ultimately replacing workers with automated technologies (179). What these authors point to is a more complete conception of supply chain logistics where power lies not strictly in the ability to speed circulation up, but also in 'retaining an active power to slow [circulation] down' (Chua, 2017b: 178).

On the whole, this aspect of logistical power, the power to slow the movement of commodities down, has received less attention and remains conceptually underdeveloped in the critical literature on supply chains and capitalist circulation. The intentional deceleration of circulation is not only employed as a strategy through which competing firms attempt to capture existing value from one another at the 'seam spaces' of global capital flows where commodities change hands or transportation modalities (Gregson et al., 2017). Slowing circulation and increasing the turnover time of capital accumulation is also used as strategy through which value is generated. Indeed, much of the oil stored in tank farms at Cushing, OK, is held not because it is unable to move, but rather because sellers do not want it to move. Temporarily storing crude can help sellers fetch higher prices, increase profit, and ultimately result in greater capital accumulation than would otherwise be generated by compressing turnover time and circulating the commodity more quickly. In these circumstances, the circulation of things is deliberately decelerated in the service of capital accumulation, and for reasons that are internal to the logic of the capitalist mode of production.

## The annihilation of time by space

As Mazen Labban (2008) has argued, the oil industry is structurally prone to overproduction. This is to say that there is an inherent tendency in the industry to produce so much oil that ongoing production inhibits accumulation by creating a glut on the market which lowers prices and limits profitability. Overproduction is structurally pervasive in the global oil economy in part because so much fixed capital investment is required to produce and circulate this commodity. This is especially the case with the extraction of unconventional fossil fuels which requires massive capital investment in infrastructural mega-projects such as offshore drilling platforms or bitumen upgrading facilities (Watts, 2015; Zalik, 2015). Large-scale and continuous production becomes necessary in order to make these infrastructures worth the fixed capital investments that they require. In the case of Alberta's tar sands, the imperative to produce has proven so strong that even during periods when the price of that heavy crude falls well below levels at which extraction remains profitable, bitumen production has continued to increase nevertheless (Austen, 2015). Tar sands producers will avoid turning off the taps at all costs, in part because many of them would still be responsible for servicing loans on their mega-projects regardless of whether or not they continue producing. The costs of shutting down and restarting operations can also be considerable, and in some cases (as with in situ tar sands extraction), shutting down can potentially 'damage the resource reservoir', thereby sacrificing the possibility of future extraction (Fielden, 2016). The problem for producers is that continuing production can result in an abundant supply of oil which limits the price that the commodity can command on markets. So, if producers want to avoid selling their commodity at low prices and risk taking a loss, but simultaneously want to avoid relenting the rate of production, then they must find other ways to manage supply, such as taking crude out of circulation and placing it in storage. Constraining supply in this way by removing it from circulation can contribute to driving prices back up.

Sellers are especially incentivized to store now and sell later when futures prices are higher than the current market price – a market condition known as contango. The Western Texas Intermediate oil markets at Cushing were in a state of contango for roughly a three-year period from November 2014 through to November 2017 (Figure 3). At some points over this period, futures prices outpaced spot prices to such an extent that analysts described the market as being in a state of 'super contango' (Kilduff, 2015). When the spread between the current spot prices and futures prices of oil is greater than the cost of storage over that same period, sellers can lock in a profitable return with relatively low risk – a strategy known as 'cash and carry arbitrage'. What results is the production of tank farms at sites like Cushing, where infrastructure is constructed for the purpose of keeping oil at a standstill as the owners of the commodity await higher prices. Far from being a scenario where capital accumulation necessitates the smooth flow and continual circulation of crude, or where storage indicates a failure or shortcoming in the system, here oil is stored *in the service of capital accumulation* by producers or other speculators who seek to sell their commodity at higher prices in the future than they can fetch at the present moment.

Whereas Marx described how price discrepancies between different markets that are spatially distant require producers to move their commodities across space in order to maximize returns, here we have a scenario where price discrepancies at different points in time require producers to hold their product over time in order to do the same. If transportation is the circulation of goods across space, then we can think of storage as the circulation of goods across time. And, if the annihilation of space by time is the use of supply chain technologies to accelerate the velocity with which commodities move across space in order to overcome price discrepancies at different spatial locations, then I would suggest that we might think of storage at sites like Cushing, OK and elsewhere where oil remains immobile awaiting better prices promised in the future, as the annihilation of time by space, that is the use of the spatial infrastructures of supply chains to hold commodities stationary in order to overcome price discrepancies located at different points in time.

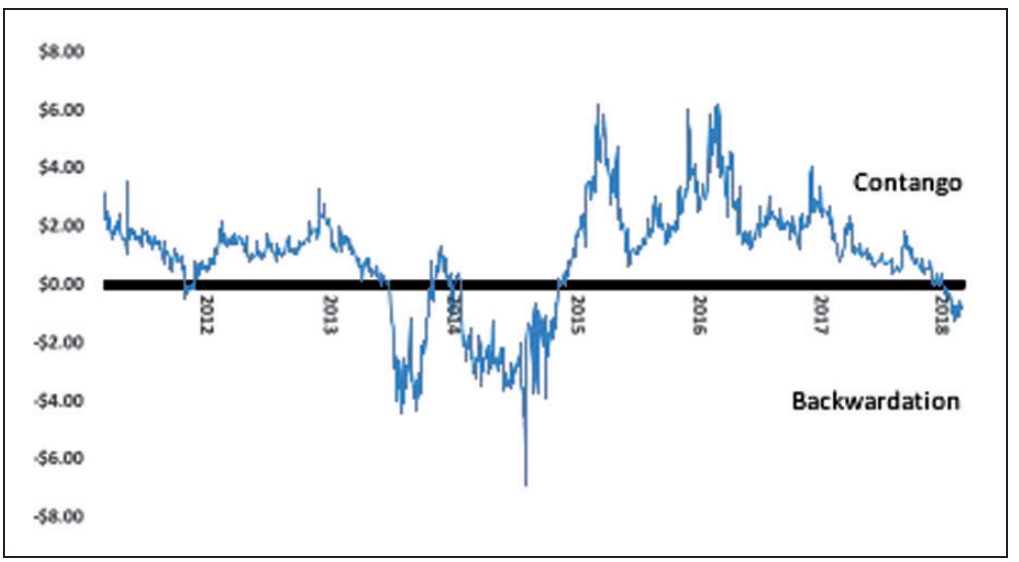


**Figure 3.** Spread between Western Texas intermediate spot prices and futures at Cushing, OK (dollars per bbl). Source: Created by the author with data from the US EIA.

Tank farms at sites such as Cushing function as a type of spatial fix, where the systemic crisis of overproduction in the oil industry is resolved spatially by building up massive storage reservoirs that sprawl out over hundreds of acres, allowing surplus crude to be temporarily removed from circulation. The problem for the oil industry is that the underlying crisis of over-accumulation is not resolved by this spatial–temporal fix of slowing down the tempo of accumulation. Transferring surplus product into holding tanks may allow the impending crisis of overproduction to be temporarily averted, but the crisis can only ever be merely forestalled and displaced – before long it emerges elsewhere. Indeed, this spatial fix effectively transfers the crisis onto the supply chains themselves, and eventually resurfaces as a dilemma of insufficient storage capacity when tanks fill up and additional surplus can no longer be accommodated. In other words, the spatial solution of storing oil eventually leads to its own problems once existing storage capacity is filled.

At this point, if producers remain unwilling to either relent production or dump their surplus product onto the market, then more storage capacity must be built. Tank farms and storage infrastructure thus expand outwards, swallowing up ever larger tracks of land, and imprinting an ever larger footprint upon the landscape. In just three years between 2014 and 2017, while the market was in contango, the total capacity of crude storage in the US increased 23%. EIA inventories recorded a utilization rate at Cushing of 88% in March 2017. Even with new tanks being built, demand for storage outpaced the construction of additional capacity. During this extended period of contango, new tank farms could not be built fast enough to assuage rising demand. Even as the total working capacity of storage tanks increased, the utilization rate of this capacity remained on the incline, meaning that the available storage capacity declined even as new tanks were rapidly being built (Figure 4).

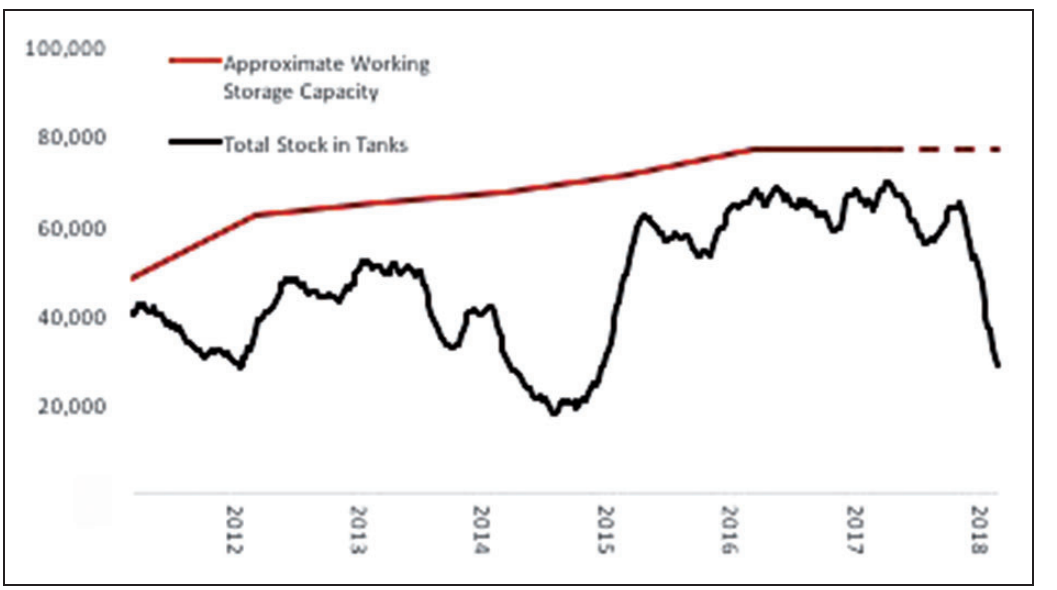


**Figure 4.** Crude oil working storage capacity and stocks at Cushing, OK March 2011–March 2017 (thousands of bbls).
Source: Created by the author with data from the US EIA.

## Commodifying the absence of the commodity

This repeated pattern of expanding storage capacity by building new tanks that are promptly filled eats into oil industry profits in two significant ways. First, with each new tank farm that is built, more capital becomes fixed into this storage infrastructure, thereby disabling its circulation and potential to generate value through investment in other productive activities (Harvey, 2014: 76–78). Second, and perhaps even more importantly, as the actual available capacity declines, the cost of storage space becomes inversely expensive, which threatens to negate any profits that might be yielded from actually storing the oil. As available storage space in tanks becomes scarcer and thus increasingly prized, it can be sold at a premium to producers, refiners, oil traders and speculators, or smaller users and distributors. As the *Financial Times* reported in May 2016, 'With crude oil piling up around the world the space inside terminals is now a hot commodity' (Meyer, 2016).

Here we see a situation in which the absence of a commodity (in this case the absence of oil inside tanks) becomes its own valued commodity. The empty space inside tanks becomes bought and sold on secondary markets. Because parties that lease tanks pay the same monthly fee regardless of how full their tanks are, it makes economic sense to utilize as much of their tank space as possible. If a lessee does not entirely fill a tank with their own product and has a little space to spare, they might sublease the remaining partial tank to another party who can then add their own product to the mix – a situation which is known in the industry as 'co-mingling'. In some cases, where customers have signed long-term leases and have a monthly rate locked in that is lower than the current going rate of storage space, lessees can sublease their tank space to other parties at less than or equal to the going rate and turn a profit on the space.

Other firms work as brokers, specializing in the exchange of tank space. Tank Tiger is one such firm. This company formed in 2015 to serve as a clearinghouse for the trading of oil tank leases and subleases, connecting those who have available space with those who need it. As the company describes on its website:

> The enormous growth in the midstream and terminal storage industry has quasi-commoditized what these assets offer to the marketplace. A brokerage function can improve the efficiency of this process. The founders and staff at The Tank Tiger have recognized, and are stepping up, to satisfy the prevailing need created by the excitement and opportunity of these changes. We're kind of like Uber for storage tanks. Think of it as StubHub, Priceline and Match.com all rolled into one. (Tank Tiger, 2018)

Again, what is being traded here is not the oil itself so much as the empty space in which oil could potentially be stored. Other firms, such as Matrix Global Holdings, auction off oil storage futures contracts. Here, it is not only the empty space that is commodified, but the value of the empty space at a future moment in time which is bought and sold as a commodity.

At moments when capacity at tank farms is scarce or perhaps not available at all, producers or speculative investors will also seek out unconventional storage solutions such as leasing railcars that can be filled with oil and left to sit in the terminal as described in the opening of this article. As Ernie Barsamian of Tank Tiger was quoted as saying in the *Financial Times*: 'At the end of the day, you just never run out of storage. People just get clever about where they put the barrels' (Meyer, 2016). In addition to railcars, oil tankers offer another creative storage option for speculators. According to data from Kpler, in June 2017, nearly 112 million barrels of what is known as 'floating storage' was being held in oil tankers worldwide (Wingfield, 2017). In 'super contango' conditions, speculators will lease oil tankers for tens of thousands of dollars per day just to keep

them stationary. According to Clipper Data (2017), as of February 2017 64 million barrels of floating storage (the equivalent of 32 Very Large Crude Carrier supertankers) was being held off the coast of Singapore, which has been described as an 'oil parking lot'. In addition to Singapore, volumes of floating storage were reported to be increasing off the coast of Iran and off the coast of England in the North Sea during 2017 (Wingfield, 2017). It has also been reported that oil tankers will take circuitous routes to deliver products to market, hoping that by the time they arrive at their destination prices will have already risen. For instance, in March 2016 the *BBC* reported an increase in tankers choosing to round the bend of the Cape of Good Hope in South Africa on the way to Europe from the Persian Gulf or Asia rather than taking the much faster and more direct Suez Canal route. As the report explains:

> [the shippers] choose to be at sea longer in certain cases and they can take longer routes, even shopping unsold cargo round various ports in Asia, Africa and Europe, in an attempt to find the right buyer at the right time [...] For now some ships have decided to take those additional thousands of miles round the Cape, hoping that at the end of the voyage they'll come out in profit. It may seem strange – but in the world of oil, sometimes you're better off taking the long way round. (Baraniuk, 2016)

In other cases, oil tankers have been described as drifting aimlessly, uncertain where to go in order to receive the prices they require for their cargo. In 2017, Bloomberg reported on a 'lonely drifting oil tanker' that had left Britain filled with oil heading for China when it suddenly stopped off the coast of Morocco and remained suspended, floating for a week with no interested buyers and thus no immediate destination (Hurst and Blas, 2017). Far from supply chains facilitating the speedy circulation that we are used to hearing about in much of the literature, these cases exemplify the very intentional practice of using supply chain infrastructures – trains, oil tankers, pipelines, storage tanks – in order to decelerate the velocity of circulation and forestall the completion of accumulative cycles in order to generate greater profit. These infrastructures, which are typically known for facilitating speedy delivery, can also act as stationary and immobile containers of capital in the commodity form.[3]

Oftentimes, the exchange of ownership of oil in tanks takes place without any actual physical movement of the good at all. In some cases, this is because the commodity is exchanged as an 'in-tank transfer', meaning that ownership merely changes hands on paper. In other cases, when crude futures contracts expire, the balance owing is settled through the exchange of money or offsetting contracts rather than the actual physical delivery of the goods sold. In these cases, profits are derived from the exchange of the commodity on paper, but the only things that actually circulates are deeds, contracts, payments, or electronic data. The oil in the tanks itself remains stagnant, functioning much like a giant financial battery, or a bank account accumulating interest. We might think of this as fixed capital in the commodity form.

## Conclusion: The pluri-temporalities of capitalist circulation

Simply put, my argument is that there are situations in which the imperative of capital accumulation is to accelerate the speed and velocity with which commodities circulate along supply chains, and there are likewise other situations in which the imperative is to intentionally slow this circulation down. Deceleration is not always indicative of imperfections in supply chain design or logistics, nor is it necessarily the consequence of an interruption. It can also be deliberate, consistent with the ultimate objective of capital accumulation, and internal to the logic of the capitalist mode of production. I am therefore

arguing that capital accumulation employs *pluri-temporal cycles* of circulation and accumulation. Whereas geographers are highly attentive to the 'multiple, simultaneous spatial strategies' that capital pursues in order to offset crises in diverse sites of investment (Zalik, 2015: 2452–3; see also Smith, 1984; Storper and Walker, 1989), here I want to call attention to multiple temporal strategies that capital employs, accelerating and decelerating the speed and velocity of the circulation in order to evade economic crisis by responding to the fluctuating and somewhat erratic market conditions that are reflective of global capitalism's underlying structural contradictions.

But, what is also important to emphasize here is that the multiple temporal logics of circulation are often driven by speculative capital and futures markets. The relation between these futures markets and current spot prices determines oil inventories and the rate of circulation. When markets are characterized by conditions of contango there is an economic incentive to store. However, when markets veer towards backwardation, then the incentive becomes more immediate circulation. Thus, whereas Marx (1973) claims that if '*circulation time* [...] were = 0, then value-creation would be at its maximum' (539), the case of oil is illustrative of why this is not always the case. This may generally hold true in conditions when current prices are lower than spot prices; however, when the opposite is true, delaying the arrival of oil to markets can sometimes allow sellers to obtain higher overall profits in the long term. The case of speculative oil storage also provides a clear example of how current market prices are impacted by futures markets and speculation and not entirely determined by the economic fundamentals of supply and demand (Labban, 2010). As futures prices rise in relation to spot prices, more oil is stored, which in turn limits supply and causes current market prices to rise.

This speculative activity produces space and nature in distinctive ways, resulting in the creation of new storage facilities and tank farms which sprawl across landscapes. While much attention has been paid to the ways that neoliberalization produces distinct 'neoliberal natures' (Bakker, 2009, 2010; Bigger and Dempsey, 2018; Castree, 2008a, 2008b; McCarthy and Prudham, 2004), I agree with Loftus and March (2015), who note that 'the discussion of neoliberal natures remains somewhat unsatisfying for the frequent neglect of the growing importance of financial markets, financial institutions and financial actors'. While recent scholarships in the field of geography and other disciplines have examined the centrality of financial capital and speculation in the contemporary global and economic order (Hall, 2010; Konings, 2018; Pike and Pollard, 2010; Sheppard and Barnes, 2017), as well as its ubiquity in everyday life and processes of subject formation (Hall, 2011; Joseph, 2014; Martin, 2002), less attention has been paid thus far to the ways that financialization produces space and nature. As French et al. (2011) write, 'a glaring lacuna at the heart of the financialization project [is] its relatively uncritical approach to the role of space and place within monetary and financial processes' (805). I contend that oil markets and sites of storage offer an entry point into thinking more broadly about how futures markets and financial capital produce distinct spatio-natural formations (Kay, 2017; Knox-Hayes, 2013; Loftus and March, 2015).

As I write this article, markets have recently veered away from contango and towards conditions of backwardation (Figure 3). As this occurs, and the incentive to store is gradually eliminated, the spigots on storage units begin to open up, and oil gushes back into circulation. According to data from the EIA, in just four months between November 2017 and March 2018, oil stocks at Cushing were drawn down from over 64 million barrels to just 28 million barrels. The emptying out of oil storage occurs in an uneven and graduated manner, beginning with the most expensive storage arrangements, such as floating storage and railcars. Oil being stored in tanks with the most expensive leases (typically those that

were leased at premium rates when demand for space was greatest) is the next to go. Tanks that were leased out long term at lower rates before space was as highly coveted will often continue to hold on to stored oil longer. All of this is ultimately governed by the economics of cash and carry arbitrage. As oil empties out, some firms are left paying monthly fees on empty tanks that they have already signed long term leases on, which may incentivize them to sublease these tanks at a lower rate in order to try to recoup some of their expenses.

However, the fact that oil is now flowing once again does not necessarily indicate that the underlying structural dilemma that led to storage has been alleviated – it may ultimately result in exacerbating the crisis in accumulation. This is because backwardation does not necessarily mean higher prices and profits – it only means that future prices decrease *relative* to spot prices. Ultimately, the problem of low spot prices may remain. The nature of the global oil assemblage (Appel et al., 2015) is such that even when producers or cartels in one part of the world cut output in order to eliminate global overproduction and rebalance supply and demand, this can result in production increasing or coming online elsewhere, effectively cancelling out any price gains that would otherwise have been made. Moreover, because backwardation results in the emptying out of storage, excess oil is dumped into circulation and onto the market, which further contributes to limiting spot prices. For producers and sellers of oil, the problem of backwardation is that it can ultimately force their hand, leaving no other option but to sell low and potentially take a loss because their storage fix no longer pencils out economically. Moreover, because storage capacity was rapidly built-up during the previous period of market contango, the oil industry now faces the additional burden of having more capital than ever before fixed in grossly underutilized and unproductive storage infrastructure.

Attention to the ways that futures markets and speculation shape the economics of storage and produce storage space raises several other avenues for investigation. Future research might consider the forms of labour that are required at oil storage facilities (Loewen, 2018), and the economics of insurance and security technologies that are employed at sites such as Cushing where millions of barrels of oil lay at rest. Another angle worth considering would be the geographical location and distribution of tank farms or other storage facilities. Cushing, OK, provides a strategic location for oil storage due to its relatively central location, offering access to and from sites of oil production across the continent, as well as its relative proximity to Gulf of Mexico where many refineries are located and where ports offer access to overseas markets. However, there is another advantage to Cushing, which is the relatively low cost of real estate. In other words, there is an economics to the location and spatial distribution of storage spaces that could be studied in greater detail.

While the focus of this article rests on the circulation of oil as a global commodity, I do not want to suggest that oil is perfectly exemplary of all other commodities, but nor is it entirely unique. Indeed, while there are other commodities that are stored and speculated upon in a manner that is comparable to oil, this is certainly not the case with all commodities. In the case of many manufacturing industries, just-in-time production strategies are specifically designed to reduce or eliminate storage by producing only as many goods as can be sold at an optimal price at a given time. Managing just-in-time production can therefore require slowing down or even halting the pace of production at strategic moments in order to prevent overproduction. The fact that the oil industry does remain prone to overproduction suggests that just-in-time strategies have not been successfully applied at the stage of production. The logistical solution is to compensate with just-in-time strategies at the delivery state which involve storage and futures markets. Moving products to markets at the optimal time becomes a problem for logistical sciences to resolve, and logistical solutions may involve different temporalities of production and

circulation in different circumstances. A comprehensive account of logistics must therefore account for these diverse strategies that are applied to different industries and different commodities under different market conditions.[4]

The application of these diverse logistical strategies, and the different temporalities with which commodities are produced and circulated, is partly informed by the specific material qualities of the commodity. Future research on supply chain logistics might therefore consider how the materiality of things renders some commodities better suited to just-in-time production strategies than others, or why futures markets incentivize the storage of some commodities but not others (Bakker and Bridge, 2006; Braun, 2005; Bridge and Le Billon, 2017; Le Billon, 2012). Greater attention might also be given to how these material qualities render some commodities more or less amenable to storage, or demand different storage conditions and infrastructures.

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## Notes

1. Gregson et al. (2017) later refer to this as 'logistics-in-action'.
2. In a review of Deborah Cowen's book, *The Deadly Life of Logistics*, Mazen Labban (2017) points out that not all capital circulates through space in the same ways or with the same velocity. Labban reminds us that the 'the physical movement of commodities within production or from production to market' is only one form of circulating capital on Marx's account. Other forms of capital, such as capital fixed in infrastructure, circulate at very different temporalities (267). To this, however, Cowen (2017) replies that the emphasis on logistics and the speedy circulation that she is concerned with specifically concerns the circulation of stuff, as in commodities (268–269). Likewise, the form of circulation that I discuss in this paper relates to what Marx referred to as 'capital in the commodity form'.
3. Labban (2017) remarks that the 'mobile components of fixed capital' such as ships, planes, trains, and trucks 'need to move constantly so that the value in them is valorized'; however, this example suggests that even these forms of capital can retain value when immobilized or when moving at different tempos and rhythms.
4. I would like to thank the two anonymous reviewers for their help in developing this point.

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