OIL PRICES, NON-DETERMINISTIC PATH DEPENDENCE AND THE FUTURE OF THE WORLD ENERGY ORDER

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RESUMO

A visão dominante nos estudos sobre a Economia da Energia é a de que o surgimento do moderno sistema de precificação de petróleo é a confirmação da hipótese dos mercados eficientes e da tese de que os sinais de preços seriam suficientes para guiar a transição energética rumo a um futuro renovável. Entretanto, o que se tem efetivamente observado é a continuidade da dominação do petróleo e do gás na matriz energética mundial, a despeito dos problemas ambientais associados a essas fontes de energia e de acordos para limitar seu consumo. Neste artigo argumenta-se que o poder importa; isto é, que decisões sobre como precificar o petróleo e o gás natural são também o resultado das decisões de atores importantes – guiadas por interesses investidos - em determinadas junções críticas da história. Neste sentido, o atual momento, que tem-se revelado extremo profícuo para a difusão das energias renováveis, representa também uma junção crítica para decidir como será o modelo de precificação de energia do futuro. Sob essa perspectiva, preços não são o reflexo neutro da interação entre ofertantes e demandantes no mercado; eles são instituições que refletem um determinado balanço de poder, e que, portanto, são capazes de estruturar o futuro. Para tal, demonstra-se que o moderno sistema de precificação do petróleo surgiu por meio de um processo não-determinístico dependente da trajetória, cuja origem remonta aos anos 1970. Nas décadas seguintes os participantes do mercado - empresas de petróleo, *traders*, países exportadores e atores do mercado financeiro - optaram por seguir essa trajetória, o que fez com que esta passasse a ter retornos crescentes de escala. Além disso, a decisão dos participantes foi determinante para que a lógica financeira se tornasse hegemônica neste mercado. Embora o resultado desse processo dependente da trajetória seja o "*lock in*" de um dado arranjo institucional, é demonstrado que em determinadas junções críticas existem possibilidades de mudança institucional, que são precipitadas sobretudo pelas decisões de agentes do mercado financeiro, pela estratégia geoeconômica da China, e pelas mudanças na matriz energética mundial. Sugere-se que a consideração dos custos sociais e ecológicos do sistema de precificação petrolífero dominante

possa ajudar a precipitar as próximas mudanças institucionais. O artigo é concluído com uma análise das perspectivas de uma transição deste sistema para modelos de precificação elétrica e para a chamada economia do custo zero marginal no âmbito da energia.

Palavras-chave: não-determinístico; dependência da trajetória; regime de precificação do petróleo; eficiência; financeirização dos preços do petróleo.

ABSTRACT

The dominant view in Energy Economics is that the emergence of the modern petroleum pricing system is the confirmation of the efficient market hypothesis and of the thesis that price signals are sufficient to guide the energy transition towards a renewable future. However, oil and gas are still dominant in the world´s energy matrix, despite of their environmental costs and of agreements to curb their consumption. In this article it is argued that power matters. In other words, decisions about how to price oil and natural gas are also the result of the decisions of important actors in certain critical junctures of history, which are guided by their vested interests. In this sense, the current moment, which has proved to be extremely useful for the diffusion of renewable energies, also represents a critical junction for deciding what the energy pricing model of the future will be. From this perspective, prices are not the neutral reflection of the interaction between suppliers and demanders in the market; they are institutions that reflect a certain balance of power, and that thus can structure the future. For that purpose, it is shown that the current market-based oil pricing regime has emerged through a non-deterministic path dependent process that has its origins in the 1970s. In the decades that followed, market participants - International Oil Companies, traders, oil exporting countries and actors of the financial market - acceded to that path, hence increasing its returns and leading to the dominance of a financialized market logic in oil & gas trading around the globe. Although the acceptance of market participants led to a seemingly “locked in” institutional arrangement, it is shown that at critical junctures change is possible, which has taken place mostly due to the agency of financial outfits, because of China’s neo mercantilist approach to energy, and due to the accelerated shift to sustainable energy carriers. Further, it is demonstrated that social and ecological non-paid costs profoundly encumber the current market-based pricing approach and put in check its future. Concluding, the perspectives of a radical departure towards electric pricing systems and of the zero-marginal cost society in the realm of energy are assessed.

Keywords: non-deterministic; path dependence; market-based oil price regime; efficiency; financialization of oil prices.

1. INTRODUCTION

In the past, the bulk of trade of oil and oil products took place between subsidiaries of the same group (Noreng, 2006), which operated, as it is common to say, “from the well to the wheel”. When needed, these internal transactions were enhanced by swaps of crude oil and products between oil companies, increasingly after oil exporting countries nationalized their industries. Today, oil is traded in a big global market, which in principle allows forces of supply and demand - albeit supported by some subsidies and the military guarantee in the Middle East - to manage global oil (Grubb, 2014).

The dominant view in Energy Economics is that the emergence of the modern petroleum pricing system is the confirmation of the efficient market hypothesis and of the thesis that price signals are sufficient to guide the energy transition towards a renewable future. However, oil and gas are still dominant in the world´s energy matrix, despite of their environmental costs and of agreements to curb their consumption. In this article it is argued that power matters. In other words, decisions about how to price oil and natural gas are also the result of the decisions of important actors in certain critical junctures of history, which are guided by their vested interests.

In that vein, Bridge and Le Billon (2012, p. 155) argue that “contemporaneous oil governance – the set of rules and organizations that guide how decisions over oil are made - is fragmented and incoherent, consisting mostly of a patchwork of organizations with mandates focusing on the vested interests of their members”. Borrowing from Thorstein Veblen “old” (Hodgson, 2004) and from Dugger and Sherman´s “radical” institutionalism (Dugger and Sherman, 2000), probably the main driver of institutional change what concerns pricing in the world oil industry are the vested interests of dominant participants, which in critical moments have the power to block or permit change, due to economic interests and geopolitical concerns. This concerns also pricing, which has always been what Cohen (2008) would call the “big question” of world oil governance.

Mabro (2005) has argued that every price regime which has emerged in this or that period of oil history reflected the balance of power prevailing at that period of time. The current moment, which has proved to be extremely useful for the diffusion of renewable energies, also represents a critical junction for deciding what the energy pricing model of the future will be. Throughout this paper it will be argued that the next pricing system will emerge – or not – according to the balance of power.

From this perspective, prices are not the neutral reflection of the interaction between suppliers and demanders in the market; they are institutions that reflect a certain balance of power, and that thus can structure the future. Nevertheless, power in a geopolitical and geo-economic sense is a complicated thing, what also concerns the oil industry. Although dominant actors – the American government, big oil, Russia, China, financial traders, OPEC, and the like - usually take the lead, intermediary stances do matter. As will be shown later on, without their acceptance the way oil is currently priced would not work.

In this paper it is argued that Ebbinghaus' (2005) non-deterministic path dependence model can be applied to explain to a great extent the transformations that took place in the world oil market since the late 1970s, which Carollo (2012) calls the "oil price revolution". In other terms, the path dependent process that will be described is the grand narrative behind these transformations. Some of the main features of that revolution are an increased importance of spot markets, the financialization of oil prices and products prices, the quasi universalization of the use of reference prices and a widespread liberalization of energy markets and policies around the globe. It is shown that, although the decisions made by some strategic actors at the critical juncture of the late 1970s and early 1980s has structured the decisions of other participants in that market, there is openness to change.

The paper is structured as follows: the first section presents a review of the literature on path dependence in general, and on non-deterministic path dependence in particular. In the next session the reasons for change from state-pricing to market-price and the critical moment in which that change took place – in the early 1980s - are described. In the third session it is shown how that new set of institutions was accepted by world oil market participants. In the fourth section openness to change is debated, and particular forms of how it happens place are shown. After this, the (in)efficiency of a partially "locked in" path dependent process is described. Finally, the conclusion provides an account of the perspectives of a radical departure of the departure of the path towards a low-carbon electric pricing system.

2. NON-DETERMINISTIC PATH DEPENDENCE

The concept of path dependence first appeared in the 1980s and in the 1990s, due to the seminal contributions of Brian Arthur and Paul David (Arthur et al., 1983, 1994; David, 1985, 1994). According to Arthur (1994, cf. Ackermann 2001), there are four conditions for a process to be described as path dependent: (1) in the initial moment each path should have equal starting conditions; (2) once a path is chosen, more and more participants will accept it, thus augmenting its returns;

(3) given that choice made by many, the path gets locked in due to sunk costs; and (4) there is a possibility that an inefficient path is chosen. However, since the early contributions the path dependence literature has evolved quite a bit. For instance, Pierson (2004), Crouch (2005)[1], Ebbinghaus (2005) and book chapters in Magnusson and Ottosson (2009) have, above all, sought to make path dependence theory equipped to explain institutional change.

In this vein, Ebbinghaus (2005), without discarding conditions (2), (3) and (4), argues that "developmental pathways" have a logic that is different from regular path-dependent processes. Institutional change happens at critical junctures where, constrained by choices previously made, strategic actors establish new rules. After the critical juncture those choices are institutionalized through self-reinforcing processes, were positive feedback to that institution by the rest of the participants allows for the societal acceptance of the newly established institution, providing it with legitimacy. And, like in a loop, earlier decisions made in the initial critical juncture and institutionalized by self-reinforcing processes that followed might be questioned again in a further critical juncture. There are then three possibilities of change: path stabilization, marginal adaptation to environmental changing or path departure (Ebbinghaus, 2005).

By their turn, for Streeck and Thelen (2009) institutional change can also be accounted as a never ending, many times subtle, dynamic process. According to Streeck (2009, p. 179), institutional building is a "continuing process of social, political and economic experimentation, of successive trial and error", (...) extremely dependent on "political persuasion and on a legitimating societal discourse". In this sense, it is important to realize that what one perceives as the trigger of a historical transformation is in fact nothing more than the crucial moment where a series of conditions, which strategic actors continuously seek to destabilize, trespass a certain threshold.

Orthodox economic theory has been reluctant to accept the logic of path dependence - with the notable exception of North (1991) -, mainly because that approach has "forgotten history" (Hodgson, 2001) or because it addresses historical developments through a "cliometric" approach, in which the entire history of mankind is portrayed through the lenses of neoclassical analysis (Boldizzoni, 2011). Further, the narrative of perfect competition and rational choice is convenient for the dominant approach because, due to its simplicity, it helps to elegantly "close" models which build on "optimization" techniques, such as

1 Crouch (2005) uses the concept of 'recombinant governance' to argue that institutional entrepreneurs may use their influence to steer institutional change into new directions, hence creating new path dependencies.

Computable General Equilibrium (CGE) models. In that sense, Liebovitz and Margolis (1995) argue that the scope for path dependence is small because rational actors always tend to choose the most efficient path. “Third degree path dependence” is an exception because in it economic actors would deliberately choose the most efficient path.

However, as Pierson (2004) shows, because economists started to embrace the idea of “increasing returns”, to the detriment to a world of stability and unique equilibria, path dependence started to be used to explain the developmental trajectories of certain countries - successful and failed alike. Furthermore, Post-Keynesians use the term “non-ergodicity” mostly as a synonym for non-deterministic path-dependence. Dunn (2012, p. 437) argues that non-ergodicity is related to a “creative and emergent conceptualization of history in which choice is genuine, matters, and can make a difference in the long run” (...), and that “sensible agents recognize that the environment in which they make decisions is characterized by the absence of programmed and predetermined processes and is creative, open, emergent and uncertain”.

If in Economics (non-deterministic) path dependence is by far not unanimous, in other Social Sciences its use is widely diffused. Historical institutionalism uses path dependence formally as its logic of explanation (Schmidt, 2005). More specifically, Hall and Soskice’s (2009) Varieties of Capitalism (VoC) firm-centered approach posits that the fact that capitalism appears in different varieties is due to the increasing returns of “locked in” institutional complementarities. For the “varieties school” radical institutional change happens only very seldom, due to exogenous shocks - in a sense that successful institutional complementarities are considered efficient and resilient. Path dependence is also part of Economic Sociology´s toolkit, as Beckert (2002) defends that it helps to explain why certain institutional characteristics are socially embedded, alongside norms, social networks, traditions, customs, routines, habits, power and trust. Finally, path dependence also seems to find a fertile ground in International Political Economy. As Eden and Hamson (1997) argue, international regimes are not spontaneous or randomly generated political orders but represent formal institutional responses to specific allocational and distributional problems in international relations. Further, they are “not necessarily optimal in terms of their efficiency, resource allocation, and distributional impacts” (Eden and Hamson, 1997, p. 377). As it is demonstrated in the following sections, regimes - such as the current oil pricing one - are the result of non-deterministic path dependent trajectories.

3. DECISION STRUCTURING CONDITIONS AND THE FIRST CRITICAL JUNCTURE

The first aim of this section is to identify which conditions structured the rise of WTI as the main benchmark of oil price in the United States and in the Americas, and well as the institutionalization of Brent as the most used global oil benchmark. Given those conditions, as will be shown in the second subsection, the "oil price revolution" could take place.

3.1 Decision structuring conditions

In this framework, a first condition was the degree of influence oil had and still has in international politics and in the world economy. Huber (2009, 2013), Torres (2004), Fouquet (2008), Ayres (2009), Altvater (2010), Labban (2010), Mitchell (2011), Bridge and Le Billon (2011) and Foxon (2018) all have exhaustively shown to what extent the global economy relies on fossil fuels, especially on the products delivered by the oil and gas chain and on its infrastructure. That was especially true of the post-war economy, when oil became embedded in social institutions and material infrastructure (Bridge, 2011) to an impressive degree. Although the world is now shifting to a more diversified energy mix, a "locked in" economic-geographic arrangement centered on automotive transportation which is still dominant in the United States and being reproduced in developed countries such as Brazil and China-, probably assures that oil will continue to be very important in the decades to come. Oil is so important in geopolitics that the probably dominant explanation for the "oil wars" witnessed in the last three decades, namely Harvey (2005), centers its argument on the premise that the control of the oil supply in the Middle East is the precondition for controlling the world economy. According to Roberts (2005), in that knotty geopolitics of oil the United States still have a preponderant position, mainly due to the size of its domestic market (Roncaglia, 1985), although in the last two decades China has presented itself as a serious challenger.

Nevertheless, this preponderance was threatened in the early 1970s, when most OPEC countries such as Libya (1970), Iran (1979) and Saudi Arabia (1980) nationalized their oil companies. The nationalization of oil in those countries brought upon a second condition that structured the decision to change pricing. Although spot markets existed before those events, being used mostly by independent oil companies, they only gained on importance when International Oil Companies (IOCs) such as BP were forced to heavily relying on spot markets after having lost a great part of their supply. Later other companies saw

themselves forced to follow suit (Yergin, 2003).

Linked to the nationalizations, a third condition was the takeover of global pricing by OPEC in the early 1970s. Although its consequences are undisputed, the inner meaning of the takeover of global pricing by OPEC is highly controversial. Bina (1985) argues that the takeover was devised to enable the exploration of marginal fields outside the Middle East. By his turn, Odell (1986) interprets the takeover as a plot between the United States and the OPEC countries aimed at undermining the competitiveness of other developed countries, as the former were living economic hard times in the wake of the crisis of capitalism in the 1970s, which led to the end of the Bretton Woods arrangement.

A fourth condition was the rise of non-OPEC production, in particular in the North Sea, which until the 1970s used to be historically marginal. Because of the nationalizations of the 1970s, the IOCs had to find new - sometimes so-called “marginal” - exploring areas. According to Parra (2010), the number of Non-OPEC producing countries rose from under 20 in 1950 to over fifty in 2003. As it began to become relevant in the international market and economically competitive, production in the North Sea - the Brent oil field started to produce in 1976 - began to play a key role in the political and economic balance in the oil world (Carollo, 2012).

A fifth condition - in a context of intense deregulation and acute financialization - was the new approach to energy both in the United States and the United Kingdom, which was based on the conviction that a free market could allocate scarce supplies most economically and efficiently through prices set by market forces (Singer, 1982; Coll, 2012). That approach sought to radically replaced the energy policies of the 1970s, as the oil crisis led to a wave of new regulatory efforts in order to lower domestic oil prices (Gordon, 2011). As argued by Mitchell (2011), the influential neoclassical economist Robert Solow played a decisive role in spreading neoliberal ideas in the field of energy, especially for having recovered Harold Hoteling’s forgotten work. The rising neoclassical paradigm in Energy Economics built on the claim “that in a competitive market there would be an equilibrium path in which the price of oil would rise at the prevailing rate of interest for capital invested in projects with a similar degree of risk” (Mitchell, 2011, p. 195). The diffusion of those ideas pushed governments away from energy governance, or at least altered its role, which from then on should limit itself to establishing futures markets for energy and to gathering information for market participants. Another interpretation for a market approach to energy was that in the early 1980s the Reagan administration attempted to put the economy back on track through “supply-side economics” (Melosi, 2006), thus giving preference to private investments in a deregulated market environment. The reliance on globalized oil marketing

was also seen as an approach to energy security. In this sense, Greenspan argues that the activity of markets created a "buffer layer to geopolitical threats" (Greenspan, 2008, p. 426-7). In the UK, national oil company BNOC had been privatized in the early 1980s, an intensive bidding policy from the 1980s onwards was launched and depletion policies were removed during the same decade (Parra, 2010).

3.2 The first critical juncture

This set of conditions brought upon a major transformation in the way oil was priced, a decisive shift towards an almost full commoditization of oil under the control of the Anglo-Saxon world. The first step towards that objective took place in the United States, with President Reagan's decision in January 1981 to deregulate oil prices and to remove controls that had previously encumbered the industry, which in hindsight could be described as the "crossing of the threshold". This decision resulted in the reintegration of the US petroleum sector into the global petroleum economy for the first time since the 1950s, in such a way that this market once again began to exert itself forcibly on global oil pricing (Morse, 1999). The decision to remove governmental control on prices fostered an immediate convergence of WTI spot prices into a single commodity that prior to the decontrol was split into various categories under the control mechanisms. By its turn, the end of federal regulation opened the opportunity for the rise of futures energy markets. In October 1981, a gasoline futures market was set in NYMEX; a futures market for oil was instituted there in 1983.

By its turn, as an important producer and because it's crudes were widely traded, and their prices widely quoted (Parra, 2010), the British oil and gas industry was hurt by the arbitrariness of OPEC's policy in the late 1970s and the early 1980s. At first, since the London Agreement of 1983, the country accepted to cooperate with OPEC on price matters, adopting an interventionist line on oil prices (Parra, 2010). But later, during the oil war of 1985, Britain showed no intention of reducing North Sea production, even though oil prices had reached very low levels. In this context, the Thatcher administration wanted to reach the objective of having a crude oil price that was the result of free market transactions not submitted to the political control of the OPEC cartel. An alternative solution for fixing the price of crude in a market context was offered by Shell UK, which published the so-called '15-day contract' in 1986. Brent started to be traded in a sort of primitive petroleum exchange and soon became a regional reference for oil and trading companies, which were linked to majors and independent operators. When the 1987 "blood bath" occurred, an event in which the biggest companies producing the Brent Blend (Shell, Exxon, Chevron and BP)

had to take responsibility for the traders who were missing in the chain, it was clear that the Brent '15 days contract' had to be transformed into something bigger (Carollo, 2012). In this sense, a further step was taken when, in 1988, the International Petroleum Exchange launched the Brent Futures contract. A purely financial market for oil was created, which Carollo (2012) calls a "supermarket Brent". In it, no obligation for the participants to buy physical cargos applied. Hence it became purely financial, thus diminishing the costs of entry for the regular investor. The author argues that this shift was the precise moment in which the revolution in the international oil market took place, in such a way that the newly financialized oil market had no longer any connection with the physical crude oil market. Thus, as Labban argues (2010, p. 541), "finance has emancipated the circulation of oil in the world market from its circulation in physical space, fragmenting the oil market into a physical and a financial component, but reintegrating both under the dominance of financial logic". As Jessop (2008) would put it, the financial logic became "ecologically dominant" in the markets for oil. By the late 1980s - after the institutionalization of the new path, as will be shown in the next section - the Brent market had become quite complex, including also a futures contract traded on the IPE, options, swaps and other trading instruments (Fattouh, 2006).

4. THE INSTITUTIONALIZATION OF THE NEW PATH

In this section it is shown how the new path - which first appeared as a primitive market-based trading regime and then exploded as the "oil price revolution" - was institutionalized through the acceptance of the participants of the market. It can be argued, hence, from the point of view of Ebbinghaus' (2005) path dependence, that a widespread acceptance of the new oil pricing institutions meant that their returns increased to such an extent that they managed to stabilize. Hence the accession to the new institutions of the global market, which in the limit sets the tendency towards the oil market becoming a global oil exchange (Nöel, 1999) was far from homogeneous amongst the diverse countries and companies and had different meanings for each country that acceded to it.

The first to adhere to the new path where the oil companies that operated in the American market. As Clô (2000) argues, first the majors first preferred to stay away from the blooming "free market", as the they considered it unreliable and inherently unstable. Nevertheless, the loss of the bulk of their supply due to nationalizations had forced them to trade at a higher cost on spot markets, including in those which were set by OPEC countries. Because prices sold in spot markets are indeed volatile and uncertain (Yergin, 2003), and are subject to squeezes and

manipulation (Fattouh, 2006), a hedging mechanism to minimize those companies´ risk had to be created. This was especially true after the second oil shock (Pinto Jr., 2007). This gave rise, with the industry's support (Juhasz, 2009), to the NYMEX oil futures markets, in 1983, in which the right to buy the commodity at some point in the future started to be bought and sold (Yergin, 2003). Hence crude oil traders in the international market could hedge the prices of cargoes en route to the United States which were to be sold on arrival on the spot market by selling WTI futures as protection against possible price declines while the cargo is in transit (Seba, 1998). The future markets - in which the volume of transactions is quite large - offered the necessary transparency and liquidity for those market participants which had already been involuntarily pushed to a non-integrated transaction environment.

A second case was that of Mexico. The country's national oil company PEMEX was the first to adopt a market related pricing system in 1986, in the shadows of the collapse of the OPEC administered pricing system in 1986-1988 (Fattouh, 2010). According to Mabro (2005), this new concept involves a formula linking the price of a given export crude to a reference price or a set of reference prices. Mexico's oil exports are almost entirely directed to the United States, and in that market, it has to compete with domestic oil producers. Hence the fear of losing their market share led Mexico to develop that pricing technique (Morse, 1999).

What concerns the institutionalization of Brent as the leading global benchmark - with the exception of the US and the Americas - it was in great part achieved when Saudi Arabia started to abandon strategies such as flooding the markets with their cheaper oil (Parra, 2010), which they used during the price wars against OPEC and NON-OPEC countries. Constrained by a growing budget, the Kingdom started to perceive that having a larger market share and increased oil revenues was more in their interest than controlling prices at a higher level (Askari, 1991).

The Saudis became aware that regulating simultaneously output and the price of oil was a difficult task, which led them to choose the former (Clô, 2000) and to set prices administratively, permitting it to emerge out of the interaction among buyers and sellers (Bridge and Le Billon, 2012).

In 1988, guided by Saudi Arabia, OPEC also chose the Brent as its new benchmark. According to Mabro (2005), the conversion to a market-related pricing system in which each member country has a differential in relation to the benchmark was not due to some mystical conversion to the lights of some of good economic truth, but due to the fact that the cartel was facing not only strong competition from new sources of oil production and export, but also had to deal with the fact that customers could buy at a lower cost the oil that was priced via Brent.

The decision had a stabilizing effect for the cartel, because it provided an incentive for cooperation, as the market, which brought prices down, made it more rational for OPEC countries to reestablish agreement rather than seeking individually to profit from their own actions (Ayoub, 1994). Thus, by giving up only pricing, the Saudis and OPEC could take over, whenever possible, the role of "swing producers", which in theory permits to control the accrual of extraordinary rents by coordinating produced quantities.

Finally, many countries – importers and exporters - and most of the other market participants followed suit. Most exporting countries, but also traders and refiners, accepted the new benchmarking technology according to their geographic region or their exporting markets. On their turn, because of conditions of abundance of oil supply and convictions about the institutional efficiency of markets, many importing countries were encouraged during the 1980s to dismantle public policies in the field of energy (Clô, 2000). This meant that conditions were set also for the liberalization of internal energy markets, including markets for crude oil products. Through the further opening and liberalization of energy markets it started to become possible not only to use international markets to arbitrate between sources of supply of crude oil products, but also to create new hedging mechanisms.

5. NEW CRITICAL JUNCTURES: CONTESTATION?

The aim of this section is to provide some interpretations about what new critical junctures could be, and what forms of institutional change could follow. The turning over of prices to the market and growing financialization, which are the main outcomes of the first critical juncture, structured decision-making in more recent critical junctures, in which there is a growing role for emerging market participants such as banks and China.

The first example - which probably falls in between "path stabilization" and "marginal adaptation to environmental changing" concerns the further deregulation of futures markets, a process which started in the 1990. Financialized oil markets proved to be an extremely lucrative market, in a context of downward pressures on prices and of growing volatility, thus attracting new protagonists. According to Labban (2010), these new protagonists were big investments banks and other financial outfits - the so-called "Wall Street refiners"- which in a first moment assumed the risk for companies trading in physical oil markets, setting up specialized trading departments, but later on started to act as traders and market makers, taking positions of their own on the market. In this sense, the possibility of exploring new markets acquired an efficacy of its own that engendered the further transformation of the whole oil sector.

Hence the highly innovative American financial capitalism - which became more important to the American economy than any other industry - involved the "real" oil economics into an ever complex and nontransparent edifice of financial institutions and actors (Zündorf, 2008). If rules for speculative position limits were historically much stricter in the decades before (Medlock and Jaffe, 2009), the ability to speculate on oil prices increased with the deregulation of energy derivatives (Bridge and Le Billon, 2012). These new entrants actively fostered the deregulation of futures markets and of derivatives trading, engaging charismatic and/or powerful personalities for that purpose (Zalik, 2010). In that context, the Commodity Futures Modernization Act effectively cleared the way for more lax regulation of new oil risk management products. That regulation also designated certain OTC derivatives transactions to be outside of the jurisdiction of the CFTC (Medlock and Jaffe, 2009).

A second example is the change of benchmark, which is described here as a "marginal adaptation to environmental changing". Following Montepeque (2012), pricing benchmarks may be severely challenged by logistical, regulatory, geopolitical or geological conditions, but if they fail to adapt quickly, their usefulness ebbs away. For market participants such as traders and refiners, it is important that the physical and "virtual" oil price converge, as they use it in their netback calculus. Hence if the price is believed to be disconnected from global market conditions, the benchmark's usefulness erodes (Montepeque, 2012). According to Horsnell and Mabro (1993), the Brent stream is a good benchmark, which fulfills these conditions, because it has a very good infrastructure, a good taxation structure, is very liquid and very transparent. The same cannot be said of the late WTI that, in a seemingly inexplicable fashion started to cost significantly less than the Brent. According to Carollo (2012), this anomaly was planned in the financial environment some months in advance, exploring the industry's constraints and the market's structural problems. These explored the fact that it is not possible to move WTI from Cushing to the refineries on the east coast of the USA and started to sell WTI on NYMEX and buy Brent on ICE, inverting and widening the price spread between crude oils. Due to the lack of reliability of the WTI price countries such as Malaysia and Australian oil & gas companies shifted from WTI to Brent. And yet, Fattouh and Sen (2013) indicate that the WTI may still preserve its strength and relevance due to the fact that the US market is still very attractive to many producers despite the price differential towards Brent. This is more likely to happen should Saudi Arabia (or any other country willing to assume that role, such as Iran, Iraq, Russia or the US) decide, as a swing producer, to defend prices by lowering production in the case of other market participants increasing theirs.

A third example, of a possibly more persistent nature, is the establishment of "loan-for-oil deals", as China has been pursuing a (partially)

neo mercantilist approach to energy in the last decade. In that barter-type of deal - which a country like Brazil used in the 1970s while trading with Iraq -, promises are made to sell an agreed amount of oil in exchange for a loan, rather than in international oil markets to other parties (Lee, 2012). Following Bridge and Le Billon (2012), it is possible to argue that in them prices reflect much more reliably the value a given society puts on oil and that it ceases to be a commodity like any other to become a strategic good. With these steps, China could perhaps diffuse an alternative to the market-centered approach to oil pricing and trading, highlighting the importance of non-market state centered coordination[1]. However, China's oil policy also points at another direction, much more market-based. It has been speculated that Shanghai International Energy Exchange, known as INE, is in the cusp of launching crude oil futures, which could offer a rival to UK´s Brent and to US´ WTI[2]. Although the market is still skeptic about the fact that the Chinese government could interfere in that market, as oil is increasingly flowing from west to east (Dale, 2015) - with important implications for energy markets, financial markets, and geopolitics -, it might be that this development may lead to a path diversion. Should that market offer renminbi-denominated contracts, its financialized competitors could face important consequences.

However, the most serious threat of path departure is currently being posed by renewable energy sources. There are clear signs that an energy transition is underway, as renewables has been contributing the largest part of the world's new power generation capacity and in 2014 have become the second-largest source of electricity (International Energy Agency, 2015). For Klare (2016), as the planet is heading for a green energy revolution, the global political order that once rested on oil's soaring price is doomed. Hence, at the same pace at which the "´firewall´ which separates the (closed) fossil regime from the (open) life energies provided by the sun" (Altvater, 2006, p. 19) is removed, the current market-based oil & gas pricing system will be either handed over to the electricity market and/or taken out of the market´s reach, in the wake of Rifkin´s (2014) "zero marginal cost society". The prospects of that transition will be further assessed in the conclusion of this paper.

1 Another example of China´s state centered approach to oil&gas can be given: recently the country stabilized retail energy markets through government-financed subsidies to keep price down for consumers (Rogoff, 2015). Those costs had become quite massive when oil prices peaked for China (as well as other emerging economies). An important step to overcome that difficulty was to reform its oil pricing mechanism by introducing a government-set benchmark, which sets prices at a higher level than in the US and is significantly less oscillating than the international world market (Meidan, Sen and Campbell, 2015).

2 See http://www.reuters.com/article/china-crude-futures-idUSL5N11F04A20150910.

6. THE (IN)EFFICIENCY OF THE "LOCKED-IN" PATH

As has been argued in the first section, one of the characteristics of "path dependence" is that it may lead to the stabilization of inefficient paths. It is this section's objective to explain why. The bulk of studies that assess the efficiency of oil, gas and products markets do that through the lenses of the Efficient Market Hypothesis (EMH), as Brent and WTI prices are determined in futures markets and products prices have some connection to them. Especially in the 1980s, there was a quest for prices to become "visible" (Goldthau and Witte, 2009), and, in that context, the growth in the use of financial instruments explicitly linked to oil aided in price discovery by bringing open accessible, readily available information about current and expected future market conditions into the market price (Medlock and Jaffe, 2009). Due to this fact, the EMH was extremely popular in the 1980s and 1990s, as it provided not only a theoretical framework to analyze the efficacy of the new energy policies that were being implemented, but also a theoretical justification to implement it. In that vein, econometric studies by Charles and Darne (2009), Wang and Liu (2010), and Ortiz-Cruz et al. (2012) suggest that the Brent could qualify as "weak form efficient", that WTI crude oil market was gradually close to random walk behavior for short, medium and long-time scales, and that there is evidence of time-varying efficiency for daily crude oil returns over the deregulation period starting in 1986 for the WTI. The same conclusion, however, cannot be taken what concerns the other oil and products prices (Clô, 2000; Alvarez-Ramirez et al., 2010).

Notwithstanding, the hypothesis of growingly efficient oil prices started to be questioned in the aftermath of the 2008 oil crisis. After a drop from a $150 level to around $30-40 that was followed by another rise, the predictive content of future oil prices started to be scrutinized. As Serrano (2008) shows, Chinese demand, the "Super spike thesis" and geopolitics were not sufficient to explain the rise of oil prices from the 2000s on, as speculation played an important role in that price rise. In that context, "the analysts who tried to explain the movement of crude oil prices on the basis of the evolution of the relationship between demand and supply of physical crude have failed, simply because the links between the financial market and the crude oil market has become increasingly ephemeral or non-existent" (Carollo, 2012, p. 377).

Hence alternative explanations for the failures of the incumbent oil pricing paradigm started to be sought for. As Hodgson (2015, p. 1) puts it, the "Great Financial Crash of 2008 and the subsequent global crisis have led many people to question the viability of capitalism or to consider major reforms to its financial and corporate institutions". In particular, Eugene Fama's Efficient Market Hypothesis (EMH), which until then endorsed theoretically the operation of financialized oil markets,

came under major criticism for its highly questionable assumptions (Hill and Myatt, 2010) - such as frictionless markets, unbounded information availability, transparency and investor rationality-, and for the claims that in an efficient market there are neither undervalued or overvalued financial assets, and that prices alone are a proper guide for capital budgeting and allocation. In hindsight, as Rodrik (2015) debates, the excessive reliance on the EMH and on its predicaments led economists and policymakers in general to forget other models and ideas, especially Hyman Minsky's "financial instability hypothesis" (Minsky, 1982). What Lavoie (2014, p. 20) quotes as the "paradox of tranquility" says, after Minsky, that "stability is destabilizing". Hence, the more successful financial operators are, the more they will induce market participants to indulge in even riskier financial structures (Lavoie, 2014).

In that vein, Spector (2005) shows that traders frequently take their decisions based on poor quality information about the fundamentals in the entire world oil market and with a poor understanding of how they work. Oil, gas and products prices are assessed by reporting agencies such as Platts, which sometimes have to "guess" prices - through market knowledge, information about specific deals and econometric calculus - that are not always disclosed since market participants have different interests and different positions (short or long), and therefore have a limited interest in revealing the actual price used in the deals. As they typically operate within a short-run context, fundamentals are drowned out by psychological noise and concerns, with herding, imitation and leadership tendencies (Garis, 2011). Hence a strong herd instinct which encourages bubbles and significantly aggravates volatility might follow (Stevens, 2005). In this context, following Bridge and Le Billon (2012, p. 90) "although the role of market speculation in driving the price of oil is disputed, what is clear is that price signals emerging from oil markets are not translating into the sort of changes one might expect what regards supply and demand".

Given the above described shortcomings of the dominant approach, it is suggested that a more complete analysis of the hidden costs of the current oil pricing regime ought to be performed through the lenses of the "production paradigm". As Pasinetti (2011) puts it, there is a divide in economic theory which separates what he calls the "trade paradigm" from the "production paradigm". The "production paradigm" flips the coin of the "trade paradigm": while the latter focus is set on static market transactions, the former concentrates on the production side of the economy, particularly on the question of how the surplus is produced and distributed; while the latter leaves history outside, the former does not; while the latter assesses if the conditions for allocative efficiency are fulfilled, the former evaluates "dynamic efficiency" of production.

Polanyi (1944) and Kapp (1950) decisively influenced the way that the "production paradigm" appraises social and economic costs of the process of production. Inspired by the former, O'Hara (2009) defends that one of the core principles of political economy is the "principle of contradiction", which concerns the fact that in an economic realm disembedded from society social and ecological costs are systematically not internalized. By his turn, Kapp (1950) wrote an environmental analysis of business enterprise explaining in detail how costs were passed on to others to create an apparent "surplus". In contrast to the now commonly cited "externality theory", he did not describe these costs as "external" because they are an integral part of the economic system (Mearman, 2009). In that vein Fouquet (2010) argues that:

> there is an incentive for individuals and, especially, companies to pass on their costs to others, if they can get away with it. They will seek and welcome new processes and technologies that allow them to substitute external costs for internal costs. Once the opportunity exists to externalize costs, a power struggle ensues between the "polluter" trying to pass on the costs and the "victim".

In line with neoclassical theory, which suggests the need of complete market, it has been decided that the pricing and compensation of the negative externalities related to oil prices should take place in other spheres, such as the Carbon Markets. In those other spheres, the success of the "victim" to internalize costs will depend, as Fouquet (2010, p. 318) on the science, the legal system and his/her economic and political power. It follows that the internalization of those costs is not always possible. The next subsection identifies three "negative externalities" which also concern the way oil is priced but tend to be overlooked by the dominant discourse.

6.1 The missing (in) efficiency judgements

A first form of social and distributional efficiency which also concerns the pricing of oil is "social efficiency", a term used by Dymski (2011). In orthodox economic analysis the equity goal is always subservient to the efficiency goal. It is argued that there is a trade-off between equity and efficiency, in such a way that transferring income would be like transferring water in a "leaky bucket" (Hill and Myatt, 2010, p.11).

Crouch (2011) argues that this has led conservative politicians and businessmen to implement the “trickle down” principle, arguably leading to an inequitable distribution of income for society as a whole (Palma, 2009). In a different direction, Sen’s (1999) “capability approach” is the definitive guide towards understanding that there is also a type of social efficiency that influences its economic counterpart, as people which do not have social liberties - such as the access to health care and education - are incapable of exercising their economic liberties. From the perspective of the “21st developmental state” (Evans, 2008), in which development growingly stems from those capacities, this means that societies as a whole can be worse off. In that context, it has been observed that rising products and oil prices affect proportionally more the poorer, transferring both income to the rich and to oil exporting countries, at the expense of “social efficiency”. Oil prices also affect indirectly this indicator, through their influence in other commodity markets. According to Stevens (2005), the decisions to trade paper barrels are often influenced by what is happening to other elements in the financial portfolios which have nothing to do with oil markets, such as commodities, equities, carbon, the weather, and so on. For Mabro (2008), a rational objective for traders which deal with oil is to optimize the performance of this portfolio, in a way that a non-oil factor can influence oil price formation. Thus, Qiang and Ying (2012) argue that the crude oil market occupies the core position in the whole chain of commodity markets, and that its volatility spillover effects on other commodity markets were relatively greater than that of other markets on crude oil markets. In some countries it affects significantly, for instance, the electricity prices, which have important triggering effects on the economy as a whole (Clô, 2000), with important distributive effects. Especially in food commodities markets, the consequences have been staggering, and this has inaugurated a debate on whether speculation with that type of commodity should be allowed at all (Ziegler, 2012). Perhaps establishing an alternate take of how oil prices are “socially inefficient”, Klein argues that because in some communities fossil fuel companies are “virtually the only game in town” (Klein, 2014, p. 316), which may arguably lead to the disruption of what Bourdieu (2005) and Putnam (1994) call “social capital”.

A second type of (in)efficiency in the wake of oil pricing will be called here “ecological efficiency”. Considering their ecological costs, oil, gas and products perform badly if one tries to obtain Daly and Farley`s (2010) “comprehensive efficiency identity”, which considers the efficiency of services stocks and flows and the inefficiency of waste stocks and flows. Furthermore, contrary to renewable energy carriers, oil & gas production, marketing and consumption involves transforming low -entropy energy and materials into high-entropic forms (Georgescu-Roegen, 1971), thus releasing CO^2 and other types of wastes into the planet.

The current financialized pricing mechanism has been systematically "used" by powerful producers to raise or lower oil prices, who alternate between flooding the market with oil with keeping off it, with the purpose of maintaining the overall long-term profitability of the business (Mitchell, 2011), albeit not always smoothly. Or, as Roncaglia (2015) argues, oil demand and supply are interdependent, and not decisions that are made simultaneously. Increases in production following positive demand signals are possible because companies count on (floating) storage, which permits them to arbitrate between prices and hence to influence prices dynamically. In that vein, Huber (2015) argues that low oil prices are a "sedative" for political forces aiming to transform energy policy away from carbon-intensive energy. When prices are low, there is a disincentive to invest in renewable energy, which then leads to a cycle of high oil prices. By their turn, high oil prices permit energy companies to exploit what for Moore (2015) is "expensive nature": offshore petroleum, shale gas, tar sands, etc. Even though high energy prices also encourage renewable energy carriers, the magnitude of the price incentive is insufficient to encourage a full diversion from carbon fuels, leading to further cycles. Those cycles tend to be further reinforced by the agency of "Wall Street refiners", which, as has been shown above, exert an effective leadership in the futures markets. Arguably, being in that position, those financial outfits are also empowered to translate other types of economic shocks which impact the oil market into profitability. In a context of high frequency accelerated trading, whose corollary is the intensification of time–space compression and a radical new dynamic in the financial market, those outfits envisage capturing short-term information and time rents (Grindsted, 2016). As Torres (2004) explains, when oil pricing shifted from OPEC to futures markets, contracts started being governed by volatile expectations in an uncertain environment. Hence although a green energy transition is priced by traders in those contracts, expectations are chiefly guided by "fossilist" short-terms positions. Even though oil futures effectively aid "price discovery" due to their relative transparency and liquidity, having acquired an efficacy of their own, they effectively contribute to the postponement of a clean energy transition. Following Victor´s (2008) analysis - for whom "dynamic efficiency" is a property related to the passage of time - what concerns the ecological footprint of the world´s current patterns of consumption, the current oil pricing system performs very badly at allocating the intergenerational distribution of waste and of energy output.

It is also cited that oil prices by no means account as negative externalities the military costs and the resulting casualties of what Bichler and Nitzan (1995) describe as "Energy conflicts in the Middle East" also highlights an inefficient side of the current oil pricing system. The operation of the world oil market - as has been shown by Labban

(2011) and Di Muzio (2015) -, has systematically relied on American military expenditures which have protected Middle Eastern exports and the flow of oil cargoes through transportation conduits. Quite paradoxically, “not even the neoliberals of the North American establishment trust the geo-economic mechanisms of supply and demand. On one side, they preach the benefits of the free market. On the other, they implement a rigorous geopolitical doctrine, which, scrupulously, resorts to military might” (Altvater, 2010, p. 259). In a study, Delucchi and Murphy (2008) estimate the hidden cost of military expenditures at $0.03-0.015 per gallon of diesel oil that is consumed in the United States.

In his groundbreaking work, Mathews (2017) has shown that China’s decision to increase its renewable energy production are above all geo-economic, local environmental and geopolitical concerns related to the military and diplomatic costs of exploiting the world’s oil reserves. The author argues that China’s move is forcing other actors to follow suit, leading to a process of Schumpeterian creative destruction. In the terms used in this article, it can be suggested that the consideration of some of the non-paid that can be - directly or indirectly, knowingly or not - related to oil pricing may precipitate a deviation from the current path. The perspectives of the deviation from the path are analyzed in the following conclusion.

7. CONCLUSION

In this conclusion, the possibilities for a radical departure from the currently “locked in” path of market-based oil pricing are assessed. Path dependence theory, in its non-deterministic variant, shows that, in the very long run at least, that institutions do change (Pierson, 2004). In a similar vein, Fattouh (2006, p. 95) argues that “as the eventful history of oil has taught us, an imperfect pricing system can continue to survive unchallenged for a long time until a powerful shock or a series of small shocks exposes its weaknesses and limitations and most importantly alters the balance of power (or perceived power) among the main players.” But, considering that the widely established market-based approach seemingly has also “locked in” incentives to produce oil - high prices still do not consistently change consumption patterns and low ones do not rule out investments - is it reasonable to presume that a radical alternative is really possible?

The first possible alternative would be similar to Bridge and Le Billon´s (2012) proposal of a democratic global governance of energy, whose objective would be to stabilize prices in a stable range, leading them to reflect more frequently their “normal or “natural value”, as of

Classical Political Economy (Roncaglia, 1985, Martins, 2013), with a smaller economic rent. In that framework prices would only oscillate moderately due to demand and supply down and upswings. Even though not a sufficient condition, market prices are indeed an important determinant of the investments that must be made in low carbon energy carriers. Less wildly oscillating prices would "tranquilize" governments and private investors, leading to a more stable horizon for the planning of investments and hence to "green growth". As history has taught, there are no theoretical barriers for prices such as oil´s - which is "Marshallian market-determined" (Harcourt, 2006, p. 11) and tends to oscillate according to the world´s demand - cannot be stabilized through some mechanism.

However, this is a scenario that is unlikely to occur given the interest and stakes and due to the fact that globalized oil pricing is a relatively trustworthy form of and reducing transaction costs. Strategic actors in the geo-economic and geopolitical game - mainly big exporters such as the Saudis, but also governments and participants from what Bichler and Nitzan (2015) call the "Weapondollar-Petrodollar Coalition" - are not necessarily keen on cooperating to create a radical alternative. As Mitchell (2011) and Roncaglia (2015) scarcity can be managed by the owners of fossil capital. The current market-based pricing system - based on the assessment of the future value of oil prices - offers precisely the transaction cost reducing techniques that the market participants require, avid to know that oil prices will rise again and that their future profits will be capitalized (Harvey, 2011, Di Muzio, 2015). According to the World Energy Outlook 2015, the plunge in oil prices has set in motion forces that lead the market to rebalance, via higher demand and lower growth in supply, in such a way that a tightening oil balance should lead to a price around $80 per barrel by 2020. By his turn, Queiroz (2016) argues that although a hypothetical price level of U$60 is difficult to predict, it is very likely that in the next decades the current cycle of low prices will lead to another one of higher prices, as current investments in additional capacity are being discouraged.

And yet, as Klare (2016), has argued, the green revolution has indeed given a profound blow at the "carbon economy", as forces that will lead to the final triumph of sustainable energy have already been set in motion. As Helm (2017) explains, the electrification of energy supply, which comes with the massive diffusion of renewable energy into the world's energy mix, brings states back in as the most important coordinators/designers of the markets of the future, with some exceptions. As Fligstein (2001), Bourdieu (2005) and Mazzucato (2013) have explained, states have historically assumed the task of "making" markets. With the input of new former-fringe technologies - such as the Internet of Things, blockchain, electric vehicles, electric batteries, smart

grids, among others - states will devise tomorrow´s markets, constrained by the interplay of political forces or following its own agenda. In that setting, there is a gradual very long run tendency for globalized oil and products markets to become less relevant and eventually disappear. However, the cost of producing one unit of renewable energy will still be influenced by globalized commodity markets, where the prices of metals and raw materials - which are needed for the manufacturing of those technologies (or the devices that enable them) - are established.

Is it reasonable to presume that in a post-petroleum world energy could be priced by principles that are not the market´s - based on Jeremy Rifkin´s (2014) thesis of “energy commons” - and hence pointing at a radical deviation from the course? Criticizing Rifkin´s faith in the Internet of Things (IoT) and Zero Marginal Costs as the driving force of an upcoming green energy revolution, Matthews (2017, p. 53) argues that the same technologies that enable such a shift could also be viewed as enhancing the power of other large corporations. In that vein, Mathews sees the growing environmental and economic attractiveness of renewable energy sources much more as a developmental opportunity than could lead to the substitution of the current oil pricing regime by a similar electric pricing regime.

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