CRESC Working Paper Series

Working Paper No. 24

Speculating on geographies finance

Michael Pryke

CRESC, Open University

October 2006

For further information: Centre for Research on Socio-Cultural Change (CRESC)
Faculty of Social Sciences, The Open University,
Walton Hall, Milton Keynes, MK7 6AA, UK
Tel: +44 (0)1908 654458 Fax: +44 (0)1908 654488

Email: cresc@manchester.ac.uk *or* cresc@open.ac.uk

Web: www.cresc.ac.uk

The support of the Economic and Social Research Council (ESRC) is gratefully acknowledged.

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Michael Pryke
Faculty of Social Sciences, The Open University

Abstract

This paper responds to a call for a 'distinctively geographical approach to global finance'. Against the background debate surrounding culture and economy, and recent work on geographies of finance, the paper argues that the approach offered by Michel Callon, together with those who make up a broad church that includes the social studies of finance, equips geographers with tools to open processes of financial calculation to empirical observation and theoretical analysis in a manner that foregrounds geography. With its emphasis on the *agencements* of financial markets and the performativity of financial economics, this body of work draws attention to the range of components that make contemporary markets in finance and how this hybrid mix puts the flow and movement into financial flows. The range of calculative tools at the core of modern finance and the calculative agencies they stimulate, configure financial geographies. Over simply, to make a financial market is to make geographies. The paper argues that a cultural economy of finance can provide a way to analyse and keep such configurations at the heart of the analysis of financial markets.

Speculating on geographies of finance

1 Introduction

'Buy and sell: three little words that make the world go around'. Under this title the authors of a guide to business at the New York Mercantile Exchange (NYMEX) capture some of the vibrancy of a world made through the sometimes frenetic activities of financial markets.

> Each day, billions of dollars worth of energy products, and other commodities are bought and sold on the trading floor of the New York Mercantile Exchange. And, shortly after the trading floor closes, overnight electronic trading picks up. That's because night and day, minute by minute, the value of these strategic commodities are changing, and those changes can have an effect on everything from the price you pay for gasoline at the pump to the cost of copper tubing the plumber replaces after your pipes freeze in winter
>
> (undated, 1)

Investment decisions directed by the likes of hedge funds, pension funds, mutual funds, so called 'large and complex financial institutions' such as JP Morgan Chase and UBS dominate NYMEX, just as they do in other leading financial centres and markets. Equipped with the latest ICT these and related organizations prowl the globe in search of investment opportunities: world stock markets from Japan to London; any number of market indices such as the Dow Jones; energy markets; bond and money markets; metals from aluminium to zinc; markets in currencies; wheat and shrimp futures; the impact of bird flu and 'mad cow' on soy and corn demand; the growing interest in ethanol production and its effect on the demand for sugar … all and more are scanned daily, 'minute by minute'. Everything it seems, from a shrimp to the weather, stands in line waiting to be drawn into the processes that channel investment 'globally'. The materials of finance, such as the latest ICT and research reports, and the daily practices of interpreting and making sense of data flows that stream into dealing rooms, meld together to make markets and to set finance in constant motion. As Georg Simmel might say finance exhibits a tireless malleability as it seeks to fulfil its desire: to possess the world in 'financial garb' (Buchan 1997, 278), multiplying daily and unevenly across the globe as capitalism once again develops a dangerous financial lopsidedness (see Arrighi 1994).

Such is the centrality of finance and financial markets to so much of life on the planet one cannot but agree with Gordon Clark's recent call for economic geographers 'to develop a distinctive approach to global finance' and for the development of 'conceptual tools that allow us to map its origins and destinations, assets and liabilities, and its flows in time and space' (2005a, 108). The geography of finance – with a focus in particular on financial markets, flows and institutions, as Clark highlights (2005a and b) - is certainly a 'vital research project for economic geography' (Clark 2005b)[1]. Taking up this call, I wish to extend a cultural economic line of inquiry that aims to contribute to a better understanding of financial markets and flows, both of which are rightly at the heart of Clark's agenda.

The contribution that a cultural economy approach to finance can make to geographies of finance will I hope become clearer as the paper develops. It roots lie most specifically in the writings of Michel Callon whose work on economics and markets is the subject of the next section (Section 2). What a cultural economy of finance offers and how such an approach aids geographers wishing to explore the world of finance, form the core of the following two sections (Sections 3 and 4). Before concluding, the paper's penultimate section adopts a cultural economy of finance approach to begin to rethink geographies into finance, to show how financial market making can be rewritten as processes that make geographies.

2 From Callon to cultural economy…

As a way of introducing Callon and my reasons for finding his style of conceptualizing markets in particular attractive and useful, I want to raise several questions which are returned to at various points in the paper. The questions prioritize markets and flows and the need to think of how both can best be reconceptualized to a give a *geographical* approach to finance a certain 'distinctiveness'. If geographers wish to talk of financial flows, then what types of geographies do the movements of finance assemble and what links such assemblages of time-space to the making of markets? What effect, for instance, might today's finance theory and its mathematical expressions (as they 'represent and disguize' (Gorz [1988] 1989, 122) the world through formalizations) have in the world 'outside' the cloistered markets and exchanges to be found in the likes of New York, Chicago, and London? Are the geographies of economic geography suited to the task of capturing the geographies of finance when finance is expanded to include components that range from dealing rooms packed with everything from mathematical expressions to bespoke visualisation software? How should global finance be re-described to highlight the spatial impact of the workings of such compositions and the imaginaries that enable financial flows to move around the earth: in effect to geo-graphize?

The debates within and related to economic geography, specifically those surrounding the culture / economy controversy offer a reasonable place from which to begin to answer these questions. As the debate has been ongoing for some time and there is no need to rehearse the history of the theoretical differences here. (The opposing positions are set out amply well in Amin and Thrift (2000) and Martin and Sunley (2001).) More recently, however, there are those such as Barnes (2005), Castree (2004) and Hudson (2004) who offer promising possibilities of how to escape what seemed for a time like a theoretical rut. In the pages of this journal, for example, Ray Hudson (2004) has provided a very helpful guide to those wishing to negotiate the treacherous waters that have long divided cultural and political economy approaches within human geography. Hudson finds it puzzling that the two are separated and insists that progress in economic geography demands the dovetailing of these differing theoretical impulses. The way he talks about the economy reflects this belief; for him, the economy refers to 'those processes and practices of production, distribution and consumption which are simultaneously discursive and material constructions through which' economies are constructed (448). From this position Hudson argues that 'cultural economy and political economy both can and should be regarded as complementary perspectives' (466)[2] although as he notes in the next sentence there is 'comparatively little evidence that those practising economic geography operate in this way'. What is at stake, as Hudson remarks in his conclusion, 'is precisely what *is* defined as and taken to be the economy' (467, original emphasis; see also Lee (2002, 335)). Whilst I am in agreement with this conclusion, in so far as what is defined as the economy and how its workings are understood holds political implications as well as the potential either to enable or to stifle theoretical and research initiatives, Hudson's sympathetic approach to cultural economy could be taken further if it were open more to the work of Michel Callon. I am thinking in particular of his notions of calculativeness, tools of calculation and calculative agency in relation what he refers to as the performation of the economy, and the more recent introduction of the idea of *agencements*. As will become clear, this approach to conceptualising markets, economy and economics can be put to effective use in geographies of finance.

More significantly, the cultural economy argued for in this paper does not view culture as a context *within* which economic action takes place, as something external to economic action[3]. 'Economic discourses' as understood from this position 'format and frame markets and economic relations, "making them up" rather than simply observing and describing them' (Du Gay and Pryke 2000, 2; see Callon 1998, 2)[4]. Culture in this understanding is already wrapped up in the 'calculative tools' such as accounting techniques, and the processes of calculativeness that as it were sit between the 'economy' and economics; in other words,

economics gains the capacity to perform the economy through sets of calculative tools which enable calculative agencies (Callon 1998 20-23). As Barry and Slater (2002, 182) point out, calculativeness 'cannot be regarded as an exogenous social feature, as something to be accounted for by terms such as "socialization", "culture", "embeddedness" or any other "social context". Calculativeness is not to be imported from somewhere else into the economic field'. Moreover, in an echo Callon's critique of economic sociology and its turn to culture[5], it is misguided to try to 'identify the cultural preconditions of observable economic behaviour' (ibid). For the purposes of this paper, what these pointers flag is the central role of calculating tools – that is, devices that 'constitute the spaces of calculability and define the way calculation is made up' (Callon 1998, 24) - in the making of a market. Thus, for example, financial economics, quite obviously, helps to make financial markets but these economics are greatly aided by the range of calculative tools, such as finance theory, employed to give shape and *meaning* to what is framed as the 'market', be this a market in foreign currencies or so-called catastrophe bonds. As section 4 stresses, these tools call out for attention and inclusion in research agendas focusing on geographies of finance because of the relationship established between 'what is to be measured and the *tools* used to measure it'. The important point is: 'the latter do not merely record a reality independent of themselves; they contribute powerfully to shaping, simply by measuring it, the reality that they measure' (Callon 1998, 23).

Callon helps to lend form to a cultural economy that enables such agendas chiefly because his conceptual excavations make room to explore *practices* through which markets and economies are equipped, as the above suggests - and their effects. In a reply to Danny Miller's critique[6] of *The Laws of the Markets* Callon (2005) clarifies his approach and draws attention to the all important idea of *agencement*. For those familiar with actor-network-theory, to which Callon is, of course, central (Callon and Latour 1981), and Callon's (1998) 'performativity programme' outlined in his *The Laws of the Markets*, the introduction of the notion *agencement* suggest that agency 'as a capacity to act and to give meaning to action' is not confined to individuals. Once corralled or 'framed', to use Callon's language, and made attributable to one agency amongst potentially numerous – from the adaptive to the calculative, for instance – agency is most satisfactorily understood for Callon as made up of 'prostheses, tools equipment, technical devices, algorithms, etc.' in addition to human bodies. Altogether, such an arrangement or 'hybrid collectives comprising human beings as well as material and technical devices, texts, etc.' is termed an *agencement* and it is through this action is achievable. [7] Expressed in terms of cultural economy, culture is already distributed through the *agencement* that configures the realm of possible calculations[8].

Callon's influence, it is contended, together with that of others who make up a broad church that includes the social studies of finance[9], holds the promise of injecting fresh imagination into research agendas that focus on geographies of finance and financial markets. This body of work, I would argue, helps to make sense of just how a range of calculative tools that lie at the heart of the components of modern finance and the calculative agencies they enliven configure 'geographies'.

3 …to a cultural economy of finance

To emphasize a *cultural* economy of finance is not of course to imply that geographical work on finance undertaken to date has sidelined culture. Clearly, this is not the case. Over recent years geographers exploring finance and the financial system have made numerous and important contributions, not only to debates about finance and its geographies (for example Corbridge, Thrift and Martin 1994; Clark 1997, 2000, 2005a; Clark and Thrift 2004; Clark and Wojcik 2003; French and Leyshon 2004; Gilbert 2005; O'Neill 2001; Tickell 1996, 2000a and b; Leyshon 1995, 1996, 1997, 1998, 2000; Leyshon and Thrift 1998; Martin 1999; Pryke 1991; Swyngedouw 1996; Wrigley 1999; Wrigley et al 2003) but also the importance

of culture to the working of money and finance (for instance Allen and Pryke 1999;Clark, Thrift and Tickell 2004; Leyshon and Tickell 1994; Leyson and Thrift 1995; Pryke and Allen 2000; Pryke and Lee 1995; Tickell 2003; Thrift 1994, 2001, 2002). Indeed, as Adam Tickell rightly points out, what this body of work makes clear is the need to abandon 'unhelpful distinctions between the separate spheres of economy and culture, and develop a more sophisticated approach to the integration of cultural and economic explanations' (2003, 125).

The point is well made, but it can be extended further. As articulated in the research of for example, Beunza, Hardie and MacKenzie (2006), Callon and Muniesa (2005), MacKenzie (2001, 2003a and b, 2004a and b) and Mackenzie and Hardie (2006), it is possible to show how this integration is achieved within financial markets. These authors argue that these markets are actively made,[10] insisting (in line with Callon's original performativity thesis (1998)) that they are performed and that moreover this performance depends on the *materiality* of these markets – a materiality that includes finance theory itself (for example Maurer 2005a and b; Miyazaki 2005). In other words, seen through the conceptual lenses provided by these authors, financial markets are understood as hybrid collectives or *agencements*.

To view a financial market as an *agencement* is to recognize it as a very particular congregation of the social, cultural and the technical. The NYMEX trading floor, for example, is a mix of the yells of men (and a few women) in colourful jackets and sophisticated trading technologies held together by an agreed understanding of just how the outcry and the technology should combine to aid price discovery and liquidity in the formation of a marketplace. The screens, models, and so on are active components in the making of this and other financial markets; they do not collectively form a passive backdrop to human traders[11] [12]. Even mathematical models need attention as these too stake out a terrain of possibilities for market making.

Yet, arguably, there is some other process that co-exists within such a gathering. NYMEX, CBOT, Wall Street and other market places, and the weight of investment they help to direct, have the potential increasingly to spatialize. Not only do financial markets 'make the world go around', the practices of buying and selling, of making markets, share a growing tendency to shape the world that finance circulates through. To reflect on the hybrid nature of the practices that work to put the flow into the flows of finance is to find a starting point to conceptualize the exchanges between the spatialities and temporalities that make financial markets. The mathematical formulae and the assumptions they contain about space-time, the manner in which their assumptions become entwined in the workings of modern finance as a result of increasing centrality of financial engineering based upon such mathematical expressions, the streams of data, their manipulation and presentation on the screens in financial organizations, may now all be viewed as active players in the hybrid troupe called a financial market.

In this sense, contrary to Paul Hirst and Grahame Thompson (1999) global finance today is not the same as that of one hundred years ago. If, as Doreen Massey (2005, 85) points out the analysis is less about degree and more about form, then today's financial markets are different in that they work through, to use Callon's (2005, 2) words, 'reconfigured socio-technical agencements'[13]. Such reconfiguration has effects within market cultures. As the work of Alex Preda (forthcoming) shows, for example, the introduction of electronic screens alters the behaviour of traders in relation to the 'market', while Caitlin Zaloom's work in Chicago Board Of Trade and the City of London suggest that technology 'reconfigures numbers differently and thus influences traders' practices by shaping this basic unit of financial knowledge'(2003, 258). Arguably, the introduction of new components into financial market making has effects on the world outside of the exchanges. The consequential power of finance to spatialize, for example, is different nowadays because the constituent components have changed: the markets are, Callon (1998) would say, prepared differently. The financial

models, the latest forms of ICT, and so on, as well as the 'money imaginary' that weaves its way through and feeds on the possibilities of such materials, are all potentially capable of reworking the space-times drawn into financial flows; that is, flows made through the *agencements* that frame each of the variety of markets and their related flows that together sum up to modern finance. Such *agencements* in other words configure the realm of possible calculations that may take place within these markets. The notion of social-technical agencement moves the analysis to the core of markets, the hybrid collectives that make them, and the effects of their making. Equipped to layout what makes a market, the task of effectively critiquing 'financial markets' or an 'economy' fuelled by financial capitalism is made at least a little clearer,[14] though not necessarily straightforward. The tricky bit is not simply how to keep 'geographies' in the mix, as it were, but as earlier sections have suggested, how to think about these geographies in relation to financial markets.

Movement and flow are certainly involved in the sleepless, human and electronic trades, the continual search for high yields, the negotiation of any number of risks, the activities of market making, and in a sense represent the 'financeness'[15] of finance. Yet this same 'financeness' does not leave spatialities unaffected. The geographies of finance are born in the busy, energetic, rhythmic, dynamic that are financial market making. 'Flow' and 'circulation' do not quite capture the entanglement of time-spaces that accompany the motion of finance and the traffic in financial instruments. As analytical concepts, they join the story half way through as it were; they miss out the formative stages, the processes and practices that *shape* and *generate* the flows and the circulation. As stated earlier, a central aim of this paper is to engage in a re-description of finance so as to bring out the impact of the workings and the imaginaries that enable financial flows to move around. In a sense, part of that aim is to speculate on how best to conjure the potential for financial markets to 'de-' and 're-territorialize' the earth. Thus to the vocabulary of flows and circulation that tends to dominate geographies of finance, I want to introduce the idea of rhythms, of the entanglement of time-spaces, of coding, and territorialisation in an effort to re-imagine geographies of finance. Through the examples of the grafting of derivatives, the climate and weather to produce financial gizmos such as carbon emissions trading and weather derivatives, I suggest why such language can make a difference to the way we understand the world of finance and its spatialities (section 4).

4 Rethinking geographies into finance

The growth of 'scientific finance' over the past forty or so years has influenced the workings of financial markets in a number of ways. Not least, as Donald MacKenzie has argued, is the relationship between mathematical expressions and the world: the

> …decades since 1968 have seen the world of finance change in such a way that the apparently ungrounded models that horrified Durand [a leading figure in old school finance] have gained verisimilitude as they have become incorporated into the structures and practices of markets
>
> (2003b, 860)

This tendency does not mean however that 'human behaviour is naturally "mathematizable"': as Callon reminds us, 'it is because the *calculative agencies* are there to introduce interrelated calculations in decisions and in the formulation of actions' (Callon 1998, 50 emphasis added) that the mathematics works. And as already noted, the calculative tools – such as the financial models that disturbed Durand – toil in an effort to ensure that the financial expressions succeed, as noted earlier, because of the way 'they contribute powerfully to shaping, simply by measuring it, the reality that they measure' (ibid, 23).

Such guidance notwithstanding, there appears to be a certain deference when it comes to the models of modern finance in particular, perhaps because it is presented as a rigorous set of scientific procedures (and because it looks so difficult to do!). What this often means is that it is all too easy to accept the reality wrapped up in finance. The equations are viewed as above question rather than as part of an ongoing 'struggle to configure the world' through financial markets, struggles which are 'and will remain, at the heart of the history of our times' (MacKenzie ibid). To go along with the realities framed by finance theory, in my view, holds consequences. One is that economic geographers are in danger of failing to recognize and unpack the *agencements* that help fabricate the realities presented by finance and so miss the opportunity to demonstrate why these realities are not unalterable and, equally importantly, how spatialities are drawn into and 'configured' by such models (subsection 4.1). Another consequence is that just when the belief in the powers of modern finance has grown to such an extent that finance theory (through the development of climate and weather related financial instruments) is looked up to to quell the fears of the risks presented by 'mother nature', such as climate change, drought and hurricanes, geographers put themselves in the position of potentially accepting rather than questioning the world made through such marriages. The development of such instruments as weather derivatives should at least be within the frame of interest of 'geographies of finance', not least because of the ways in which these markets provide an opportunity to 'think across the divide' (Harrison et al 2004)[16] regrettably formed between human and physical geographies.

The approach offered by a cultural economy of finance tries to highlight the spatialities that may be configured by the embroidery of financial calculations[17] made through financial markets (and derivatives in particular, in the case of so-called weather futures) and the need for a conceptual language to describe these configurations (subsection 4.3). But, first, I turn to the sensitive issue of the realities of finance.

4.1 The 'realities' of finance

In *Why Globalization Works*, Martin Wolf claims that '[t]he failure of our world is not that there is too much globalization, but that there is too little' (Wolf 2004, 4). Although he would very likely protest, such a declaration has already knitted together the *cultural* and *political economy* at its very core. No doubt Wolf feels himself able to label his concerns as clearly 'economics', free of the troublesome and 'murky waters' of the cultural and the social (14), yet the markets he wishes to see propel globalization[18] further are already deeply cultural - because they are deeply discursive[19]. Global financial markets, as politics by other means, are the products of an Anglo-American cultural economy. Thus, when Wolf happily refers to 'economics', what he overlooks is precisely the deliberate shaping of the object he holds dear: his economics, like all economics, are made not found. He and others would do well to note that 'it should be obvious that there is nothing like an economy out there, unless and until men construct such an object' (Dumont 1977 cited in Buck-Morss 1995 page 439 FN 11, gender in original).

To take this a little further, much effort has been spent by the proponents of capital mobility to 'bamboozle' people into 'celebrating the new world of trillions of dollars moving about daily in a borderless world, creating gigantic economic gains, rewarding virtue and punishing profligacy' (Bhagwati 1998 page 11). The bamboozling is, as Bhagwati notes, an 'ideology' at work. To say uncritically, for example that, 'global financial integration' (capital mobility, in other words) is essential to the welfare of significant majorities of people living on the margins of the global economy, is to accept with an almost religious like faith a very specific discursive formation of financial markets and the financial economics that perform them. To argue that markets, specifically the idea of capital mobility, are not given from on high but are deliberately put together by the likes of what Bhagwati calls the 'Wall Street - Treasury complex'[20] with specific effects, is to make a case for a geographical approach to economics that has 'real world' purchase.

In a similar fashion, the desire to be able to repeat the jargon of financial economics ('capital asset pricing models', 'capital flight', 'efficient market hypothesis',…) is to leave unquestioned the world-making that the circulation and imposition of such a discourse involves. Take, for instance, Latin America, where discursive battles to reformulate the market rules of the international financial economy are ongoing. The presidents of Argentina and Brazil, and other Latin American leaders, are trying to persuade the international institutions, such as the IMF, to rethink their understanding of government expenditure in times of economic downturn (Bretton Woods Project 2003, 2004a and b). The argument is part of a larger debate about how national accounts should deal with the concept of asset creation and how related expenditure should be viewed by the IMF with its, some might say blinkered, view of sound fiscal policy[21]. Such a challenge to the rational, orthodox economics that so many on the Right favour and view as pre-given, demonstrates how an alternative discourse can make up such markets differently, with potentially positive effects. What Lula in Brazil and Kirchner in Argentina are doing, surely, is (a) cultural political economy. They are taking apart the markets made by the economics of the international lending community and trying to make them differently; they are not accepting 'economics' and measures such as 'fiscal austerity' as given and unalterable.

Brief though these examples may be, they seem to revolve around the nature of the reality presented by the world of private finance, whether it should be contested in the case of Lula et al or accepted in the case of Wolf. To have faith in finance or to confront its workings is also an issue that seems to bedevil geographers wishing to explore financial markets. For instance, in a recent paper 'Money flows like mercury' Gordon Clark rightly wishes to 'provide a different conceptualization of global finance from that which dominates the (sometimes) arcane world of financial theory and mathematical models' (Clark 2005a, 108). This would seem to signal a left turn at the fork, heading the agenda in the direction of contesting the

world of finance. Yet maybe this is not the case. Helpful though his chosen metaphor may be[22], a problem remains with a conceptualization that delivers this image and what thinking rides on it, so to speak. The endpoint reached suggests that although obscure at times, finance theory, its models and data, all do adequately convey a reality[23] which economic geographers must then investigate. The currency crises witnessed in Argentina, Mexico and Brazil, for instance, are understood by Clark in terms of their being 'endogenous', the outcome of 'capital flight' (ibid, 109)… grasped, that is, in the very language of the models of the global finance he wishes to re-conceptualize. The acceptance of this language and the reality it purports to portray seems to me, first, to ignore the work carried out through the particular *agenencements* to be found within the 'global microstructures' (Knorr Cetina and Bruegger 2002) of Chicago, Wall Street, Tokyo… For it is in such spaces that socio-cultural and material practices[24] weave the realm of possible calculations, and hence the remedies required to put them right. Second, the acceptance of this language also ignores, as Bhagwati noted above, the labouring of the likes of organizations such as the IMF that help peg out the ground in which the metrology[25] of finance and its language can survive. The work of such organizations contributes to the production of a 'common sense' voiced by many, such as Wolf above, which allows current private financial markets to be viewed as essential girders supporting not just the relatively affluent everydays of many in the 'West', but the only real way that developing countries can pull themselves out of the pit of under-development[26].

To buy into this only possible future world is to accept the world desired by private finance, where the models work; a world that is intricately tied to the way leading financial economists whole heartedly believe that financial markets can solve any problem and deal with all risks – it's just a case of the 'right mathematics and enough information' (Green 2000, 86 cited in de Goede 2005, 140)[27]. For whom they 'work', the ethics of finance, the broader politics of financial markets …are questions that this particular reality discourages simply because they are never allowed to be visible within the frame of bond markets, currency markets, and the like. In short, mathematical finance drapes the world in financial code in an effort to ensure that its models deliver according to the metrological regime of finance theory (see Mackenzie 2001, 2003a and b, 2005). To accept the world according to such technical (supposedly) apolitical finance[28] is to be shielded from the very geopolitics of financial markets and the associated power to spatialize which matter to geographers.

What I am not saying however is that it's just a case of shouting 'Boo!' every time private financial markets are mentioned and to leave it at that. As Donald Mackenzie (2000, 32; see also 2003a) has written

> [m]athematical finance is part of the infrastructure of the modern world. The techniques developed out of the research of Black, Scholes and Merton [all highly influential financial economists and behind LTCM] continue to work perfectly well in millions of transactions daily, and to abandon them would be unthinkable folly.

And he continues '…finance theory describes not a state of nature but a world of human activity, of beliefs and institutions' – and, as more recent work (including MacKenzie's) has shown, their materialities.[29] To belabour the point, the theory does not mirror a reality, the reality is the outcome of very particular socio-cultural-technical handiwork. The interest of economic geographers should thus lie in how the *agencements* of finance are able to authorize geographies. They should be alert to the potentially significant worldly effects contained in the belief in finance, and its reality, once it overflows the black boxes[30]. As the next subsection highlights, the expansion of such beliefs in financial markets is now about to encompass 'nature' as even meteorologists are drawn into the metrological regime of finance[31].

4.2 Coding and 'blending' the climate, the weather…

As Craig Calhoun (undated) notes in his introduction to the US SSRC research initiative 'The privatization of risk', there is a growing policy preference for 'private property over public institutions'. Perhaps unsurprisingly the drive to privatize risks looks to private property rights and market mechanisms. Inevitably this has enveloped private sector financial markets and is fast becoming a global policy. What is perhaps more surprising is the belief that it is possible to harness these markets in order for humans calmly to maintain a course of expanding economic growth and endless consumption. In her SSRC privatisation of risk essay, 'Catastrophic risks: the need for new tools, financial instruments and institutions' Graciela Chichilnisky[32] (undated) writes

> Nature has raised the stakes. In 2004 a record number of hurricanes and typhoons struck Florida and Japan…While people watch on TV screens in shock and disbelief, scientists forecast a new global trend. Hurricanes that could impact the US are increasing in strength and frequency. Many believe that we are entering a new geological cycle and that the increased storm volatility is caused by the warming of the seas, part of an overall pattern of global warming. We may need to prepare for an increasingly dangerous physical environment, and we need to do it fast.

To act swiftly and effectively calls for, as Chichilnisky continues, 'new forms of social organization and tools for decision making in periods of uncertainty. It requires *new types of financial instruments* and institutions, and leads us to rethink public action and the role of governments' (2005, 1 emphasis added). The turn to financial markets in the face of an 'increasingly threatening physical world' has already begun.

The creation of a global market in emissions trading (in which Chichilnisky was a key player) began life in The Chicago Climate Exchange, part of the Chicago Board of Trade (CBOT). The Exchange now facilitates trade in CO2 emissions, as well as S02, where the latter began under the US Environmental Protection Agency sulphur dioxide emissions trading programme.[33] Similarly Catastrophe bonds[34], again traded in the CBOT, are new financial means to cover the risks that nature presents and combine the use of securities to hedge correlated risks, leaving the independent risk to be hedged through insurance markets. As Chichilnisky (undated) observes, this manoeuvre works because

> [c]orrelated risks are hedged through securities by taking advantage of *negative* correlations. For example, most earthquakes in California are followed by a boom in the construction industry. Therefore appropriate securities can be created that hedge the correlated risk by investing in the construction industry
>
> (undated, 6).

In the case of hurricane Katrina, this would mean that 'victims could therefore be compensated for their financial losses through negative correlation between the catastrophe and the value created by rebuilding efforts'. (As noted above, it seems that 'It's just a case of the right mathematics and enough information…'.)

The knitting together of the climate, the weather and financial markets does not, however, simply allow the structuring of instruments that can supposedly cope with the either. To yoke nature in the form of hurricanes, floods, above average temperatures, drought[35], earthquakes …to futures markets, creates something new. What is produced is shaped by the cultural economy of these markets and the money imaginary running through them. The climate and the weather are reframed in relation to notions of risk and the culture of finance. This is how 'we' now deal with Mother Nature. The Chicago Climate Futures Exchange, CCX, for instance, refers to the innovative financial instrument that provides a financial market based mechanism to deal with greenhouse gas emissions as an SFI– Sulfur Financial Instrument

(CCX 2006). The entanglement of weather and investment markets is reflected in the successful bids made by hedge funds and investment banks at the US Environment Protection Agency's 14th (!) Annual auction of S02 allowances held in 2006. For example, Morgan Stanley purchased US$ 62 million in allowances and JP Morgan US$8.8 million in the 2006 spot auction. In the 2013 advance auction, the same two investment banks successfully bid for a total of US$ 18.4 million (CCX 2006, 2).

The imaginative marriage of financial markets and the so-called natural world made up of unpredictable upheavals is not a mere case of opening up the latter to financial flows. It is a cultural-social-technological fusion of the components that, in a sense, make finance 'finance' – which can range from anything from the self-image of futures traders fashioned in the act of placing financial orders (e.g. Zaloom 2004), to mathematical models (Mackenzie 2004a and b; Mackenzie and Millo 2003), to computer screens (Knorr Cetina 2003) and to software designed to help make specific markets[36] - *and* the rhythms of nature and weather systems. Arguably, the outcome is not yet another financial geography captured adequately by the descriptor 'flow', but is a set of processes that actively produce spatialities through the paraphernalia that make financial markets. The stuff and 'things' of these markets, in other words, are important because they frame markets and they combine to *transmit motion and meaning* as they congregate in metrological regimes. It is in these markets that the embryonic financial topologies that reflect modern finance's approach to the risks of nature are to be found. The development of weather futures serves as a good working example where meteorology meets one of the stars of contemporary finance: the financial derivative. Collectively, derivatives have become the dominant rhythmic motifs of financial capitalism encapsulated in the exchange traded market weather derivatives which began life in1999 on the trading floor of the CME (Chicago Mercantile Exchange). A research paper by Deutsche Bank sets out something of the preparation of this market.

> Weather derivatives are financial innovations based on weather data, such as quantities of precipitation (rainfall, snow depth), number of days on which it rains, hours of sunshine, air temperature or wind speed. The fact that 'the underlyings' (the weather data) are completely independent of goods or financial markets distinguishes these from other financial derivatives. Typically, an *index* is created on the basis of data and quoted on the stock market, for indices *make it possible to depict* the underlyings continuously over a period of time. The weather variables can be quantified objectively, but cannot be traded or stored as they are *not physical assets*. Settlement between the seller of the risk (e.g. a utility faced with a weather risk) and the buyer (e.g. a bank) is thus always in *monetary units*
>
> (2003 page 4; added emphasis).

The index showing changing rainfall, the technically aided human decision to buy or sell… have been brought together to make a market in weather derivatives that draws the weather into flows of financial signs which 'alter forms and carry nature into successive metamorphoses' (Jeanneret 2001, 50).

The newly formed NORDIX (Normal departure Weather Index) emerged as a 'tool of calculability' and established a new parameter of calculation 'extending the spaces of calculability' (Callon 1998, 27) and proved essential to the framing[37] of this market.

> The NORDIX index facilitates the aggregation, formulation, production and distribution of weather indices. Indices consisting of weather elements such as temperature, windspeed [sic], precipitation, and sunlight hours. Perpetual numerical values making up the NORDIX, are applied specifically to the financial markets worldwide, for the trading, facilitation, risk transfer, and liquidity of such markets. The index is generated using a configuration system and process for collecting and

> calculating weather data. …The indices and their numerical values are derived from weather measures and enable parties to participate by means of bid and offer.
>
> (NORDIX 2002, no page numbers)

Metrological developments of this kind – putting 'new objects into circulation and creating new objects 'that make a difference in the world' (Barry 2002, 277) - not only provide 'financial economics' with access to an area that had previously been thought of as always able to escape the reach of money, they 'feed back to economics' 'through all their collecting, generalising and integrating' (Callon 1998 28). As a component of finance, the knowledge represented by such an index allows the financial imaginary boosted by ICT to calculate the weather in a manner that implies more than simple risk assessment. It is about blending new financial forms and weather systems; in effect to financialize 'good' and 'bad weather'.

In their recent study of financial derivatives Bryan and Rafferty (2005) underscore the points made above when they argue that the importance of today's derivatives lies in two related spheres. First, is their role in *binding*, through options and futures, the present to the future. Second, and perhaps more pertinent to the arguments in this paper, is their function of *blending* through swaps in particular to establish

> *pricing relationships that readily convert between different forms of asset. Derivatives blend different forms of capital into a single unit of measure.* (They make it possible to convert things as economically nebulous as ideas and perceptions, weather and war into commodities that can be priced relative to each other and traded for profits.)
>
> (2005, 12 emphasis in original).

The moves by investment banks and hedge funds into the US Sulfur Allowances market (noted above) in search of high yields in a low interest rate environment is perhaps one example of the possibility of imagining the weather and, say, an emerging market bond as 'commensurate'. That is blending as a process involves the establishment of pricing relationships across any number of entities that then makes compatible what were previously distinct and separate[38].

The transformation into something that can be indexed and priced also involves a shift in meaning and understanding. In such a financial culture, the risks of nature no longer present a string of unsolvable problems. Hurricanes and floods may be on the increase, Mother Nature may have upped the stakes, but now such risks can be absorbed into the core sites of today's money culture, the intensive spaces of CBOT, Wall Street, Tokyo…and such risks of nature are made manageable by reshaping them through the practices of making financial markets, in this case in derivatives. The intensive spaces of financial market making 'perform temporal [and spatial] syntheses', their rhythms 'assemble bodies and distribute intensities' (to borrow from Turetsky 2004, 140) to produce spatialities - financial topologies - that extend through an ever increasing range of entities cum investment categories such as metals, grains, stock indices, currencies, money markets, and now through derivatives, financial market making resonates through weather, floods, earthquakes...

The significance of this point is that because the climate and the weather blended alongside other assets they become subject increasingly to the decisions of the asset allocators moving an estimated US$45 trillion (that is 150 per cent of OECD GDP)[39] around the globe. The market in weather derivatives, for example, has recently attracted the attention of leading hedge funds such as Citadel Investment Group, DE Shaw and Co., as well as specialist hedge funds, such as Takara and Pyrenees Capital Management, which were set up specifically to facilitate private investor and fund investment in weather and weather-related products. Indeed, hurricane Katrina boosted hedge fund interest in weather derivatives – trade volume

was up fivefold in 2005 on the previous year (*Hedge Fund Street* 2005; *The Economist* 2005). (The same degree of interest however has not been shown by 'traditional end users' – companies exposed directly to the effects of unfavourable weather (see *Environmental Finance* 2005).) Moreover, the weight of this money is not simply a *flow*. The asset allocation decisions that move potentially vast sums in and out of asset classes as situations change, 'increasingly "make markets"' as the International Monetary Fund has recognized (IMF 2005, 65): the same decisions spatialize too. 'Institutional flows' flow, certainly, in the sense that they are moved from one asset class to another, but the range of decision making that influences asset allocation, varying as it does in terms of, say, differing liability structures, tax exposure, accounting requirements, time horizons (IMF 2005, 70-76)[40], the mix of social-cultural-technical components that aid these investment decisions and then circulate them through markets, mean that the complete process is not a dispassionate, smooth flow. It is a lively unpredictable entanglement that actively rhythms financial topologies.

Financial markets as distinct gatherings that bind together the social, cultural and technological, work collectively as 'cartographers' busily marking out the contours of the intensive spaces of global finance. For to become part of the capital markets, to acquire the attributes that allow blending, requires what might be termed *reterritorialization*: the weather, the climate …have to be *decoded*, they have to have the natural shaken out of them, as it were, and *recoded* as part of financial capitalism's new terrain. The weather, then, is not the weather of old; it's been coded, marked by the intensity of financial market making. In this way, paying close attention to the making of financial markets might allow economic geographers to see just how financial markets, as cartographers, make its maps. This may, however, require a search to find another conceptual language that can adequately describe the geographies in finance.

4.3 … conceptual language and the spatialities of finance

To say that the weather is undergoing 'reterritorialization' through the practices of financial market making is to grapple with the developments that, in effect, seek to re-place the weather into categories recognisable by private finance that thereby allow its risks to be managed through tailor made financial instruments. The splicing together of the conceptual worlds of Deleuze and Guattari – theirs is the world of reterritorialization, decoding, entanglement - and Callon is an attempt allow the processes of financial market making and the production of spatialities to inform one another, and thus to unravel the world making of financial economics. In turn, this should help to undo the worldly implications of financial market making. One such implication is the *interference* that results from the application of multi-spatial and multi-temporal calculations contained within financial flows - those, say, of the futures markets - to the equally variable space-times of nature. As I understand it, to design and employ this type of 'environmental finance' is to interfere with the world in ways that geo-graphize through processes of de-and re-territorialisation. The recent proposal to develop a financial instrument from phenology models that predict the time of events in an organism's development illustrates this point well. The models employ a physiological (rather than a calendar day) time scale to judge accurately the development of insects, such as the potato leafhopper, as temperatures alter. The aim is to combine such a model with a derivative, such as an embedded weather option, to be sold together with a pesticide by a manufacturer to a farmer. 'Accumulated leafhopper degree days', financial swaps, and more thus become entangled in agricultural pest management.[41] Through recoding, leafhopper is 'becoming finance', to use the language of Deleuze and Guattari[42]. Whilst the language may sound odd and unfamiliar, if developed, such an instrument goes much further than simply being described as part of the flow of finance.

nIn the same vein, and to return briefly to the earlier example of weather derivatives, the design of this instrument was not simply a case of exposing the weather to financial flows. It involved the coding and re-categorization of nature. Meteorologists help to represent weather

patterns to financial markets in a code that participants can understand and act upon. An extract from an article in an industry journal *Energy Marketing* gives a real world flavour to this process.

> Since weather plays ….such a vital role in energy price movement and profits, traders need to rely on the expertise of meteorologists to provide both short-term and long-term forecasts as an input into their trading strategies. Over the past few years, faster computers have opened the door for more forecast[ing] models to be developed by the U.S. National Weather Service (NWS) and for more frequent updates of these models. Knowing the update times and biases in each of these models can provide a trading edge over less informed traders.
>
> (Marcus1998, no page numbers)

What this quote illustrates is how the decoding permits the *deterritorialization* of, say, temperature and rainfall, to take two examples. The act of deterritorializing is a process of *recoding* such elements into a rhythm that makes them amenable to *reterritorialization* within financial markets. As the same article continues

> The NWS provides general update times, and those updates that occur during market trading can have a significant impact on short-term price movement when forecasts are adjusted warmer or colder. At the other end of the time scale, relationships between phenomena such as El Nino, volcanic aerolsols, and sunspots are used to make forecasts one to three seasons ahead, with forecasts based on an analog cycle approach
>
> (ibid).

Moreover, and in tune with this conceptual language, organizations, such as Earth Satellite Corporation (an independent entity that calculates a key index, the HDD (Heating Degree Day) Index relied upon by those trading in the CME exchange-traded weather derivatives), might be seen as more than yet other components of finance, rather they can be viewed as 'techno-human rhizomes' through their ability to translate the world's topographies into an 'embroidery of calculations'. But maybe this is the first step towards a new financial vocabulary that has space/time at its core.

5 On the road to a conclusion

In an effort to contribute to the emerging field of the geography of finance, and in the wake of the culture/economy debate, this paper has drawn upon Michel Callon and others whose work offers a new interpretation of the making of financial markets, the performativity of economics and the materiality of finance theory. The main point argued through the paper is that not only does economics make markets, but to do or to perform financial economics is to geo-graphize. In that respect, it can be argued that threaded through 'buy and sell', the three little words that make the world go round, are numerous spatialities. When we speculate on geographies of finance, we speculate on the nature of time-space that occupies or should occupy centre stage when thinking about finance and its worlds. Finance both has time written through it and simultaneously helps to write time; or, to put it differently, it aids the production of futures that are shaped in the name finance and its attendant imaginary. The ability to achieve this production of time arises out of the mix of components - of mathematical expressions, finance theory and visualisation software … - and their interaction. When combined these components produce the *temporalities* and *spatialities* of finance. One implication of this thinking about the time-spaces of finance means, first, dropping the idea of space as an inactive backdrop[43] , where, for example, it is seen as a straight edged scale that reduces the spatial to a geography of distances, or space as a landscape across which pass

passive flows. A second implication is that it also requires jettisoning the idea that the 'reality' presented by finance is unalterable.

International financial markets are arguably in much need of opening to question and debate (Wade 2006, 127). This paper has responded to Gordon Clark's recent call for a 'distinctively geographical approach to global finance' by arguing that the approach offered by Michel Callon, together with the associated work of others, most obviously Donald Mackenzie, encourages those who wish to open processes of financial calculation to empirical observation and theoretically analysis (Callon 1998, 268; Callon and Muniesa 2005, 1245). With its emphasis on the agencements of financial markets and the performativity of financial economics, this body of work draws attention to the range of components that make contemporary markets in finance and how this hybrid mix puts the flow and movement into financial flows. The range of calculative tools at the core of modern finance and the calculative agencies they stimulate, configure financial geographies; a cultural economy of finance seeks to help analyse such configurations and thus keep geography at the heart of its analysis of financial markets.

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[1] It is a project that would seem to chime with calls for geographers to enter more fully the debates about 'globalisation' (see for example Amin 2004; Coe and Yeung 2001; Dicken 2004; Martin 2004) and, in the light of the financial world's increasing entanglement with the stuff of nature, recent invitations to physical and human geographers to begin to converse (see Massey 1999; Harrison et al 2004).

[2] Similarly in concluding his review of recent writing at the interface of culture and economy Trevor Barnes is sympathetic to those such as Gibson-Graham and Thrift who "prosecute a hybrid economic geography" (2005, 76).

[3] As Barry and Slater remark, this was Callon's and STS critics' disagreement with those who attempted to develop a socio-cultural line in STS (2002, 182).

[4] There are echoes here of debates both about what an economy is and how it might be re-conceptualized (see for example Massey 1988, Gibson-Graham (1996; 2000 page 103; 2004), Thrift and Olds (2004)).

[5] See for example DiMaggio (1994), Spillman (1999) and Zelizer (2002).

[6] As Miller writes, his critique "was essentially that Callon's emphasis on calculation and disentanglement ends up as an attempt to rescue more conventional notions of the market, for no particularly good reason" (2005, 3). Miller does though "share a commitment to materiality and performativity. The key differences are that I prefer a dialectical tradition of that of agencements and actor-networks, and that I see *The Laws of the Markets* as a retreat from this agenda" (ibid, 8).

[7] In a similar fashion John Law (2002) approaches economic calculation as 'materially heterogeneous practices'. In this and in Callon's sense it is acceptable to talk of the stuff and things of markets. As Law writes "Think, then, of a spreadsheet. It is a thing…it is also, at least in relation to its use, a performance. Together with the person using it, it acts to produce effects" (2002, 17).

[8] Because it forms part of an *agencement* culture is not solely 'socially constructed' as Abolofi (1998, 84) argues in his conclusion to the 'markets-as-culture' approach.

[9] Such as Daniel Beunza, Fabian Muniesa, Yuval Millo and Donald MacKenzie, amongst others.

[10] What follows from this is the issue of the role played by financial economics in making financial markets. The question 'What are financial economics' may strike a familiar tone. Questions such as 'What is an economy anyway?' were raised by geographers some time ago (see for example Massey 1988 page 252) and by bodies such as the GLC in their London Industrial Strategy (1985). The questions revolve around how we 'conceptualize the economy' (Massey 1988 page 253). Arguably what Callon et al do is to take this further and open the stuff of markets to conceptualisation. Cultural economy highlights the relevance of creating room in the analysis for the meanings such stuff carries through the performance of economics and market making.

[11] See FN 7.

[12] Although such objects do not lie within the accepted field of economics, they "contribute to the performation of calculation and modes of calculation…they also contribute directly to the shaping of a discourse through which agents account for their action" (Callon 1998 page 26). Working together, they "induce a change in behaviour" (page 26); they help, in other words, to build knowledge of markets and establish parameters of calculation.

[13] See Bill Maurer (2003, 73) for similar points. As he says, when it comes to capital mobility in particular, there is a need to investigate the nature of 'movement and the objects being moved'.

[14] Methodologically, the task would seem to centre on ethnographies of the socio-technical *agencements* of finance. These form part of Callon's overarching anthropological approach: "It is because economics is an anthropology of the economy, engaged in the transformation of the world through a network of alliances, that it is political anthropology" (2005, 8). Hardie and Mackenzie's (2006) work on a hedge fund offers an extremely help example of how such an ethnography may be done.

[15] Geoffrey Ingham (2004) talks of the 'moneyness' of money. The 'financeness of finance' is shameless borrowing.

[16] Indeed, Nigel Thrift argues that one option open to the discipline is to come up with research initiatives that allow both sides to speak to the same issue. Weather derivatives or carbon emissions are areas that yell out for the combining of research interests and theoretical approaches.

[17] In Margaret Atwood's Surfacing she uses the phrase 'embroidery of calculation'.

[18] See Massey (1999) for excellent and related points about the whole business of 'imagining globalisation'.

[19] One simply has to look at the way that financial 'markets' have been assembled and sold as the solution to so many problems to appreciate this.

[20] See also Martin (1994) and Goldman (2005) for similar points.

[21] See Wolf (2004) for arguments about why 'it's mostly fiscal' and why "beggars", that is developing countries, "cannot choose but adjust" (pages 289-290).

[22] Like those who coined similar metaphors such as 'stock' to apply to money, one problem with such metaphor is that, as Geoffrey Ingham reminds us, they fail "fully to capture money as socially constructed and constituted by social relations" (2000, 31). Although of course finance is not money, the fact that it is socially constituted, that it too is a form of "sociation", that like money it requires authority to work, and so on, should not be forgotten (see Arrighi 1994; Ingham 2004; Simmel 1990).

[23] Donald Mackenzie's work on finance theory is particularly instructive on the relationship between the equations central to modern finance, such as option pricing theory, and 'their world'. He is rightly cautious in his use of the idea of reality in relation to financial equations. As he writes "Neither finance theorists nor sophisticated practical users of financial models believe in the literal truth of the models' assumptions" (2004a, 16-17). The interesting point however is that despite this acknowledgement still key equations and techniques such as arbitrage have a "tendency to become more realistic" (20); in effect, come to 'embody the world' (2003b, 852). MacKenzie's work highlights Callon's emphasis on the performativity of in this case a key area of financial economics. Option pricing theory displays what MacKenzie calls 'strong' performativity: It "did not simply describe a pre-existing world, but helped create a world of which the theory was truer reflection" (2003b, 835). For insightful accounts of how the expressions of pure mathematics gradually come to be "performed in flesh, blood and silicon in the markets" (2004a, 22). See also MacKenzie (2003a and b, 2004a and b).

[24] See Hiro Miyazaki (2005) for an interesting ethnographically informed attempt to broaden the understanding of the "materiality of finance theory" – through for example the translation into Japanese of key US finance theory articles, promotional literature, and so on - and its effects. He seeks to show how the objectification of economic theory in the work of Callon and MacKenzie, and Miller, "entails a narrow view of its materiality" (176).

[25] Andrew Barry uses the notion of "metrological regime" (2002, 273) – making things measurable and thus calculable - to highlight the importance of measurement to framing and thus the performance of

calculation. As he says "metrology puts new objects into circulation. …metrology creates new objects that make a difference in the world".

[26] See Robert Wade (2006) for example for a critique of effect of the present system of liberalized world finance and what he argues are its detrimental effects on a majority of developing countries. As he concludes "There is little evidence to support the proposition that open capital markets generate a more stable and equitable world order; and much to suggest that they increase volatility and propensity to financial crisis" (127).

[27] This is of course intricately linked to the modern way risks are approached and the growth and acceptance of risk management. See De Goede (ibid, 141) (who follows Green (2000, 81-82) and Porter (1999, 142)) on this point and for the way that mathematical models translate into financial instruments and become 'routine' techniques for supposedly coping with risks.

[28] See de Goede (2005, 121-143) for strong argument that helps to show the gradual depoliticization of financial practices in the twentieth century and the rise of 'scientific finance', particularly post 1960s, as part of this process. See also Mackenzie 2002.

[29] As MacKenzie has written more recently "There are few more critical topics [than the structure of and behaviour in financial markets] for today's social sciences, for policy, and for political action" (2005, 571).

[30] As MacKenzie (2005) stresses the 'black boxes' of finance - such as option pricing theory, arbitrage and regulation - need to be opened. Other black boxes, of course, exist in the world of finance; ones that more explicitly perhaps re-rhythm and entangle spatialities and temporalities to the motifs of financial calculation. Similarly, the latest visualisation software that represents financial data and in the process reconfigure spatialities and temporalities of finance in an effort to root out investment opportunities could be viewed as one such black box. Perhaps such boxes should be targeted by geographers for analysis? See also Bill Maurer (2002) for a similar point.

[31] Meteorologists, so central to the growing market in weather derivatives, can be seen as members of a metrological regime: framing the weather in terms that can be used by financial actors; connecting the weather and financial markets in a way that may leave the politics – the politics of climate change, for example – out the frame, not amenable to questioning. Callon offers a reminder of how such systems of measurement that help to prepare such a market can be conceptually unpacked and why opening the processes to scrutiny are important. See FN 25.

[32] Chichilnisky is the holder of the UNESCO Chair in mathematics and economics and professor of statistics at Colombia University. She is one of the key figures behind the development of markets for tradable CO2 emissions.

[33] By 2005 registered trades in S02 allowances reached around US$2bn with a similar amount estimated to have been traded in the form of allowance derivatives such as options (CCX web site).

[34] These form part of a drive to find solutions to the insurance industry's increasing financial exposure to 'unprecedented catastrophes' such as hurricanes. Securitization enables such risks and the financial losses that go with them to be packed as securities that can be traded in the capital markets. What this means for the insurance industry, both insurers and re-insurers, is that financial exposure is greatly reduced as risks are shared with capital market investors. Similar devices include contingent surplus notes, exchange traded cat bonds, and catastrophe equity puts (see www.iso.com/studies_analyses/docs/study013.html (accessed 11th April 2006) for further information and illustrations of how this financial engineering may work.

[35] The Sydney Futures Exchange is due to trade water futures (derivatives) contracts that will settle to an index measuring dam and reservoir levels. The idea is to reduce the risk of financial losses stemming from water shortages and the impact on for example cotton, wheat and beef production.

[36] Climetrix® for instance is software designed for use in weather derivatives trading to help regulate the valuation and risk analysis of portfolios of weather trades.

[37] Framing is an operation used to define agents; it is used to define objects and goods which can be separated from other goods and actors involved in a market. "It is owing to this framing that the market can exist and that distinct agents can be brought into play. Without this framing the states of the world

can not be described and listed" (Callon 1998 page 17). This is also an act of 'cleansing' and 'disconnecting'.

[38] Binding and blending are also highly spatial acts, too (see Pryke and Allen 2000).

[39] These investors include insurance companies, pension funds, investment companies including mutual funds and unit investment trusts, and hedge funds (IMF 2005, 66-67).

[40] Even within 'hedge funds' strategies vary to include for instance 'global macro', 'equity hedge', 'high yield', 'emerging markets' and 'fixed-income arbitrage' (see IMF 2005, 50-51).

[41] See http://www.ipm.ucdavis.edu/WEATHER/ddphenology.html accessed 7th January 2006. This idea of linking weather derivatives to the agricultural chemicals industry was floated by the Aquila Energy Derivatives Group.

[42] On the possibilities of linking a Deleuzian geophilosophy and a cultural political economy see Bonta and Protevi (2004).

[43] The sense of space I wish to subscribe to is, to borrow from Massey, "not static, not a cross-section through time; it is disrupted, active and generative. It is not a closed system; it is constantly, as space-time, being made" (1999, 274). Debates about the production of space, the multiplicity of time-spaces for instance seem to be absent from geographies of finance.

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