



Constraints and sources of nonequilibrium: a case of radical market transformation in Brazil

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ABSTRACT

Illycaffé entered Brazil in 1991 with the simple goal of finding high quality coffee and with a simple but revolutionary procurement strategy based on a) direct interaction with farmers and b) on an Award for the best coffee quality beans. The entry of Illycaffé unleashed a series of long-lasting consequences and unintended effects that revolutionised the Brazilian coffee industry and enabled the emergence of the quality coffee sector from the undifferentiated segment of commodity production. This paper analyses the 'butterfly effect' of the emergence of the quality coffee in Brazil in terms of complexity theory; and more specifically in terms of constraints and sources on nonequilibrium. I show how the entry of Illycaffé worked as an attractor (pull-strategy) that caused the decommodification of the coffee sector, enabled the emergence of a network of quality producers, and caused the rise of a 'long tail' of diversity.

Introduction

The article describes the entry of the Italian firm Illycaffé in the Brazilian coffee market and details the cascading consequences. Drawing from Complexity Theory the article proposes a theory to explain the autocatalytic properties of unfolding cascades. In the quality/commodity transformation described here, I suggest that the cascade takes the specific form of a decommodification process, which occurs through the development of a long tail of diversity.

The case presents several interesting aspects that deal with:

1. The role of discontinuities in the development of socio-economic structures. The discontinuity corresponds to the emergence of the quality sector that breaks the self-stabilising commodity cycle.

2. The relationship between the architecture of a system and its innovation potential. The quality sector is built on an architecture that favours and encourages the emergence of diversity whereas the commodity architecture favours and encourages standardisation and economies of scale.
3. The triggering cause of the discontinuities and the non linear relationship between micro-causes and macro-effects ('butterfly effect'). The triggering cause of the macro-transformation of the Brazilian coffee sector is the entry of a SME ('Illycaffé'). Illy changed the rules of the game by launching an award for the best coffee beans.
4. The macro-transformations induced by butterfly effects develop as cascades in which one change generates the conditions (scaffolding) for the following ones. The unfolding of cascades is fed by underlying and unexploited sources of energy ('energy gradients' or 'sources of nonequilibrium'). The award caused a long series of unfolding changes and consequences, most of which unintended, that went well beyond Illy's strategy and business model. The effects fed on underlying energy gradients that were partly pre-existing Illy's entry and inherent in the logic of commodity markets. Other energy gradients were generated by the very dynamics unleashed by the 'butterfly effect'. These gradients are related to the 'geography of food' and to the emergence of 'long tail' effects.
5. Cascades occur in correspondence of major phase transitions. When they occur the system goes through a bifurcation and evolves a new architecture of relationships between its constituents. The award triggered the decommoditisation of the coffee market and the emergence of a new sector, the quality coffee sector, dominated and regulated by a different set of routines, norms, cultural values and regulatory institutions.
6. The collective effect of the cascade is the generation of a new architecture that regulates social economic and cultural exchanges. The quality coffee sector is geared toward 'long tail' innovations that are based on the dynamics of diversity

Theory

Scale-free causes are what Holland calls '*levers*'. Holland (2002: 29) says: '...Almost all *CAS* [complex adaptive systems] exhibit *lever point* phenomena, where 'inexpensive' inputs [his 'tiny initiating events' or TIEs] cause major directed effects in the *CAS* dynamics'. TIE effects constitute nonlinear outcomes that occur when a single event out of myriad of very small ones gets amplified to generate an extreme effect extending across multiple levels. Scale-free theories (Andriani and McKelvey 2009) refer to the same causes operating at multiple levels to yield what Gell-Mann (1988: 3)

labels 'deep simplicity' – a single theory explaining dynamics at multiple levels. Fractals result from scale-free causes; these are explained by *scale-free theories*. Such theories point to a single generative cause to explain the dynamics at each of however many levels are being studied.

Extreme events that start from TIEs and spiral up into macrophenomena,¹ orders of magnitude larger, raise a problem: where do they acquire/find the energy to do so? In a linear world, such as the case with neoclassical economics and disciplines inspired by the equilibrium assumption, large-scale deviations from equilibrium can only be generated by large-scale causes, i.e., the outcome is a linear function of the cause. Butterfly effect can't exist. Systems change gradually. In a nonlinear world, for TIEs to unleash radical change, however, it must exist – often invisible and unexploited – a source of energy.

A well-known example is hurricane formation. A small local instability taps into a reservoir of potential energy, used to amplify the instability. The instability provides a structuring pattern that entrains the potential energy in a pattern capable of self-amplification.

But the description of butterfly effects given above raises several issues: are all instabilities potentially able to trigger self-sustaining dynamics that escalate into extreme events? If not, why certain TIEs activate avalanches and others don't? What do we know about the role of patterns in entraining available sources of energy?

A field of complexity theory based on the concept of *constraints 2* (Juarrero 1999; Kauffman 2000; Turner 2002) comes to rescue.

Constraints and sources of nonequilibrium

Juarrero (1999) notes that the distinction between an aggregate of parts and a system rests on the emergence of a set of relationships that links parts together and form modules of interactive elements. The set of relationships generates a micro-environment, a context, that transforms an element into a component of a larger system. The relationships effectively limit—*constrain*—the element's degrees of freedom by embedding it into a local context. 'Constraints are therefore relational properties that parts acquire in virtue of being unified—not just aggregated—into a systematic whole.' Constraints, however, are not only 'limiting or closing off alternatives' (p.133), as in the common understanding of the term, but also generating new states and possibilities at a higher level. Juarrero writes:

By correlating and coordinating previously aggregated parts into a more complex, differentiated, systematic whole, contextual constraints enlarge the variety of states the system as a whole can access (p. 133).

Kauffman (2000) notes that constraints play a generative role in the expansion of diversity in the social and natural sphere. The generation of any entity, from information to artefacts, including constraints, involves work, that is, a *constrained release of energy*. To convert energy into work one needs the presence of an artefact which captures an external flow of energy and turns it into work. But to exploit a new

source of non-equilibrium (energy) one has first to discover and then harness it. For instance, since the Romans, wind energy has been harnessed to mill flour thanks to windmill technology. The blades of a windmill (free to rotate on its vertical axis) spontaneously orientate themselves perpendicular to the wind direction—i.e. they discover a source of nonequilibrium. When coupled to a device that transforms blades rotation into a different form of mechanical energy, wind is *constrained* to do work. In other words, *constrained* implies that some boundary conditions have to be in place to enable the transformation of energy into work.

The question that Kauffman asks is where do constraints come from? It takes work to 'fabricate' constraints and it takes constraints to extract work. Once new constraints are in place, more work can be extracted from the same amount of energy, the additional energy being used to generate more constraints, which are likely to intercept new sources of nonequilibrium, thereby restarting the cycle. The interplay between work and constraints reveals something deeper about the emergence of technological complexity. Constraints are the basic brick out of which complex systems arise; some constraints 'discovers' new sources of non-equilibrium and enables the conversion of energy into work. There is a third aspect of constraints that is worth mentioning. When a constraint intercepts sources of nonequilibrium and uses the resulting work to build better constraint more attuned to exploiting that source, there arises the probability that the new constraint is preadapted to intercept another source of non equilibrium or become itself a source of non equilibrium.

The example of coral growth is instructive (Turner 2002). Imagine a flat surface subject to a homogeneous nutrient-rich water flow. An irregularity (say a pebble that is dropped in the flow) distorts the streamlines and by creating a more turbulent flow immediately behind the irregularity, increases the local availability of nutrients. Coral polyps that locate there will grow faster and turn more nutrients into hard-structures, thereby increasing the size of the irregularity. This causes a further distortion of nutrient density (this time endogenously driven) causing a further increase of the coral structure. When the structure generated by the amplification of the original imperfection becomes large enough, then, existing dishomogeneities on the original structure may get amplified by the same mechanism. This gives rise to the fractal branching of the original peak into multiple radiating peaks. The interaction of the growing structure with the external gradient (water flow) generates a downstream turbulent pattern of equi-distanced eddies. Eddies alter the downstream concentration of nutrients, thereby reproducing the action of the initial irregularity. In a way they create a mechanism that modulates the selective amplification of existing irregularities.

This richly structured environment becomes home to symbionts, predators, preys and parasites that build further complexity on the scaffolding generated by irregularity/source of nonequilibrium dynamics. Once the mechanism is activated, the system doesn't need exogenously-generated dishomogeneity to keep growing, but, on the contrary, it generates them, by entraining and modulating external non-equilibrium situations. The distortion of lines flow that leads to the increased diffusion rate can be seen *à la Kauffman* (2000) as a constraint that generates a more efficient way of delivering energy. This is used to construct new constraints (more complex

structure) that are selected if they improve the energy exchange. What we have here is a propagation of organisation based on expansion in diversity. Similarly, the evolution of technological systems (Arthur 2009) often starts with a random discovery or event, which then trigger a trajectory of self-sustaining self-amplifying, endogenous dynamics.

Is there a connection between constraint theory and butterfly effect? Holland (2002: 29) says: 'Almost all CAS [complex adaptive systems] exhibit lever-point phenomena, where 'inexpensive' inputs cause major directed effects in the CAS dynamics.' These *lever-points* are constraints and the leverage effect is provided by the activation of a 'dormant' source of nonequilibrium. From this standpoint, cascades activated by TIEs can be interpreted as an unfolding chain of constraints tapping into progressively more numerous and complex sources of non-equilibrium. When the selective amplification of a dishomogeneity leads to the rise of modulated feedback loops, this causes the emergence of new niches both at the micro and macro levels. As in the coral reef example, the co-opting of progressively new sources of nonequilibrium by progressively more complex constraints leads to the emergence of new structures, structurally different from the ones they originate from. The overall result of the coupling constraint/nonequilibrium sources is the emergence of diverse and structurally new ecosystems.

Long tail and diversity

In the previous section I made the point that butterfly effects generate novel structures by expanding diversity. The fact that historical systems grow by expanding their diversity is well known since the time of Darwin (Jacobs 1967; Kauffman 1995; Saviotti 1996). We also know that higher diversity is correlated with higher innovation rates ((Jacobs 1985; Mokyr 1990; Kauffman 2000; Bettencourt, Lobo et al. 2007; Page 2008). However, this paper claims that diversity expansion triggered by butterfly effects is long tail distributed. Long-tailed distributions are non-normal, exhibit a high and unstable variance (in the most extreme case infinite variance) and often an unstable or non-existent mean. High or nearly-infinite variance (Mandelbrot 1963) is characteristics of many phenomena (Andriani and McKelvey 2007) and derives from the lack of central tendency. In their growth these system do not 'revert to the mean' but keep adding variance at both ends of the distribution. The tail of extreme events has received considerable attention in the literature (Raup 1993; Sornette 2000; Andriani and McKelvey 2007; Ormerod 2008; Taleb 2008). The other tail, consisting of the proliferation of micro-niches, micro-experiments and micro-variety (Anderson 2006), has until recently been less researched.

Anderson claims that the natural shape of unconstrained markets is Paretian with two fat tails: (a) high-volume hits comprising one extreme; and (b) a long tail of heterogeneous micro-niches at the other extreme. The emergence of virtual Internet-based markets makes the distribution of markets fully Paretian. Business models appropriate for opposite ends are very different. The most successful cases of the past 10 years – the Googles, eBays, and Amazons – are extreme events that have developed business models appropriate for the other 80% of the Paretian world. The double-tailed distribution of niches and hits holds across sectors (music), genre (classical

music), sub-genre (chamber music), and so on. In other words, nested Pareto distributions give rise to self-similar (fractal) markets, which are expressed by the statistical regularity of long-tailed (power law) distributions.

In the following section I will present an application of the theory above to the emergence of the quality sector in the Brazilian coffee industry.

The context

The world of coffee has for a long time been characterised by a double paradox and a major divide. The paradox is that on the one hand there is excess supply of commodity coffee, and, on the other hand, scarcity of quality coffee (Daviron and Ponte 2005). The success of the so-called Latte Revolution (triggered by Starbucks) has exacerbated the paradox and increased the sourcing problems of quality roasters. The divide lies in the fact that coffee is produced in the Southern Hemisphere but is predominantly consumed in the Northern Hemisphere.

The history of coffee in Brazil is dominated by economies of scale and standardisation that lead toward commoditisation and product homogeneity. In particular, global financial transactions in the commodity sector were and still are based on exchange of futures' contracts which required the evolution of objective standards to assess quality over the entire 'global commodity chain'. These quality standards pay no attention to coffee aroma and geographical origin of coffee [(Daviron and Ponte 2005): 70]. During the 20th century, the trend toward large scale of production, standardisation and efficiency were reinforced by the emergence of a cartel of countries [International Coffee Agreement (ICA)], under Brazilian leadership, which tried to reduce price volatility and increase net price of coffee via control of coffee stock and allocation of production quotas. (Pendergrast 2001; Daviron and Ponte 2005). Price stability alongside with the lack of demand for variety pushed toward commoditisation of coffee. This trend was reinforced by the internationalisation and consolidation of major roasters. Squeezed between increased competition, static or declining markets and price increase of primary material, international roasters moved away from quality and concentrated on efficiency to achieve price reduction and marketing to establish brand image. Further homogenisation of coffee blends followed and overall quality declined (Daviron and Ponte 2005: 76).

The liberalisation trend of the 80s led to the termination of the ICA in 1989. One year later, the organisation that used to regulate and manage the entire value chain of the Brazilian coffee market and served as an interface with the external world, the *Instituto Brasileiro do Caffé* (IBC), was closed by the Government. A country in which the production and trade of coffee had been finely regulated for almost 90 years (Daviron and Ponte 2005) was liberalised overnight. The end of the quota systems plunged the Brazilian operators into massive uncertainty as to how to behave in a liberalised market. At the same time coffee price collapsed below production costs due to the release of massive stocks, previously held to regulate price.

At the beginning of the 90s the situation of Brazilian coffee was abysmal. The *Gazeta Mercantil*, a national newspaper wrote: 'Coffee throughout Brazil was all the same and in general it was a pretty bad drink.'²

Illy is one of the iconic Italian brands in the world and is market leader in specialty coffee. Illycaffé (company's name) was founded in Trieste in 1933, specialising in high quality Arabica coffee blend. It currently sells in over 140 countries. Illycaffé is a family-owned and run business with about 550 employees. Its consolidated turnover in 2009 was more than 280 million Euros, 55% of which was export-based.

The unfolding of the case

At the beginning of the 90 Illy was squeezed between the need to increase sourcing of quality beans and the commoditisation of coffee that restricted the availability of quality beans. In 1990 Illy decided to change its procurement strategy, disintermediated the whole value chain and sourced directly from Brazilian producers. This choice subverted the accepted practice within the industry.

Brazil is a vast country. Hundreds of thousands of coffee producers are spread across several states of the Brazilian federation. How can a newcomer without any direct experience of the local market find its way in such a labyrinth? Illy's disintermediation strategy in Brazil started with two unconventional moves: first, Illy launched in 1991 a beauty contest for the best coffee beans for espresso, called 'Premio Brasil de Qualidade do Café para "Espresso";³ and second, they developed a business model based on direct relationships with farmers.

These two – award and new business model – acted as constraints to intercept existing imbalances in the commodity market. These constraints were at the heart of a new business model which ended up bypassing the tyranny of the New York Futures Coffee Exchange and offered an alternative channel for quality production to Brazilian farmers. The constraints set by Illy tapped into a powerful source of nonequilibrium. As the late Chairman Ernesto Illy told us:

During the 80s we noticed that the frequency of purchasable coffee lots was steadily declining. So I went to Brazil to see why this was happening. I visited several cooperatives and I suddenly found the answer I was looking for: the market was becoming more and more concentrated and there was a high demand for large quantities of coffee at low prices. What solution to such a problem? In the cooperatives some people blended the incoming lots through huge shovels, thus increasing entropy. Quality corresponds to a low degree of entropy, though. So the fundamental question was: "How do we catch the best lots before they are blended together with other lots?" Riccardo, my son, said: "the cashmere industry experienced a similar problem". Indeed, the Zegna family noticed that the cashmere fibre was gradually shrinking and was dirtier and dirtier. To reverse this trend, they put up a trophy as a prize for the best cashmere fibre. The

result was that the cashmere fibre was beautiful again in four years. So we announced a trophy for the best Brazilian espresso coffee.⁴

The award acted as an attractor that pulled the quality producers from the amorphous mass of commodity farmers. The constraints set by Illy 'broke the symmetry' of the commodity sector causing a bifurcation between the commodity and the quality sector. Quality, which had until then been invisible, emerged from the mixing practice. Mixing happened at all level of the CVC. The result was a progressive homogenisation and loss of quality. By providing a commercial avenue for quality, Illy tapped into a source of unexpressed value, which had been completely masked by the mixing practice. Mixing diverse entities creates a distribution of quality that follows a bell curve, characterised by average quality and limited variance around the mean. Although, mean and variance are usually assumed to represent the diversity of the underlying phenomenon (Barabási and Bonabeau 2003), they are in reality a statistical artefact of aggregating different things. Strong evidence suggests that the real distribution of most phenomena is long tailed and characterised by virtually unlimited variance (Zipf 1949; Simon 1955; Mandelbrot 1963; Casti 1994; Moss 2002; Barabási and Bonabeau 2003; Watts 2003; Ball 2004; Andriani and McKelvey 2007). This is not statistical sophistry. Assuming that stable means and limited variance represent the underlying diversity forces people to ignore or treat as outliers phenomena that happen in the tails. As the distribution of value is proportional to the distribution of quality, a long tailed quality distribution is potentially able to achieve unexpected and extreme results in terms of coffee price and give rise to business models based on high quality. Illy award and actions structured as a set of constraints revealed the long tail of quality distribution.

But it is the Illy differential that has made convenient for us to separate a percentage of the best coffee from ordinary coffee for Illy and fine buyers. Without someone like Illy who has helped us to produce a better quality, and that has paid a better price for our coffee, we would still be today mixing different grades of coffee and producing something that would be very cheap.⁵

Was hidden quality a source of nonequilibrium? To be so non equilibrium has to 'reveal the potentialities hidden in the nonlinearities, potentialities that remain dormant at or near equilibrium' (Nicolis and Prigogine 1989). The constraints of direct relationship with grower and the fact that for the first time there was an alternative channel that bypassed the commoditising pressure of the coffee New York Exchange revealed a series of dynamics of hidden quality as a source of nonequilibrium. Our research has demonstrated that the quality conversion spread in an epidemic way and caused the transformation of entire regions that had until that point been either unknown on the national and international coffee markets or known for bad quality. The emergence of quality from commodity started in the region of the Cerrado Mineiro.

Figure 1 shows the geographic distribution of purchases done by Illy per year per municipality in the Cerrado Mineiro region in the state of Minas Gerais.⁶ As before

Illy the market was a commodity market, it is safe to assume that at least for the first years there was a close correspondence between emergence of quality and sales to Illy.⁷ In fact as producer Enrico Grossi told us: ‘...before Illy, all coffee [exported from Brazil] was exported as a homogenous blend, called Santos 4. That included good and bad coffee.’⁸ The graphs show that the town of Patrocínio, the maximum in all graphs, acted as the centre of the epidemics of adoption of quality in the region.

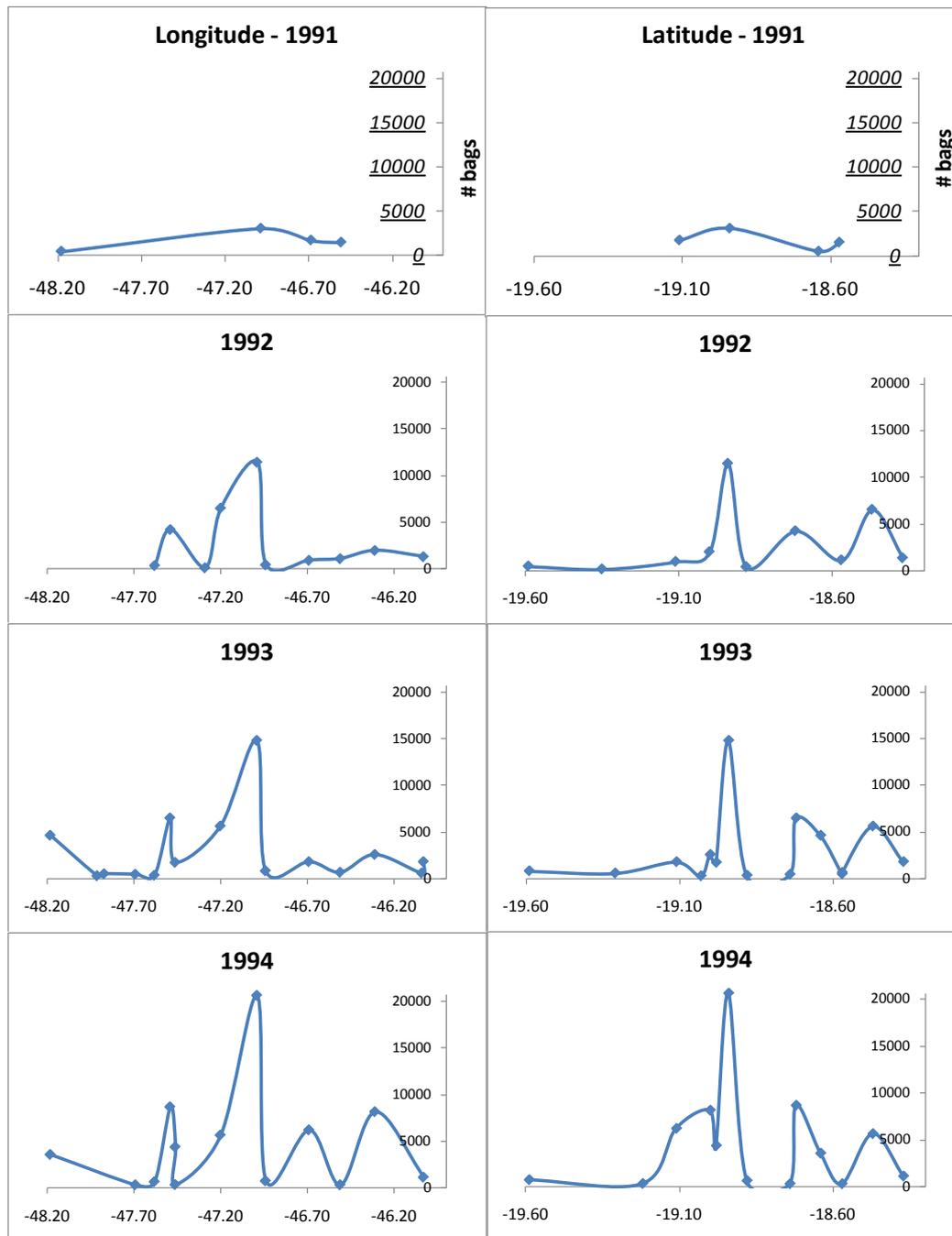


Figure 1a

Diffusion of purchases made by Illy in the Cerrado Mineiro region, 1991-1994. The 4 graphs on the left report the geography of sales; i.e. number of bags sold in the municipalities that took part in the award or sold independently from the award to Illy. The 4 graphs on the right show the geography of sales in terms of latitude. Latitude and longitude dates are shown.

Municipalities in Cerrado Mineiro (MG)	Latitude	Longitude
Araguari	-18.64	-48.18
Araxá	-19.59	-46.94
Carmo do Paranaíba	-19.00	-46.31
Cascalho Rico	-18.57	-47.87
Coromandel	-18.47	-47.20
Estrela do Sul	-18.74	-47.69
Indianópolis	-19.03	-47.91
Iraí de Minas	-18.98	-47.46
Monte Carmelo	-18.72	-47.49
Patos de Minas	-18.57	-46.51
Patrocínio	-18.94	-46.99
Pedrinópolis	-19.22	-19.22
Perdizes	-19.35	-47.29
Romaria	-18.88	-47.58
São Gotardo	-19.31	-46.04
Serra do Salitre	-19.11	-46.69
Varão de Minas	-18.37	-46.03

Figure 1b

Geographic coordinates of municipalities in figure 1a

We can also document the steps that lead to the epidemics. Chairman Ernesto Illy visited the region in June 1990 and met with Aginaldo Lima, a farmer who had become the centre of a social network of coffee growers thanks to (among other things) his leading a rebellion of coffee growers a few months before. At that time, immediately after the end of the ICA, the conditions for coffee farmers were abysmal, with coffee selling below production price. In 1990 the end of regulations had thrown the producers in the anarchy of the free markets: ‘in 1990 the homogeneous policy of Brazilian agriculture ended, and we—who operated in this sector of agriculture—were all lost.’⁹ Aginaldo understood that the region could leverage the Illy award and promised his personal support and that of his network in the promotion of the award: ‘at that time it was unimaginable that a roaster would visit us, give us an award for our coffee, and moreover, would pay a price differential.’¹⁰

Analysis of purchases (Figure 1) shows the centrality of Patrocínio (the municipality where Aginaldo was active). For the first 4 years (1991-1994) the switch to quality saw Patrocínio as the self-reinforcing centre of the diffusion. As it takes about 4 years for a new plant to produce coffee, this clearly indicates that the quality that emerged was hidden. Moreover, the non-linear and epidemic nature of the diffusion proves that indeed the action of Illy revealed the potentialities dormant at the equilibrium imposed by commodity markets.

Figure 2 shows the evolution of the constraints/nonequilibrium sources. In this paper I have analysed only the first part (the *hidden quality* source of nonequilibrium). In a forthcoming publication (Andriani, Biotto et al. 2011) we describe the *knowledge gap* source of nonequilibrium.

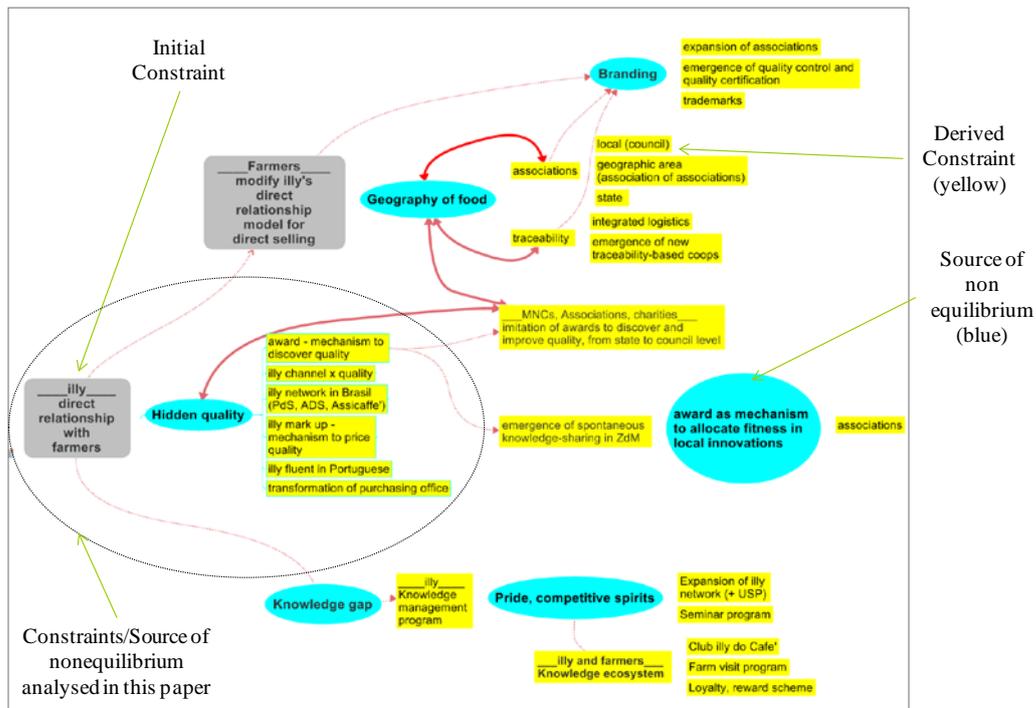


Figure 2

Temporal evolution of constraints and sources of nonequilibrium in the Illy case

Discussion

I argue in this paper that Illycaffé (largely unintentionally) triggered a process of decommodification that proceeded via a propagating dynamics of constraints and sources of nonequilibrium. The dynamics tapped into an unsuspected presence of residual diversity, covered and hidden by the domineering commodity market, business model and mixing practice. Triggered by Illycaffé, the residual diversity activated the latent market of a Paretian distribution. Chris Anderson (2006) in *The Long Tail* makes the point that markets unconstrained by scarcity reveal the characteristic feature of a rank-size Pareto distribution. Markets dominated by scarcity instead show a truncated Pareto distribution. Anderson speculates that the area beyond the truncation cut-off point constitutes a latent market for an emerging long tail. For instance the economics of Hollywood (De Vany 2004) seems to fit Anderson's point well. If one ranks Hollywood movies by revenues, and graphs ranks and revenues on a double-log scale, one finds the characteristics of truncated Pareto distribution, which indicates the limited carrying capacity of the Hollywood/theatre systems in the USA.

Commodity markets are doubly limited: first, by the fixed costs related to the economy of scarcity characteristics of tangible products; second, by the standardisation implicit in the commodity business model which limits the diversity to a subset of the potential diversity. The essence of commoditisation in the agrifood business consists in the elimination of the fuzzy, ambiguous or subjective product's variables that resist the objective quantification necessary for 'futures' markets. Hence a decommoditisation process operates by removing the second constraint.

In this section I will present some evidence that links the decommodification scheme to the emergence of a long tail of diversity. The evidence I will present indicates a) a strong increase in the diversity of various aspects related to the coffee business (from production to consumption) and b) the emergence of a long tail of quality niches.

The first type of evidence concerning an increase in diversity comes from the analysis of the database of newspaper and magazine articles. This database is composed of all the articles appeared in the Brazilian press between 1991 and 2007 that mention the word *Illy* or *Illycaffé*. They offer an unbiased and objective description of the changes in the coffee world and the relationships of these with the *Illycaffé* entry.

Diversity was classified according to 13 features that are shown in Figure 3.¹¹ It shows that the increase in diversity affected the whole value chain from varieties of cultivated coffee to forms of consumption. This is consistent with our interpretation of diversity unfolding in an epidemic way from the propagation of constraints intercepting sources of nonequilibrium, hence laying the basis for further sources of nonequilibrium to be tapped on and used as platform for the building of further diversity.

The second major sources of diversification comes from a more micro source, i.e. the analysis of the transactions of a relatively large producer (name is anonymised) in Manhumirin, a little town in the Zona da Mata region. This database covers the period 1995-2007 and is therefore ideal to study the discontinuity which occurred around 1999 and was triggered by a change in *Illy* award regulations.¹² The database covers 194 transactions. For each transaction, the following parameters are given: year of contract, number of bags sold, price in Brazilian Reals and in US dollars, and quality grade indication (consistently from 1997).¹³

First we notice an increase in the number of quality grades. Quality grades reflect different types of drinks and are assessed by tasting procedures defined by national or international bodies. Figure 4 shows the cumulative sales of quality grades. We note that the pre-1999 period (the commodity period) is characterised by 3 quality grades. After 1999 six new quality grades emerge. Despite the fact that the data under analysis are local, i.e. a single coffee grower in the ZdM, the data confirms that the interpretation advanced in this paper, i.e. a bifurcation of quality from commodity via increase of diversity, bears an impact at the local level within a similar time frame. Figure 5 shows that the frequency of transaction of price/bag in the period 1995-1999 approximates a bell-shaped distribution, typical of commodity markets. The bifurcation-through-diversity interpretation is confirmed by the evolution of the bell distribution into a bimodal distribution after 1999. Comparing Figure 4 with Figure 5 it becomes clear that the first peak correspond to lower quality grades such as *Rio*, *Dura* and *D/Riado* whereas the second peak is essentially due to the emergence of the higher quality grade *Mole*. In addition, the lowest quality grades retain a bell-shaped distribution with a relatively low variance whereas the highest quality grade *Mole* shows the highest variance and a more complex distribution.

	<i>DIMENSION OF LT</i>	<i>ATTRIBUTES/QUALIFIERS: examples</i>	Number of events
1	QUALITY INCREASE	- conversion to quality - increase in quantity of quality coffee	13
2	DEFINITION OF NEW QUALITY ATTRIBUTES	- Examples: aroma, acidity, bitterness, body, flavour	7
3	NEW QUALITY PRODUCERS	- new producers start growing quality coffee	22
4	NEW QUALITY BRANDS	- New quality brands imitating Cerrado model, Cafè do Ponto, Mellita, Cacique	10
5	CERTIFICATIONS of ORIGIN or of QUALITY	Certification of origin: - Cafè do Cerrado (Certicafè) - 100% Cafè do Cerrado - etc.	17
6	NEW COFFEE VARIETIES	- Investment in research of new or improved coffee varieties: Icatu, Novo Mundo, Açaià, Catuai, Bourbon	9
7	INNOVATION	- New coffee varieties - Traceability of coffee beans/batches - New growing techniques (irrigation, disposition of coffee trees etc.) - New processing techniques (eg. depulped coffee) - etc.	41
8	NEW ASSOCIATIONS	- Caccer	5
9	NEW AWARDS	1) Local Awards (eg. Sul de Minas; Coop de Viçosa; Caratinga; Concurso de Cafè Conillòn) 2) National-level Awards - Cup of Excellence 3) International level Awards: - Export of IC Award from Brazil to other countries (Etiopia and Guatemala)	14
10	NEW BUSINESS MODELS	- Disintermediation; - Strategic partnerships and alliances - etc.	8
11	NEW CONSUMPTION HABITS	- Increase of new quality coffee bars in big cities - New food recipes using coffee	10
12	INCREASE IN SALES and PRICE (for QUALITY COFFEE)	- New markets penetration (IC) - Increase in export for Brazilian producers (especially Cerrado) - <i>Increase in consumption of quality coffee</i> - Increase in prices paid to growers	12

Figure 3
features used to identify increase in diversity (source: (Ghezzi 2008))

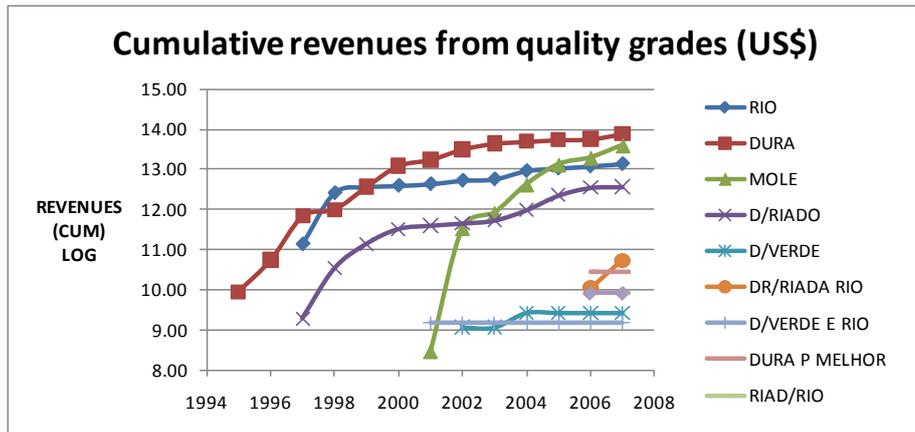


Figure 4

Manhumirin producer: cumulative revenues per quality grade (period 1995-2007)

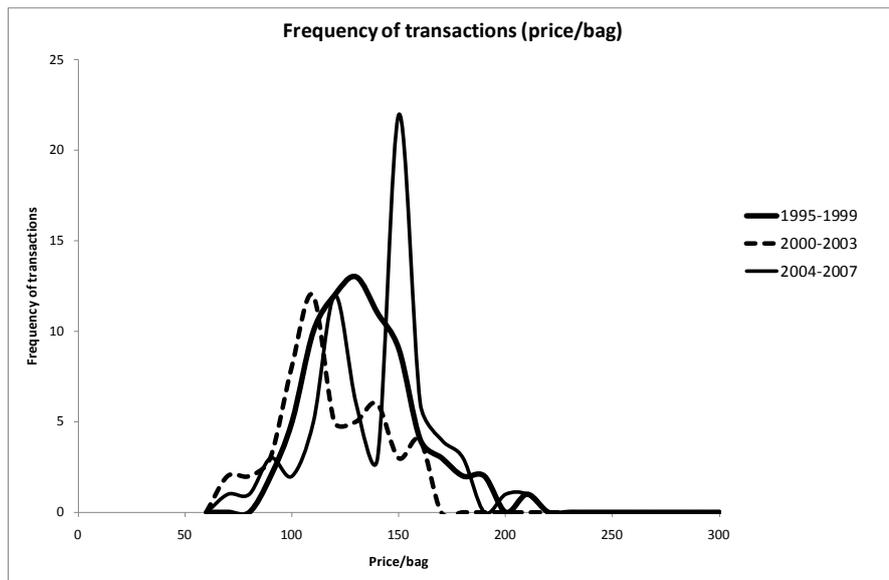


Figure 5

Manhumirin producer: frequency of transactions of price/bag. Monetary values are expressed in 1995 US\$.

This is in broad agreement with the literature. It is well known that as Nestlé Vice President for International Relations puts it ‘the degree of variety of coffee and the variation in taste is at least as great as that of wine’ (Fitter and Kaplinski 2001: 4). Evidence from the population ecology literature points out the increase in diversity that accompanies the emergence of craft-based industries (Carroll and Swaminathan 2000). What is less explored however is the role of the decommodification process in opening up the diversity trajectory and the role of the Long Tail in shaping micro-niche innovations.

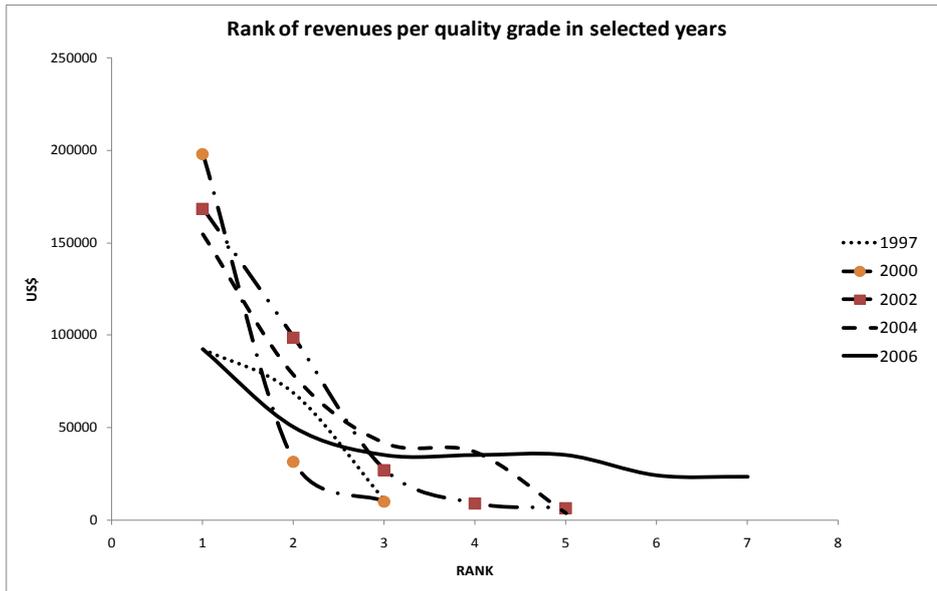


Figure 6

Manhumirin producer: rank of revenues for the main quality grades in selected years



Figure 7

Manhumirin producer: average price/bag across quality grades

In the following I will show that the transformations accompanying the emergence of quality in the ZdM exhibit elements of a long tail in action. Figure 4 shows that the emergence of new quality grades (new to Manhumirin, not new in absolute terms) happen within niches. Among the 6 quality grades that emerge from 2002 onward, 5 are confined to tiny niches both in terms of cumulative sales and number of bags. Figure 6 clarifies the temporal development of the tail. The revenue of quality grades evolves from a compressed commodity curve based on three grades only toward a curve with clearly identifiable head and tail grades. This confirms the relationship between long tail and emergent diversity. The average price per bag of the new grades (Figure 7) is in five cases out of seven higher than for the traditional grades and in two cases lower. It seems that the introduction of new grades expands the available

diversity especially toward higher quality (as reflected by sale price). This is interesting. Long Tail theory stresses the role of fixed cost reduction in the emergence of niche products. However, the evidence presented in this case study indicates that fixed costs do not play any major role. The appearance of a long tail in the coffee market is driven by causes other than fixed cost reduction. If anything, in fact, the conversion to quality implies additional investments and hence an increase in costs both fixed and variable. The emergence of a long tail of quality seems rather to be driven by the dynamic of diversity.

Conclusions

The agrifood sector in Brazil as in other parts of the world is becoming more complex. This is partly due to the fact that: 'the contemporary food sector is bifurcating into main 'zones' of production: standardized, industrialised global food networks on the one hand, localized, specialised production processes on the other' (Murdoch and Miele 1999: 469).

In this paper I have presented a case that illustrates the bifurcation between commodity producing and quality producing dynamics. In complexity terms, the bifurcation commodity/quality corresponds to the emergence of a new powerful attractor. This raises a number of questions:

1. What causes the transition?
2. What is the internal dynamics of the quality trajectory that develops from the new attractor?
3. What is the role of agency in the structuring of the trajectory?

The quality bifurcation seems to be associated with two elements: first a crisis that shocks the commodity system and, second, a tiny initiating event, a butterfly event, that builds on the tension created by the shock and triggers a process of reconfiguration of existing capabilities around a new emergent business model. Since Schumpeter (1939) we know that creative destruction occurs in bursts of rapid change. Crisis may have a generative property that we may call, echoing Schumpeter, destructive creation. By shocking the architecture of a mature system, crisis may create the conditions for the emergence of a process of reconfiguration of the system's modules (Storper and Walker 1989; Grabher 1993; Best 2003; Arthur 2009). Crisis creates a condition known as adaptive tension (McKelvey 2001) in which the resistance to reconfiguration of a system's capabilities/modules is dramatically lowered. The system gets close to a *tipping point* (Scheffer 2010) and a TIE (tiny initiating event) may triggers a transformational avalanche past the tipping point.

Building on the works of Kauffman (2000), Juarrero (1999) and Turner (Turner 2002) I offer an interpretation of the unfolding of the avalanche that characterise a butterfly event leading to a bifurcation. According to this interpretation TIEs give rise to a self-sustaining avalanche when they act as constraints that intercept and enslave a (mostly invisible) source of nonequilibrium. The intercepting allows the conversion of

potential energy into work that can be used to improve the constraints thereby reinforcing the cycle. The appearance of more sophisticated constraints constitutes the scaffolding for further discovery and enslavement of new source of nonequilibrium. In addition, the paper suggests the idea that the net effect of the 'propagation of constraints' is the emergence of a long tail of diversity.

Finally, the paper implicitly shows that an organisation can govern the transformational process by identifying commodity markets and using an emergent strategy to start a process of decommodification. The identification of commodity market is easily done by means of a Pareto analysis: a truncation in the range of diversity of the (for instance) rank-size distribution is a signature of a commodity. When the commodity market has undergone some kind of shock, the conditions and timing may be ripe for organisations to create TIEs and manage the unfolding 'constraint propagation' process.

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Notes

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- ¹ Cities like London and New York spiral up from tiny settlements hundreds of years earlier Jacobs, J. (1985). *Cities and the wealth of nations*. New York, Random House. Honda in the U.S. spiralled up from their employees' use of 50cc motor bikes in Los Angeles Pascale, R. T. (1984). 'Perspectives on Strategy: The Real Story Behind Honda's Success.' *California Management Review* 26: 47-72.. Wal-Mart began as a one-store operation by Sam Walton. Ford Motor Co. began as the Model T made on one assembly line.
 - ² Vera Brandimarte: 'Cafés finos também para o Brasil' *Gazeta Mercantil*, 11-13.09.1993: 'Café' no brasil era tudo igual e, em geral, uma pessima bebida'..
 - ³ The award was tightly connected to Illy's sourcing strategy. It works this way. Growers send coffee samples to Illy for participation to the Award. Approved samples enters the Illy competition, which consists in selecting 50 finalists, among whom, 10 winners are chosen. In parallel, the approved samples lead to purchase of the coffee lots by Illy.
 - ⁴ My interview with Ernesto Illy. Andriani, P. and A. F. Detoni (2008). 'An interview with Ernesto Illy on complexity, coffee and management.' *Emergence: Complexity and Organization* 10(1): 84-88.
 - ⁵ Farmer, my interview, 22/04/2009, Manhuacu, MG, Brazil
 - ⁶ In Brazil, a municipality is the smallest geographic administrative unit.

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- ⁷ There are other reasons as well. One of them is that Illy was ‘coffee hungry’ and bought all coffee that passed its quality test. Hence expansion was supply rather than demand limited.
- ⁸ Enrico Grossi: Farmer. Among the precursors of coffee production in the Cerrado Mineiro region, 01/03/2008, Patrocinio, MG, Brazil
- ⁹ Farmer and first president of CACCER (Conselho de Associações de Cafeicultores & Cooperativas do Cerrado), my interview, 02/03/2008, Patrocinio, MG, Brazil
- ¹⁰ Interview with Aginaldo Lima, see note 9.
- ¹¹ We are using diversity in a generic sense to indicate any emergence of differentiation in the coffee business. For a more rigorous discussion, see Stirling, A. (1998). 'On the economics and analysis of diversity' [electronic paper]. Brighton, SPRU.
- ¹² The traditional way of drying coffee in Brazil is called *natural*: coffee beans are laid on a patio and dried under the sunlight. But the Zona da Mata (Atlantic Forrest biotype) region is characterised by high humidity and irregular precipitation that during the drying period often ruined coffee by triggering fermentation. In these areas coffee can be processed by means of the so-called ‘semi-washed’ technique in which the exposure to sun is strongly limited and drying takes place within a rotating drum (called *descascado*). The Illy regulation were changed in 1999 to allow *descascado* coffee to participate to the award.
- ¹³ The indication of price in US\$ is convenient as the Brazilian currency suffered from highly volatile and often extreme inflation during the 90. Moreover, in order to compare the value of coffee contracts across an extended period of time—13 years—it has been necessary to purge the data from the volatility of the coffee market. Coffee’s commodity and quality prices are established by adding or subtracting a differential from the New York reference price; hence, made 100 the average NY price in 1995, all prices reported in this paper have been expressed in terms of the 1995 prices. In other terms the volatility of the coffee market has been subtracted from the data.

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