

Plutchik and Economics: '... Disgust, Fear, and, Oh Yes, Love.'

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ABSTRACT

One of the most challenging endeavours economic theorists currently face is the integration of emotions in the conceptual frameworks used to explain the choices and the behaviour of agents. Emotional decisions are much harder to understand, evaluate and analyse than rational ones, because emotions are diffuse, difficult to isolate and to categorise, and also because they correspond to personal inner-states that might be externalised in so many different ways. This paper suggests the use of a possible classification of emotions in order to guide economists when developing their emotional-oriented decision-making models. The classification is the one proposed by psychologist Robert Plutchik through his popular 'wheel of emotions', a diagram that highlights the existence of a few basic emotions that might acquire, each of them, various different tones or intensities.

1. INTRODUCTION

THE TITLE OF THIS PAPER MERGES TWO ELEMENTS. The second part is the end of a statement by Thaler (2000 p 139) where emotions that may be relevant for economic behaviour and economic analysis are enumerated; the first part makes reference to an influential researcher in the field of the psychology of emotions, namely Robert Plutchik, who presented a categorisation of different emotions human beings may experience (Plutchik 1980).

Emotions are pervasive in Economics: they are decisive in shaping individual preferences and levels of utility; they represent a fundamental driver of the decision-making process of economic agents; and they are prone to social contagion, thus helping in generating aggregate phenomena. Although many researchers recognise the relevance of emotions in shaping economic outcomes, a unifying theory of emotion-based Economics is far from being accomplished. This is, to a large extent, the result of the difficulty in defining, classifying and setting boundaries on emotions. In contrast with rational behaviour, which can be interpreted plainly as emotion-free, emotional behaviour might represent many different realities; to account for these realities all at once is virtually impossible.

The analogy Plutchik (1980) uses between the array of possible human emotions and a colour palette is suggestive: as colours, emotions have many shades and the differences between some of them are so subtle that they may be almost unnoticeable. Can we distinguish precisely between regret, grief, sorrow, remorse or sadness? And between rejoice, joy, happiness or delight? Moreover, emotions are difficult to observe and measure; as the same author highlights elsewhere (Plutchik 2001), emotions are personal inner-states that seldom can be expressed and conceptualised in an intelligible form; when one experiences a mix of emotions, it is hard to identify without ambiguities which are they and to what extent each of them contributes to that mix.

From this perspective, it is no wonder that despite the efforts of economic thinkers to incorporate emotions into the sphere of economic analysis, we end up with a dispersed set of contributions that, although meaningful, cannot be integrated and unified in a straightforward way. The main purpose of this paper is thus to launch the debate on how to assemble a structured map of emotions and their evolution, a map that may contribute to the demanding goal of setting up a unified economic theory of emotions.

The starting point has to be a classification of emotions that, unambiguously, separates them into different compartments. Here, we adopt the classification suggested by Robert Plutchik in his psycho-evolutionary theory of emotions. Such classification has the merit of condensing into a few categories what the author identifies as being basic or prototype emotions. These are joy, trust, fear and surprise; the four basic emotions have basic polar opposites, which are, respectively, sadness, disgust, anger and anticipation. Every other emotion or feeling one can think of can be expressed as a more or less intense manifestation of the proposed primary emotions or as a combination of primary emotions.

We advocate that classifying emotions in the context of economic science is vital at three decisive levels, which constitute the main reasons motivating this research. First, a structure is assembled to carefully stow the disperse contributions available in the branch of behavioural economics dealing with emotions, thus allowing us to take an integrated view over a plentiful but apparently disconnected literature. Second, one can employ the proposed classification to highlight the features that allow formalising an analytical structure dealing with the dynamics of the emotions that economic agents experience, in a more or less general context. Third, by compartmentalising emotions one can more accurately evaluate their role with respect to the impact they have over attention and the search for information and knowledge, which are central elements of any decision-making process. These three layers of analysis are explored in the paper; prior to that, the conceptual instrument that is the wheel of emotions is presented and scrutinised.

The paper is organised as follows. Section 2 describes the classification of emotions proposed by Robert Plutchik. Section 3 offers a brief and selective review of the literature that has explored the economic implications of assuming that individuals experience distinct and evolving emotions. In Section 4,

we highlight three main features relating the socio-economic role of emotions, namely non-controllability, contagion and pervasiveness. In Section 5, a discrete-time dynamic model is sketched to interpret the propagation of emotions in the context of the discussed categorisation of emotional states. Section 6 takes a step forward by arguing that understanding emotions, their idiosyncrasies and their dynamics is meaningful as a first stage of a more comprehensive démarche, which consists in discerning how emotions may influence attention and the search for information and knowledge. Section 7 concludes.

2. PLUTCHIK'S WHEEL OF EMOTIONS

The psycho-evolutionary theory of emotions proposed by Robert Plutchik is built upon a series of simple fundamental premises. The basic postulate is that despite the multiple different forms under which emotions can be expressed, such evidence does not invalidate the identification of a small number of basic or primary emotions. Primary emotions are essentially four: *joy*, *trust*, *fear* and *surprise*. These emotions are ideal types, meaning that they can manifest themselves with various degrees of intensity. Furthermore, each of the basic emotions has a polar opposite, respectively *sadness*, *disgust*, *anger* and *anticipation*. As with colours, by mixing primary emotions, one can obtain any kind of conceivable emotional state, i.e., every possible emotion can be expressed through the combination of their basic forms.

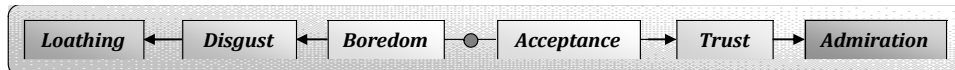
The interpretation about the meaning, classification and interrelation between emotions offered by Plutchik can be condensed in a diagram that takes the designation of a wheel of emotions. The wheel of emotions comprises four axes, each one containing a primary emotion, the respective polar opposite, and weak and strong manifestations of the basic and opposite emotions. These axes are represented in Figure 1; darker boxes, at the extremes, are associated with stronger emotional states or stronger emotional experiences.

Figure 1: The four axes of the wheel of emotions.

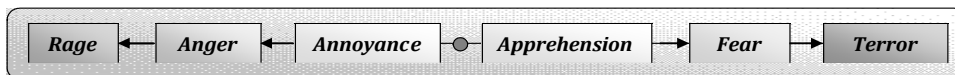
Axis 1



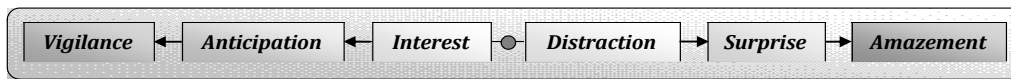
Axis 2



Axis 3



Axis 4



The schematic representation of emotional states in Figure 1 is useful at two main levels. First, it allows for the individualisation of classes of emotions; although one can experience at the same time, for instance, grief, disgust, anger and surprise, Plutchik's wheel assigns each of the mentioned emotions to distinct classes that can be scrutinised separately. Second, within each class, emotional states can be ranked; this rank provides a starting point to address the evolution of emotions. For each axis, one can expect individuals to perambulate across the different categories: sometimes, a weak form of the emotion dominates; in other moments, a stronger emotion may be felt; yet in other time periods, the opposite emotional state might prevail.

Besides identifying main axes and establishing an ordered sequence of emotions, the wheel of emotions also contemplates the possibility of formation of feelings as the outcome of the combination of each pair of basic emotions and/or the respective opposites. Most of the feelings in this way generated are frequently considered, by both psychologists and economists, as falling also in a broad definition of emotions. Although we maintain, for a matter of organisation of ideas, the separation between emotions (those highlighted in Figure 1) and feelings that result from combining emotions, the literature survey in the following section approaches both, since in many cases trying to separate them is an unrewarding task.

In Figure 2, the feelings that emerge from combining emotions are presented. The combination of the 24 identified emotional states gives rise to 24 different feelings human beings may experience.

The schematic representations in Figure 2 provide complementary elements for our discussion on the role of emotions in explaining human behaviour, beyond the framework already established with the classification of primary emotions and their direct variants. According to the diagrams in the figure, an optimistic individual is one who simultaneously experiences emotions of joy and anticipation; envy is the result of sadness and anger; alarm comes from fear and surprise, and so forth.

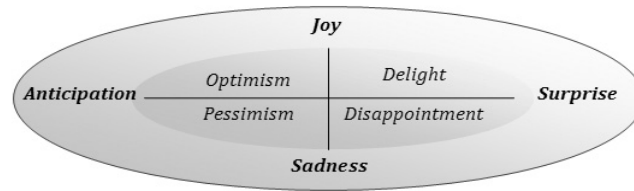
While somehow simplistic and far from consensual, the wheel of emotions, and the classification of emotions and feelings it provides, is a useful tool to organise ideas about emotions and their dynamics. This tool furnishes us with a map to guide us across the voluminous economics literature that addresses individual and collective decision-making and, hopefully, it can assist in elaborating a general and comprehensive approach to emotions in economics.

3. ECONOMICS WITH EMOTIONS

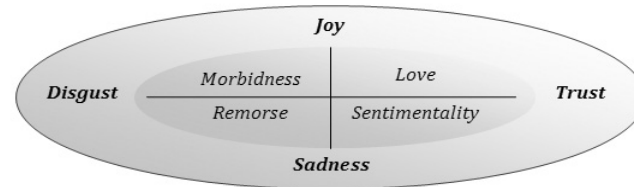
In a detailed survey about the role of emotions in economic research, Walde (2015a) reminds us that they were a central element of some of the contributions of classical economists. Most notably, Jeremy Bentham and Stanley Jevons discussed in detail how economics could be conceived as the calculus

Figure 2 - Feelings as combinations of emotions

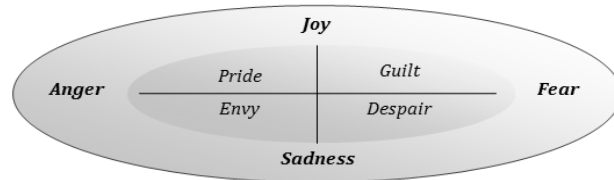
Class of
feelings 1



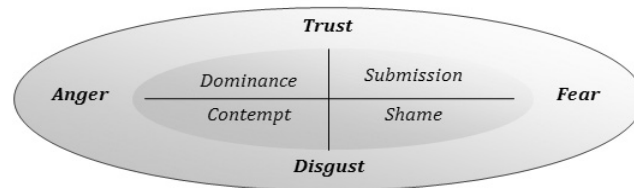
Class of
feelings 2



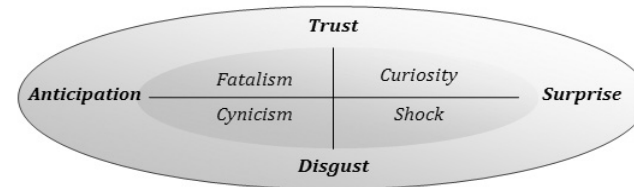
Class of
feelings 3



Class of
feelings 4



Class of
feelings 5



Class of
feelings 6



of pleasure and pain and how agents should behave in order to avoid pain and search for pleasure. Despite these early contributions, however, economics has evolved to be, in its essence, an emotion-free science. The core of economic analysis has purged emotions and has focused on the notions of rational choice and rational behaviour. With these notions, scientists were able to develop many important and powerful economic theories that cover individual decision-making, market relations, political choices and the performance of the macro economy.

Still, humans experience emotions and, unarguably, emotions drive behaviour. Many decisions with economic and financial implications, at micro and macro levels, are triggered by curiosity, contempt, despair or any other feelings or emotions mentioned in the classification offered in Section 2.³ The meaningful question is, then, the following: given the pervasive link between emotions and behaviour, why have emotions played such an insignificant role in mainstream economic analysis so far?

The answer provided by Thaler (2000) to this question is of a practical nature: economists avoid emotions because rational agents are easier to bring to the models. Theoretical models explain how the economy would work if agents acted rationally in every occasion: what, one must recognise, is a useful benchmark to start addressing the complex nature of economic problems. However, if we stop here, we might end up turning the analysis upside down; in a strict view of the economic orthodoxy, an outcome that departs from what the model predicts is not the result of a flaw of the model, but of a flaw on human behaviour: emotions got in the way, making reality to deviate from what the rationality-based setup predicts. Because science is supposed to explain the real and not the *ideal*, a careful observation of the human behaviour must precede any effort to address and study economic decisions and events, whatever the context. Therefore, the quest for the implications of human emotions is essential for economic thinking.

Although dispersed, the emotion-related economics literature is voluminous. In order to systematise it, some criterion is required for the selection and ordering of the most relevant works. Our criterion is the combination of Plutchik's emotions as suggested in Section 2. Table 1 refers to a series of contributions that we can group into six different cells. Each cell respects to a pair of the identified basic emotions. Obviously, this classification is not completely tight; several of the mentioned articles also touch on other emotions besides the two that are highlighted or give particular attention to just one emotion. Nevertheless, in essence, we believe that the table serves the purpose of offering a relatively elucidative map on how emotions have been treated in the economics literature in the last few years.

The proposed classification includes both consolidated and popular theories in economic science, as the regret theory or the Lowenstein's approach to visceral factors, and disperse literature on curiosity, envy, guilt or fear. Regardless of the possibility of highlighting a few important contributions

Table 1: Selected work on emotions and Economics

Emotion Axes	Surprise	Fear	Trust
Joy	<p><i>Regret and disappointment theories</i></p> <ul style="list-style-type: none"> • Loomes and Sugden (1982, 1986); Gul (1991); Bleichrodt and Wakker (2015). <p><i>Projection bias</i></p> <ul style="list-style-type: none"> • Loewenstein <i>et al</i> (2003); Kahneman and Thaler (2006). <p><i>Optimism and pessimism</i></p> <ul style="list-style-type: none"> • Hirshleifer (2001); Faria (2011); De Grauwe (2012); Angeletos and La'O (2014); Wigniolle (2014); Gomes (2015). 	<p><i>Visceral factors and anger</i></p> <ul style="list-style-type: none"> • Loewenstein (2000); Zizzo (2008). <p><i>Economic role of envy</i></p> <ul style="list-style-type: none"> • Grolleau <i>et al</i> (2009); Alvarez-Cuadrado and Van Long (2012); Ahrens and Snower (2014); Gershman (2014). <p><i>Economic role of pride</i></p> <ul style="list-style-type: none"> • Antonetti and Maklan (2014); Maccheroni <i>et al</i> (2014); Pawlowski <i>et al</i> (2014); Ha and Jang (2015); Magee (2015). <p><i>Economic role of guilt</i></p> <ul style="list-style-type: none"> • Miettinen and Suetens (2008); Battigalli <i>et al</i> (2013). 	<p><i>Trust and reciprocity</i></p> <ul style="list-style-type: none"> • Ortmann <i>et al</i> (2000); Cox (2009); Kanagaretnam <i>et al</i> (2010); Akai and Netzer (2012); Charness and Shmido (2014). <p><i>Sentimentality and remorse</i></p> <ul style="list-style-type: none"> • Eisenhauer (2004); Ho (2012); Mungan (2012).
Trust	<p><i>Suspense and curiosity</i></p> <ul style="list-style-type: none"> • Kim <i>et al</i> (2013); Ely <i>et al</i> (2015); Hill <i>et al</i> (2016). <p><i>Fatalistic behaviour</i></p> <ul style="list-style-type: none"> • Sunstein (1998); D'Orlando <i>et al</i> (2011); Shapiro and Wu (2011); Rui (2014). <p><i>Cynicism in organisations and market transactions</i></p> <ul style="list-style-type: none"> • Ert <i>et al</i> (2014); Lee and Mao (2015). 	<p><i>Shame in economic contexts</i></p> <ul style="list-style-type: none"> • Mathew (2010); Yi and Baumgartner (2011); Jaffe <i>et al</i> (2015). <p><i>Combining trust and fear</i></p> <ul style="list-style-type: none"> • Cox <i>et al</i> (2008); Busso (2014). <p><i>Trust and development</i></p> <ul style="list-style-type: none"> • Dearmon and Grier (2009); Ozcan and Bjornskov (2011); Bjornskov and Méon (2015) 	
Fear	<p><i>Anticipatory emotions</i></p> <ul style="list-style-type: none"> • Caplin and Leahy (2001); Bernheim and Thomsen (2005); Epstein and Kopylov (2007); Koszegi and Rabin (2007); Cowley (2013). <p><i>Stress, anxiety and self-control</i></p> <ul style="list-style-type: none"> • Gifford Jr (2002); Ali (2011); Gambetti and Giusberti (2012); Walde (2015b). 		

on emotion research in economics, the most outstanding inference one can make from Table 1 is that, in fact, we are far from achieving an integrated theory of emotions; each emotion disturbs rational behaviour in its own specific way, as a result of its peculiar features, but no definitive general rules can be drawn from a cross examination of the references in the table.

In what follows, a brief discussion on each of the subjects referred to in the table is set forth.

Emotions, when attached to economic processes, are most of the time associated with utility; the utility agents draw from consumption of a given good depends on a subjective evaluation that is shaped by the emotions experienced before, at, and after the moment in which the act of consumption takes place. Thus, it is no wonder that one of the most consolidated theories of emotions in economics is associated with how agents attribute value to consumption experiences. Regret theory, as initially proposed by Loomes and Sugden (1982), highlights how utility not only depends on the consumption of a given good at a given moment, but also on the comparison of the effective consumption experience with its direct alternatives. Utility is lowered when people feel regret, i.e., when people realise that an alternative consumption choice would have been better, and utility rises when people feel rejoice, i.e., when they are reassured that they made the best possible choice. Regret and rejoicing are, thus, quantifiable emotions that may be integrated in a straightforward analysis of utility.

Besides allowing for elegantly introducing emotions into utility theory, the approach to regret and rejoice also unveils how the departure from the pure rationality setup might modify and re-shape some of the established wisdom in economics. In particular, in this case, the analysis has served to show how fragile are the axioms of revealed preferences: under regret and rejoice, the transitivity of preferences does not necessarily hold. See Bleichrodt and Wakker (2015) for a survey on how regret theory has evolved since the original Loomes-Sugden model.

A framework related to regret and rejoice, initially developed by the same two authors, Loomes and Sugden (1986), and later discussed in a more general setting by Gul (1991), highlights the role of disappointment, also in the context of utility theory. Disappointment and its opposite, elation, play a role similar to regret and rejoice in influencing utility levels; the difference is that while regret (rejoice) exists relatively to a unique alternative, disappointment (elation) is measured by comparing the utility of a specific choice with the expected utility given all the available choices. Again, violations of the conventional expected utility model under strict rational behaviour are identified, although the implications of assuming one or the other type of emotions are not exactly identical.

Regret, rejoice, disappointment and elation are relatively easy to locate in the classification of emotions adopted. Basically, they are found in the right side of the class of feelings 1 in Figure 2. They are necessarily associated with

the surprise emotion (in fact, they are analysed in the context of utility under uncertainty, and in this case uncertainty and surprise are close concepts) and to joy or sadness, depending on which of these two polar feelings is being considered.

Attaching emotions of joy and surprise to utility brings to the discussion of economic choices a series of other intricate problems that are absent in the rationality paradigm. One of the most debated of these problems relates to the idea of projection bias (Loewenstein *et al* 2003). Because individuals make decisions today regarding the future, they must evaluate expected future outcomes independently of the current state, but they often do not: there is a projection bias because individuals tend to anchor their future preferences to current emotional states, i.e., emotions today are likely to distort decisions made today concerning future outcomes (when the same emotional state will probably no longer prevail). This type of bias led Kahneman and Thaler (2006) to distinguish between two types of utility: decision utility and experienced utility; the first relates to what one wants, the second to what one experiences. Ex ante emotions, attached with decision utility, and ex post emotions, related to experienced utility, certainly will not be coincidental.

The first diagram of Figure 2 highlights two other feelings that are essential for the analysis of many economic phenomena: optimism and pessimism. These two feelings are central elements of the new macroeconomic literature on business cycles that has recovered the Keynesian idea that animal spirits or sentiments are the main determinant of observed output fluctuations. Waves of optimism and pessimism may emerge, in this context, as the result of a departure from the paradigm of strict rationality (De Grauwe 2012) or as the result of informational constraints (Angeletos and La'O 2014). In any of the cases, it is recognised that individuals are subject to transient moods or emotions that, on the aggregate, are a major contributor to the observed cyclical pattern of the trajectories of the main macro variables.

In Gomes (2015), a model of sentiment evolution is proposed; in this model, agents are allocated to a few sentiment categories (neutrality, exuberant optimism, non-exuberant optimism, exuberant pessimism and non-exuberant pessimism) and they will evolve across categories given a simple set of local interaction rules. The idea is to show that feelings may spread as individuals exchange personal experiences, generating an aggregate outcome that in the long-run, instead of converging to a fixed-point equilibrium, will eventually reflect the formation of waves of optimism and pessimism.

Another relevant field of study where optimism and pessimism play an essential role, is finance. Following the influential contribution of Hirshleifer (2001) on the impact of investor psychology on asset pricing, there have been various attempts to explore the role of sentiments in explaining some of the most evident anomalies in financial markets. For instance, Wigniolle (2014) addresses the role of optimistic and pessimistic feelings in creating the environment that leads to the occurrence of financial bubbles.

Emotions related with optimism and pessimism may also be found in the economic growth literature. Faria (2011) studies the dynamics of a modified version of a standard optimal growth model. In this model, joy and sorrow are also, alongside with consumption, arguments of the utility function. Furthermore, joy and sorrow can be found in the production function: they influence managerial skills, thus contributing to a more or less productive work environment (i.e., emotions are assumed to influence productivity). The standard optimal growth model augmented with joy and sorrow as control variables implies, in the formalised framework, the existence of multiple equilibria: there is an optimistic solution, a pessimistic solution and a neutral solution; this last one will be coincidental with the outcome of the standard neoclassical growth model; the other two respect to favourable and unfavourable long-term steady-states that originate in high or low levels of joy relative to sorrow.

Passing to a different quadrant of the scheme in Table 1, let us now focus on the relationship between the emotions of trust and surprise. Combining trust and surprise, feelings of curiosity, cynicism or fatalism become relevant (see the fifth diagram in Figure 2). Concerning curiosity and suspense, one may highlight the work of Kim *et al* (2013), which systematises a theory of curiosity in economics. They associate this feeling with the utility one can draw directly from information, even if this information is irrelevant from the point of view of attaining an economic payoff. People like to know, regardless of the utility of such knowledge, and the actions that curiosity triggers have economic implications. In formal terms, that study associates curiosity to a biological mechanism to lower entropy.

Similar reasoning is explored in Ely *et al* (2015). These authors propose a formal model to address the entertainment utility that suspense and surprise produce; in this model, agents will search for information, despite the non-instrumental nature of such information. Some agents have a preference for surprise, others a preference for suspense; in both cases, the standard utility function is modified to accommodate such preferences, implying changes relative to the standard rational benchmark. In a more specific context, Hill *et al* (2016) discuss how creating curiosity in consumers, through marketing strategies, may increase the motivation to purchase. Marketing and advertising actions exert influence over households by appealing to some of their emotions. By stimulating some emotions and by refraining from others, these actions are important to influence consumer behaviour.

Fatalism, understood as a combination of emotions of anticipation and trust, has also been subject to debate in the economics literature. Some references at this level include Sunstein (1998), D'Orlando *et al* (2011), Shapiro and Wu (2011) and Ruiu (2014). These studies emphasise relevant issues on the relation between emotions and economic behaviour. First, it is stressed that fatalism is often selective, i.e., identical risks are frequently approached with different degrees of concern; second, fatalism is associated with the

intrinsic propensity of individuals expecting the occurrence of the worst possible scenarios, for example in what concerns labour market participation and entrepreneurship activities; third, fatalism is also associated with household savings behaviour. In this last respect, fatalistic individuals are seen as those who believe that they have little or no control over future outcomes. This view results in theoretical reasoning and empirical observation both indicating that moderately risk averse and highly risk averse individuals will behave differently: for the first, savings decrease with fatalism, while for the second type, the opposite will occur.

A last important topic to explore concerning trust/disgust and surprise/anticipation is cynicism. Ert *et al* (2014) and Lee and Mao (2015) analyse cynicism in market relations and in organisational contexts. The first study, although realising that communication is a central element in improving the efficiency of market relations, notes that this communication may involve a dark side: a cynical attitude of the market players may jeopardise the market outcome. The second focuses on organisational change and attaches the outcome of this change to the predisposition of the workers; if they adopt a negative attitude towards change, this may imply distress and cynicism that eventually attenuate or eliminate the expected gains of the adopted change.

To the sphere of fear and surprise one may allocate studies on anticipatory feelings, such as those of Caplin and Leahy (2001), Bernheim and Thomadsen (2005), Koszegi and Rabin (2007), and Cowley (2013). These studies also focus, along with some of the previously mentioned, on expected utility and on how utility results may be distorted by emotions related to the act of consumption. In particular, these authors concentrate on the analysis of the emotions and feelings people experience when facing uncertainty about future outcomes. Feelings such as hopefulness, excitement, alarm or anxiety exert influence on the deliberative process of individuals and may determine choices. Furthermore, such feelings are also linked to time inconsistency issues; anxiety, for instance, might increase significantly as one approaches the timing of a given event (or, in the words of Epstein and Kopylov 2007, people may get 'cold feet').

In a same vein, a few more or less dispersed research contributions tackle related issues: Gifford Jr (2002) and Ali (2011) construct models of choice under uncertainty to address self-control; Gambetti and Giusberti (2012) analyse the impact of anger and anxiety over the financial decisions of agents (concluding that anger triggers risky decisions and anxiety, on the contrary, typically leads to conservative financial decisions); Walde (2015b) focuses on stress and on how this feeling impacts instantaneous utility.

Turning now to the fear-joy relation, we start by highlighting the prominent contribution of Loewenstein (2000), who conducts a reflection on the economic implications of a particular class of emotions, called visceral factors, that pushes individuals towards action; emotions such as anger, fear or passion require an immediate and disruptive change of behaviour. Despite their

transient nature, actions originating from visceral factors have long-lasting consequences and therefore must not be neglected when assessing decision-making processes. Interestingly, the analysis of the implications of visceral actions might not be as hard as one might think: in fact, visceral behaviour may lead to a much more predictable outcome than a thorough cognitive deliberation on a given subject (the visceral reaction to anger, e.g. punching someone in the face, is much more predictable than a carefully planned and elaborated *vendetta*). For a detailed discussion on the economic role of a specific visceral factor, anger, see Zizzo (2008).

Table 1 indicates that the various feelings originating from the combination of the emotions of joy and fear have been accounted for in economic research, namely envy, pride and guilt, all of which are present in the discussion of economic issues. Relating envy, the studies of Grolleau *et al* (2009), Alvarez-Cuadrado and Van Long (2012), Ahrens and Snower (2014) and Gershman (2014) emphasise that this feeling is a fundamental driver of human behaviour: people will care not only about their own consumption level or labour market position, but also about the consumption or labour market position of their reference group; therefore, envy may have constructive or destructive effects since it may lead to actions to increase personal effort or to sabotage the effort of others.

Pride and guilt also have a place in economic theory. Examples of studies dealing with one or both of these feelings include Miettinen and Suetens (2008), Battigalli *et al* (2013), Antonetti and Maklan (2014), Maccheroni *et al* (2014), Pawlowski *et al* (2014), Ha and Jang (2015) and Magee (2015). People feel pride from belonging to a given community (e.g., an organisation, a club, a team or a country) and this can influence the decisions, utility and productivity of individuals. Guilt also determines behaviour and, additionally, introduces a dynamic component in the analysis of decision-making: guilt is basically a reaction to a past decision or a past event.

The combination of trust and fear has also generated some meaningful contributions to the economic science, at various levels: Cox *et al* (2008) deal with these emotions at an individual level, Busso (2014) relates them to the role and legitimacy of institutions in contemporary societies, and Dearmon and Grier (2009), Ozcan and Bjornskov (2011) and Bjornskov and Méon (2015) explore their relation, mainly social trust, with the potential for economic growth and development.

An important feeling related to trust and fear is shame. In Economics, shame is present, e.g., in the analysis of poverty (Mathew 2010), in the study of impulse buying (Yi and Baumgartner 2011) and in the debate on its role in stimulating or inhibiting social cohesion (Jaffe *et al* 2015).

The last pair of emotions to contemplate in this brief literature review is trust and joy. When combining these emotions, the theme of reciprocity gains relevance. The economic implications of reciprocity have been approached by various authors and include the studies of Ortmann *et al*

(2000), Cox (2009), Kanagaretnam *et al* (2010), Akai and Netzer (2012) and Charness and Shmido (2014). The main message coming from these studies is that, independently of the level of analysis (individual decision-making, investment decisions by firms, state-level interactions) reciprocity and altruism are evidenced, even in scenarios where pure rationality does not necessarily recommend them as a means to maximise gains. Reciprocal behaviour is more intensely found in market relations and institutional arrangements where transparency and fairness dominate.

Looking at the opposite of trust and joy, there is the literature on sentimentality and remorse. In Eisenhauer (2004), Ho (2012) and Mungan (2012), these issues are discussed. One aspect of this discussion concerns the difficulty in quantifying such feelings. For instance, remorse may be measured through apologies, but apologies are not always sincere; clearly, an information asymmetry problem arises in this context.

The above survey on what can be called emotional economics has unveiled a few facts:

- i. Emotional economics is far from being a consolidated scientific field; the contributions are dispersed and, typically, research efforts concentrate on specific types of emotions rather than searching for an integrated view over them;
- ii. Emotions are pervasive in economic thought: they appear at the individual decision-making level, in shaping market relations, and in contributing to the formation of macro outcomes;
- iii. Emotions have to do with utility under uncertainty, but also with labour productivity, investment decisions or the build-up of credibility of institutions;
- iv. Plutchik's classification of emotions does not provide a perfectly fitting framework to classify the existing contributions, but it is sufficiently flexible to allow to group the relevant literature in terms of pairs of basic emotions, as it is done in Table 1.

The next section takes a deeper look on the general properties of emotions, highlighting three distinctive features: non-controllability, contagion and pervasiveness.

4. THREE DISTINCTIVE FEATURES

The analysis so far has made it evident the multidimensional and multifaceted character of human emotions. To gain further insights into the economic implications of emotions, in this section we isolate and discuss three relevant topics. Each topic concerns the general nature of emotions and may be debated without the need to isolate any of the elements in Figure 1 or Figure 2. Searching for common traits on emotions is relevant because it allows for conceiving a relatively general framework to approach emotions in economics. A sketch of a tentative modelling framework, built upon the three features discussed in this section and upon Plutchik's classification, is proposed in Section 5.

#1 -Non-controllability

Following Elster (1998), one can classify some emotions as valuable or useful and some other emotions as undesirable and harmful. In this perspective, individuals will want to control their emotions, choosing to experience those that provide positive outcomes and avoiding the ones that generate negative results.

Suggesting that emotions can somehow be tamed or controlled has some appeal in the context of formal economic analysis, because in such cases rationality and emotions might somehow be merged or mixed: a rational decision would imply selecting a positive emotion (e.g., joy) rather than a negative emotion (e.g., sadness), or choosing a negative emotion (e.g., fear) to avoid being confronted with a given unpleasant outcome (e.g., pain), or even ranking different emotional states in the same way preferences are ranked (for instance, ranking the emotional states as they appear in the axes of the Plutchik's wheel).

However, it is unreasonable to conceive emotions as completely controllable. Individuals experience many negative emotions not because they want to or do not try to avoid them, but because they cannot control many aspects of life that lead them to the unpleasant circumstances that trigger such negative emotions. In the words of Elster (1998 p.54),

It is generally agreed that emotions cannot be chosen in this sense. Emotions are passively undergone (cp. the synonymous term 'passion') rather than actively chosen. (...) One might try to save the claim that emotions can be chosen by stipulating that there are constraints on the choice or that the costs might be prohibitive. These constraints and costs would in fact reflect, however, the involuntary nature of the emotions.

In the model proposed in the following section, emotions are assumed to be uncontrollable or involuntary, in consonance with the above argument. Agents go through different emotional states over time, however such dynamics are not mainly determined by a rational ability of the individual to control her own emotions and respective evolution.

#2 - Contagion

If individuals do not control, in general terms, the emotions they experience, where can we find the main drivers of emotional changes? Emotions are, basically, reactions to external events. Because people relate to one another and communicate in social and economic environments, emotions are, thus, shaped essentially by local interaction. Emotions tend to spread as epidemics, with some individuals, given the position they occupy and the capacities they have, being able to influence the emotions of others. Citing, once again, Elster (1998 p 56),

If emotions are predictably triggered by beliefs about the external environment, other people could try to induce emotions by manipulating either the beliefs or the environment. The art of rhetoric, as practiced by orators and as analyzed in Aristotle's Rhetoric, is largely about manipulating other people's emotional reactions by shaping their beliefs.

Besides direct and intended influence, the contagion of emotions also occurs, often, through mimicry. Individuals potentially adopt the emotions of others just by observing what emotional states they are experiencing. This happens as the result of empathy or as a tendency to cope with observable norms and behaviour in society. In the model to present in Section 5, emotions disseminate through social contact, following a set of pre-established intuitive transition rules that are adapted from rumour propagation theory.

The fact that emotions are subject to contagion leads us to the third relevant feature: the propagation of emotions might acquire an economy-wide dimension, implying relevant aggregate consequences.

#3 - Pervasiveness

Most of the discussion in this paper so far suggests that emotion research in Economics could be circumscribed, without any significant loss, to individual decision-making and to the interaction between close neighbours. This is far from being true. Many emotional states tend to propagate fast across large populations, thus shaping aggregate phenomena. Episodes of collective euphoria, indignation or fear recur in society, with obvious implications for what the economy as a whole is able to accomplish. Economists are aware of this association; Keynesian authors, for instance, strongly believe that psychological factors, or, as they prefer to call them, animal spirits, are of primary importance to explain the macro performance of the economy.

The influential book by Akerlof and Shiller (2009) offers a series of compelling arguments about the extent to which collective emotions shape the trajectories followed by national economies and even the pace of the global economy. These authors claim that a large array of noneconomic motives determines the evolution of the economy, their business cycles, the observable unemployment rate or the overall investment levels. Such motives are, in the words of the authors 'thought patterns that animate people's ideas and feelings, their animal spirits' (p.1).

Five types of animal spirits, with impact on the macro economy, are highlighted in the book, namely confidence, fairness, corruption and anti-social behaviour, money illusion and stories. These aspects are not, in themselves, emotions (at least in that they are not present in the list of emotions and feelings proposed in Section 2). They are, however, the direct consequence of assuming that economic agents go through emotional experiences: sentiments of confidence and fairness are, typically, driven by emotions like trust or anticipation; corruption and anti-social behaviour have their roots in feelings like envy; money illusion is also linked with surprise and anticipation; stories relate to what we have learned from what we and those we relate to have lived in the past and the emotions these experiences bring.

By exploring each of the above elements, Akerlof and Shiller (2009) set the foundations for a behavioural interpretation of the macro economy, an interpretation where factors outside the scope of Economics are the fundamental causes of the most relevant economic processes. In this respect, we

want to emphasise that emotions do matter for economics at all levels of analysis and, thus, we adopt a broader view than the one suggested by Walde (2015a p 2), when stating:

Economists analyse crime, family behaviour, excessive consumption behaviour and addiction, bargaining behaviour, divorce, political campaigns and (the list could be extended) strategic interaction between two individuals or in small groups. And this is where the necessity of introducing emotions into economic analyses originates. If decision making by economists was restricted to highly aggregate macroeconomic situations or to situations where only costs and benefits play a role, the standard model would be sufficient.

5. DYNAMICS OF EMOTIONAL STATES

In this section, a model of emotion dynamics, based on simple social interaction rules, is formulated. The model is a meeting point between the three generic properties of emotions discussed in Section 4 and the classification of emotions as suggested by the Plutchik's wheel.

Consider a specific axis of the Plutchik's wheel. The axis we take is the one relating to joy, but the analysis may equally apply to any other. Assume a population of individuals where each element may be found in any of the identified emotional states of the joy class, and let:

- z_t : share of individuals in a state of ecstasy;
- y_t : share of individuals in a state of joy;
- x_t : share of individuals in a state of serenity;
- w_t : share of individuals in a state of pensiveness;
- v_t : share of individuals in a state of sadness;
- u_t : share of individuals in a state of grief.

The above densities comprise the whole population, i.e., $z+y+x+w+v+u=1$. We assume that agents maintain their emotional state unless direct local interaction with other individuals implies a change, given a set of simple interaction rules, which are adapted from rumour spreading theory (see Nekovee *et al* 2007). These rules are as follows:

- i) When someone in a state of serenity meets someone in a state of ecstasy, the first is convinced to shift to the ecstasy category, with a given probability;
- ii) When someone in a state of ecstasy establishes contact with someone who is joyful or also in a state of ecstasy, enthusiasm loses strength and the first falls to the state of joy, with a given probability;
- iii) When someone in a state of joy meets someone in a state of serenity, the first falls to the state of serenity, with a given probability;
- iv) The above rules apply exactly in the same way for grief (instead of ecstasy), sadness (instead of joy) and pensiveness (instead of serenity);
- v) The mentioned transition probabilities might differ; however, to simplify the analysis let them be all equal to $\lambda \in (0,1)$;

vi) When two individuals, located in the emotion states of serenity and pensiveness, meet, the transition may go either way, depending on a global assessment the individuals make about overall emotions in the population. This assessment requires formulating an emotion index, which will take the form

$$E_t = \left(y_t + \ln \left(\frac{1+x_t}{1-z_t} \right) \right) - \left(v_t + \ln \left(\frac{1+w_t}{1-u_t} \right) \right) \quad (1)$$

The emotion index, Equation 1, is positive when joy dominates over sadness, and negative in the opposite case. Note that in this index extreme emotions (ecstasy and grief) have a stronger weight than intermediate emotions (joy and sadness), and weak emotions (serenity and pensiveness) have a lower weight still than intermediate emotions.

The following rule is adopted:

- When $E_t > E_{t-1}$, i.e., when joy, in its different intensities, is gaining weight relatively to sadness, in its different intensities, the individual in the state of pensiveness relocates to the serenity state with probability $\lambda \in (0,1]$;
- When $E_t < E_{t-1}$, i.e., when joy, in its different intensities, is losing weight relatively to sadness, in its different intensities, the individual in the state of serenity relocates to the pensiveness state with probability $\lambda \in (0,1]$;
- When $E_t = E_{t-1}$, no relocation takes place.

Note that the above changes in the aggregate emotions profile take place when agents in the two states, serenity and pensiveness, meet.

Given the established rules, applying the law of mass action, and assuming that the social network is homogeneous and of connectivity degree equal to 1, emotion dynamics are presentable under the form of the following system,

$$\begin{cases} \Delta z_t = \lambda [x_t z_t - z_t (y_t + z_t)] \\ \Delta y_t = \lambda [z_t (y_t + z_t) - x_t y_t] \\ \Delta x_t = \lambda (x_t y_t - x_t z_t) + \tilde{\lambda} x_t w_t \\ \Delta w_t = \lambda (w_t v_t - w_t u_t) - \tilde{\lambda} x_t w_t \\ \Delta v_t = \lambda [u_t (v_t + u_t) - w_t v_t] \\ \Delta u_t = \lambda [w_t u_t - u_t (v_t + u_t)] \end{cases} \quad (2)$$

with $z_0, y_0, x_0, w_0, v_0, u_0$ given; $\tilde{\lambda} = \begin{cases} \lambda & \text{if } E_t > E_{t-1} \\ 0 & \text{if } E_t = E_{t-1} \\ -\lambda & \text{if } E_t < E_{t-1} \end{cases}$

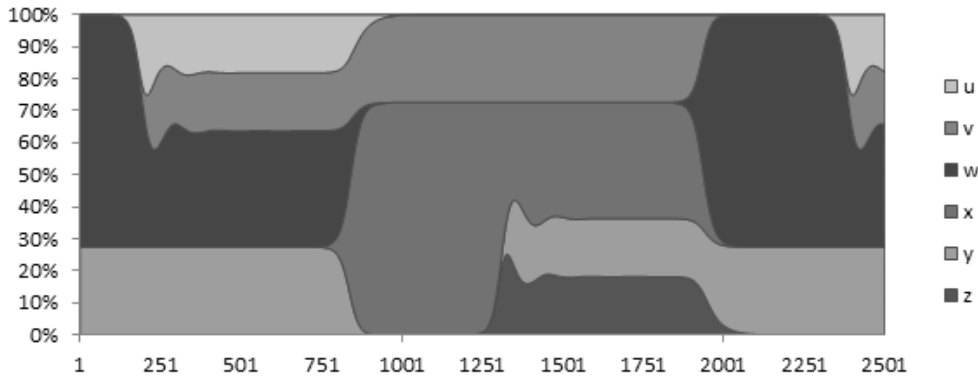
The dynamics of the emotion shares will depend, given System (2), on the initial values of the six variables and on the value of parameter λ . Consider an initial state such that individuals are equally allocated to each of the emotion shares: $z_0=y_0=x_0=w_0=v_0=u_0=1/6$. For these initial values, Figure 3 displays three dynamic long-term outcomes, for different values of parameter λ . The graphics are drawn for 2,500 observations after excluding the transient phase and they present the cumulative values of the emotion shares over time.

In the three examples, as for a large majority of the possible values of the transition probability, endogenous fluctuations are seen. The endogenous fluctuations outcome indicates that the interaction process produces persistent emotion waves, with periods of prevailing joy alternating with periods of dominant sadness.

For some values of the parameter (e.g., $\lambda=0.25$ or $\lambda=0.9$), a fixed-point equilibrium is obtained; in this equilibrium, agents will fully locate on the states of pensiveness (50 per cent), sadness (25 per cent) and grief (25 per cent) or, alternatively, on the states of serenity (50 per cent), joy (25 per cent) and ecstasy (25 per cent). Note that although this is a fixed-point equilibrium, it does not imply that the individual agent will remain forever in the same emotional state; she will evolve across emotional states, but in a way that her departure from one state to another is always compensated for by the entry of an individual in the first state and exit of an individual from the second state.

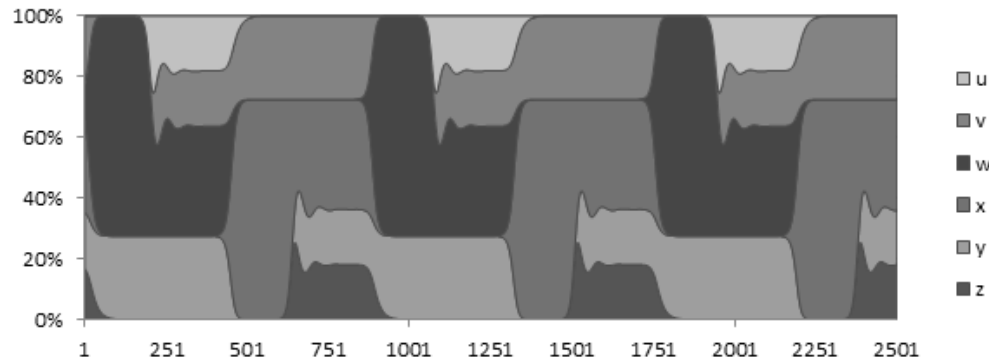
Figure 3 - Emotion dynamics

$\lambda = 0.1$



cont...

...cont. $\lambda = 0.2$



$\lambda = 0.4$

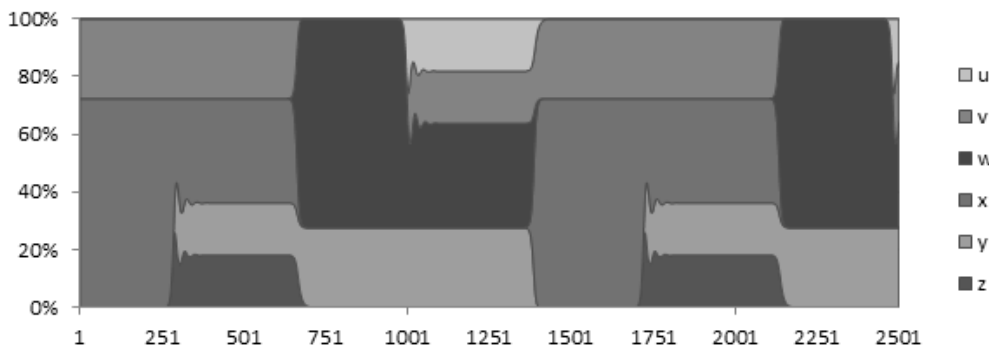


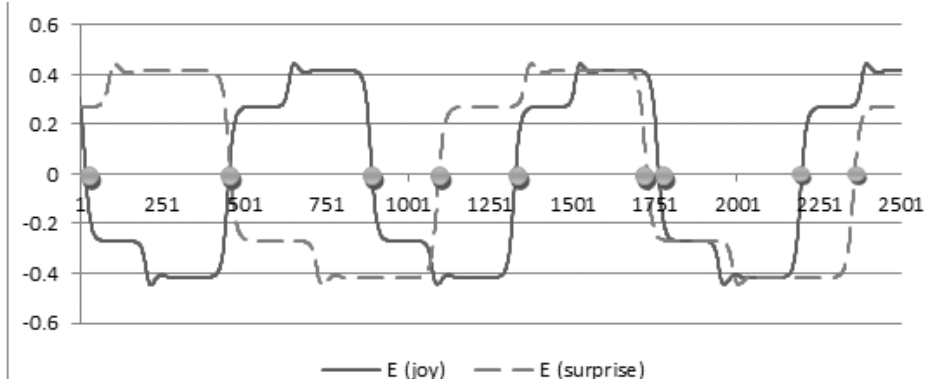
Figure 4 displays, for $\lambda=0.2$, the time trajectory of the defined emotion index, E_t , over 2,500 long-term periods. Because emotion shares fluctuate, the index will also fluctuate, with periods of dominant joy ($E_t > 0$) alternating with periods where sadness prevails ($E_t < 0$).

Figure 4: Time trajectory of the emotion index ($\lambda=0.2$).



Consider next that the emotion axis surprise is subject to the same set of laws of motion, that the initial distribution of agents across the respective emotional states is also uniform, but that the transition probability across categories is given by parameter θ (not necessarily equal to λ). Continue to assume $\lambda=0.2$ and take $\theta=0.175$. Figure 5 draws the emotion index in both cases.

Figure 5 - Time trajectories of the emotion indexes (joy and surprise).



The observation of the trajectories in Figure 5 allows us to gain a notion about the prevailing feeling in society according to the classification in the first diagram of Figure 2: both indexes start with positive values, implying that the dominant feeling in society is delight; after around 15 periods, sadness overcomes joy, and thus delight is replaced by disappointment; near observation 500, joy becomes dominant again, but surprise is overcome by anticipation: optimism replaces, at this point, the feeling of disappointment. Continuing the comparison of the two trajectories, the following sequence of feelings is found for the displayed trajectory: delight — disappointment — optimism — pessimism — disappointment — delight — optimism — pessimism — optimism — delight.

6. THE INSTRUMENTAL VALUE OF EMOTIONS

The classification of emotions and the effort to address the dynamics of the transition across emotional states based on such a classification, as discussed in previous sections, are just the first steps of a potentially wider economic research programme that eventually seeks understanding of the channels through which emotions impact agents' decision-making processes. Section 3 and the literature review have already provided a few clues to identifying those channels: emotion dynamics is a broad concept that includes the formation of anticipatory feelings that affect utility, instantaneous mood swings that influence behaviour at work and in other socio-economic contexts, and also ex-post reactions to outcomes that will, then, determine future decisions.

In this section, a particular and meaningful channel linking emotions to economic choices is highlighted, thus conveying some clues for a future exploration of how Plutchik's wheel may be employed as an instrument to understand better individual and collective decision-making: this channel is attention. Although attention is recognised in the literature as an important driver of economic decisions (see, e.g., the macroeconomic rational inattention models of Sims 2003, and Mackowiak and Wiederholt 2009, and, at the neuroeconomic research reviewed in Fehr and Rangel 2011), its determinants are seldom associated with emotions. Casual observation indicates the opposite: emotions and feelings, as characterised and organised in Section 2, direct and guide attention and, thus, determine the information and knowledge people acquire to evaluate their choices.

In Golman and Loewenstein (2015), the factors that influence the attention paid to a given question are enumerated. These are essentially three: importance, salience and surprise. All of them are, unarguably, shaped by emotions to a large extent. The importance given to a certain event is, for instance, strongly influenced by the position one occupies in the first axis of the wheel of emotions. If, e.g., the event is going to a party or to a festival, the importance that will be attributed to it, and thus the attention it will receive, will depend on the fact that the individual is in a state of joy or, alternatively, in a state of sadness.

The notion of salience is associated with the degree to which the question under scrutiny is influenced by the specific context or environment in which it arises. Environmental issues impacting on attention are also identifiable in our list of emotions. In particular, axes 2 and 3 in Figure 1 concern emotions that are most suited to addressing this issue: states of trust, disgust, fear and anger furnish the environmental factors that in many circumstances mould the salience that a given question acquires and, hence, the attention that it receives.

Lastly, surprise is attached to the dynamics of information revelation and it is also a driver of attention allocation. Besides being one of the three factors that exert direct influence over the level of attention, it is also the primary emotion in the fourth axis of the wheel of emotions.

Accepting, as Golman and Loewenstein postulate, that the attention assigned to an activated question is an increasing function of the three mentioned features — importance, salience and surprise — one confirms that particular emotional states are more amenable to generate higher attention levels to specific questions or problems than others.

Our discussion on emotions crosses the Golman-Loewenstein reflection also at a second level. These authors distinguish between two types of attention: motivated attention, for which the desire to acquire information or knowledge depends on the valence of the possible answers, and curiosity-driven attention, which is associated with the human tendency to fill in information gaps even when apparently the information has no direct usefulness. Again, in both cases, emotions are of foremost importance.

People have the ability and the freedom to select what they think about. They think about what can be useful for them but, essentially, they tend to

focus attention on what is likely to generate positive rather than negative outcomes. In other words, people seek information about questions with high-valence answers, to the detriment of questions with low-valence answers. Again, this observation highlights the role of emotions in attention allocation and information search: individuals are not neutral about what they desire to know and they do not collect information necessarily on the basis of its direct material usefulness. Emotions are a strong determinant of motivated attention, as a few examples allow to clarify. A student will attribute more attention to the date on which exam grades will be released when she is optimistic about the expected result; fear of knowing about an eventual disease may lead a person to avoid taking a medical exam; the willingness to meet someone will depend on the underlying emotion relative to the other person (e.g., admiration, trust, boredom or loathing).

In what concerns curiosity, we have already identified this as a feeling in Plutchik's wheel (Figure 2, class of feelings 5), emerging from the combination of trust and surprise. In fact, among the various feelings enumerated, curiosity is probably the most relevant in directing attention. If information gaps are significant and salient, people tend to allocate attention to them, even in circumstances in which satisfying curiosity does not contribute much to utility beyond the precise moment in which the information gap is filled.

Emotions change frequently, as agents experience the results of their past decisions, as they interact in society, and as they perceive changes in the surrounding environment. Mutations in emotional states may provoke sudden and violent changes in the importance, salience and level of surprise associated with a problem, therefore generating relevant reallocations of attention, both motivated attention and attention arising from mere curiosity. Attention, in turn, is the key for problem-solving; problems receiving more attention are those from which more valuable information and knowledge can be extracted, allowing for better economic outcomes. It is in this context that we propose Plutchik's wheel as a first step in the process of creating a unified theory of emotions. Other steps must follow, namely regarding the paths through which each emotion axis and each associated class of feelings determine awareness and attention in society at all levels of analysis (individual, local market interaction and economy wide).

7. CONCLUSIONS

How can one introduce emotions into economic models in a meaningful way? The question has no easy answer, given the multitude of emotions human beings may experience, their intensities, the velocity with which they change and the factors that drive them to change. A first useful step in the effort to build an integrated theory of emotions in Economics consists of establishing a clear classification of emotions. At this respect, it was argued that the 'wheel of emotions' proposed by psychologist Robert Plutchik may be a suitable starting point to organise ideas.

One outstanding feature of the wheel of emotions is that it considers a short list of basic emotions, each of them potentially subject to changes in their respective intensity. By ordering the intensities of a given lineage of emotions, one can then analyse and explore how individuals eventually evolve from one intensity state to another. As discussed, the dynamics of emotions are, in general, commanded by three strong ideas: emotions are non-controllable; emotions spread through social interaction; emotion contagion has society or economy wide consequences.

In this paper, through a simple framework of analysis, we have attached the transition between emotional states to the direct interaction among individuals, who will potentially change emotional states according to a simple set of transition rules. The rules are designed in order to allow for endogenous cyclical behaviour, such that the densities of agents in each emotion category will be potentially subject to perpetual irregular endogenous fluctuations. The deterministic bounded instability of emotions may, then, be a useful starting point to analyse economic phenomena where it is evident that, as highlighted by Akerlof and Shiller (2009), some non-economic motives determine the irregular and often unpredictable trajectories followed by economic variables.

Emotions influence the decisions of economic actors through a variety of channels. Perhaps the most emphatic of these channels is attention. Transitions across emotional states divert attention, making agents refocus their goals and reorient the search for the information and knowledge that are required to decide and prosper. Therefore, studying emotions is inseparable from addressing attention, information and knowledge. An important avenue for future research, in the context of the analysis pursued in this paper, will be to formalise a framework where the transition across emotional states at different locations of Plutchik's wheel is associated with faster or slower changes in the level of attention: while some emotion mutations are possibly innocuous from the point of view of the attention relevant economic decisions deserve, other changes might have substantial impact not only on everyday life but also over aggregate outcomes.

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ENDNOTES

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2. Many other, more or less detailed, categorisations of emotions can be found in the psychology literature (see, e.g., Shaver et al 1987; Parrott 2001).
3. Field evidence on the relation between emotions and economically motivated preferences, beliefs and decisions is reported on DellaVigna (2009).

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