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Nominalist Heuristics and Economic Theory*†

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Abstract

This paper introduces a new theoretic entity, a nominalist heuristic, defined as a focus on prominent numbers, indices or ratios. Abstractions used in the evaluation stage of decision making typically involve nominalist heuristics that are incompatible with expected utility theory which excludes the evaluation stage, and are also incompatible with prospect theory which assumes that, while the evaluation procedure can involve systematic mistakes, the overall decision situation is nevertheless sufficiently simple: 1) for economists and psychologists to identify what is a mistake, and 2) to be compatible with maximisation. But in the typical complex situation giving rise to nominalist heuristics neither 1) nor 2) hold, and therefore what is required is a fundamentally different class of models that allow for the progressive anticipated changes in knowledge ahead faced under risk and uncertainty, namely models under the umbrella of SKAT, the Stages of Knowledge Ahead Theory. A sequel paper. Pope et al 2009b, shows field and laboratory evidence of heuristics in the form of prominent numbers entering exchange rate determination.

Key words nominalism, money illusion, heuristic, unpredictability, experiment, SKAT the Stages of Knowledge Ahead Theory, prominent numbers, prominent indices, prominent ratios, equality, historical benchmarks, complexity, decision costs, evaluation.

JEL Classification D800, D810, F310, F330

1 Introduction

This paper investigates how alternatives are evaluated. It identifies ways in which prominent numbers, indices and ratios may enter the evaluation process. It shows that the usage of such heuristics is not an error in the sense of necessarily yielding an inferior decision. This is because their usage occurs in situations that are too complex for any economist, psychologist or other decision maker to ascertain what would be optimal behaviour. In turn this means that we lack a benchmark against which to declare their usage uniformly inferior, so that critiques of decision makers (such as those contained in prospect theory) that rely on scientists knowing the right decision, are irrelevant.

The paper's layout is as follows. Part 2 introduces SKAT, the Stages of Knowledge Ahead Theory. It depicts the four stages through which a firm progresses after encountering an exchange rate dilemma as regards its importing strategy alternatives, each stage pertaining to a change in knowledge ahead. We furnish field evidence from Savage and other adherents of EUT on the importance of stage 2, evaluating alternatives, in complex situations where

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nobody can maximise. We outline their efforts made to remedy EUT so as to include stage 2 by (i) a supplementary procedure, namely Savage's clarifying sure-thing principle, and (ii) a temporal backwards extension of EUT, and why efforts (i) and (ii) failed.

Part 3 introduces a new concept for doing evaluations of alternatives in stage 2, namely *nominalist heuristics*, which we define as a focus on prominent numbers, indices or ratios. In non-exchange rate applications, we do a literature review to provide field evidence that this nominalist focus is not limited to "business" economists, but is rife amongst academic economists, including ones using maximising models such as EUT, and who are quite unconscious that they are employing nominalist heuristics. Part 4 offers an executive summary for the busy reader. A sequel paper, Pope et al (2009), shows that nominalist heuristics have influenced actual exchange rates through the centuries, and replicates this finding in the laboratory.

2 SKAT

SKAT, the Stages of Knowledge Ahead Theory, is presented in Pope (1983), and in more detail in Pope (1995), Pope et al (2006 and 2009a) and Pope et al forthcoming. As dated from Pascal's (1670) pioneering work in the 17th century, a variety of terminologies have evolved over the centuries of decision modelling for some components of SKAT. Details of those different terminologies are in Pope (1996/7 and 2001). There are many models within EUT reflecting differences in the decision situation and the choosers' von Neumann Morgenstern utility mapping. As illustrated in Pope (1995), multiple models conform to SKAT, reflecting the analogous differences in the decision situation and chooser preferences.

Not all models lie within the SKAT umbrella. To be within the SKAT umbrella, the model must meet two basic conditions. First, it must incorporate the anticipated change in knowledge ahead, since this is the defining characteristic of whether the decision-maker faces risk / uncertainty. Second, it must be internally consistent with what the chooser and other relevant parties know at different times. Neither EUT nor its standard rank dependent extensions meet either of these two basic conditions for modelling risk / uncertainty. To explain these failures of EUT and much non-EUT theorizing, we need first to consider what a chooser knows at different stages after encountering a problem until he arrives at certainty.

2.1 Four Epistemic Decision Stages

In reaching a decision, the chooser goes through a series of epistemic stages. To be an epistemic stage, it must be demarcated from the earlier stage and from any later stage by a change in the chooser's knowledge. Let us take a firm for our chooser. As the firm solves each stage, something that was unknown before becomes known. For example, it has a change in its knowledge of the future – it has attained a new stage of knowledge ahead. There are multiple stages, as almost hourly something new is learned. Here we outline major stages,

major changes in the firm's knowledge ahead.

For the firm a decision-making process begins with recognition that the future is unknown because it has recognized a problem that may warrant action. When recognition is at an unconscious level, the subsequent steps may also be unconscious. In this paper we consider only decisions reached via a conscious process.[1]

Recognition of a problem results in stage 1, namely research and negotiation to discover at least one available act. When the firm stops its search for alternatives, it has its first change in knowledge ahead – from ignorance of the alternatives, to knowledge of its choice set. It has entered stage 2.

In stage 2 it evaluates those alternatives in order to choose amongst them. After it has evaluated the alternatives and made the choice, it has a second change in knowledge ahead – from not knowing what it will choose to having made the decision. It has entered stage 3. If it chose a risky alternative, it still does not know whether that risky alternative chosen will prove lucky.

Finally the firm learns whether it had luck. It thus has had a third change in its knowledge ahead – from ignorance of what will be its luck to full knowledge ahead (complete certainty). It has entered stage 4, the final stage. See Table 1.

Table 1
The Firm's Four Main Stages of Knowledge Ahead after Recognising a Problem

	Period	*Activity Stage*	*Unknown*
1	Pre-Choice Set	Discovering Alternatives	Choice set
2	Pre-Alternative Chosen	Evaluating Alternatives	Chosen alternative
3	Pre-Outcome	Waiting to learn if had luck	Later Outcome Segments of Chosen Act if Act is Risky
4	Post-Outcome	Living with the Now Known Outcome of the Chosen Alternative	Nothing – full knowledge ahead, complete certainty (with respect to that problem)

Before stage 4 is reached, there can be a multiplicity of each of the earlier stages, involving sub-acts. In addition Stage 3 may include numerous sub-stages simply because different aspects of the outcome may be learned at different times or because the probabilities of the outcome space may be progressively revised.

Choosers also sometimes have scope to revise the original decision, and thus go back to stage 2, or even back to stage 1. The economists' dictum, ignore sunk costs, if taken literally, can result in the chooser beginning again each time new information arrives. Thereby the economist's dictum to ignore the sunk costs of having already invested time and resources to

[1] When the chooser is an organization, the issue of unconscious choice is that its agent, or a set of its agents, makes choices unconsciously. Neuroscience is embryonic on decision making. But much of the recent evidence points to the stages not being too dissimilar to those yielding conscious decisions, and to there being an interaction of the conscious and the unconscious decision stages.

reach stage 3 can involve endless iterations of stages 1 to 3 so that stage 4 would never arrive with respect to anything. Law suits, human intolerance for nothing ever being learned, and other similar factors however keep real world agents away from implementing the economists' dictum of ignoring sunk costs to extreme extents.

In many circumstances moving backwards and forwards is rare in stages 3 and 4. Once a decision is struck that begins stage 3, the chooser often sticks with it right through to stage 4 when the risk / uncertainty of that chosen act is resolved. Such is in contrast to stages 1 and 2 where moving backwards and forwards is commonplace until stage 3 is entered.

2.2 Illustration

As a prelude to our sequel paper, Pope et al 2009, wherein we apply the nominalist theory developed in this paper to exchange rate determination, we here illustrate the four decision stages – arising out of three principal changes in knowledge ahead – with a situation for our firm that involves an exchange rate prediction. Suppose that our firm has already decided to import an item on credit for which it must later pay the bill denominated in a foreign currency. It recognises that the exchange rate may change before the payment is due. In dealing with its exchange rate uncertainty, our firm enters stage 1 of the decision process of ascertaining alternatives.

After the firm's first change of knowledge ahead, it has entered stage 2 – has decided what its alternative acts are. Suppose that it enters stage 2 because it has decided that its alternatives are in the three broad categories depicted in Table 2.

Table 2
Firm's Choice Set

	Broad Category	Number of Distinct Alternatives in this Category
1	*stay out of the foreign exchange market* and take what comes as the cost of the imports when the bill falls due.	One
2	*"hedge" against its own currency* in case this depreciates so that when the bill arrives it would otherwise have to pay more.	Numerous, as it can offer variable amounts of its own currency on the foreign exchange market up to its credit limit in borrowing from its domestic currency credit source, choose among different exchange rate agencies to convert the funds and choose different ways of investing the funds in the foreign country until the bill falls due.
3	*"speculate" on its own currency appreciating* and thus decide to borrow money abroad and bring that money home.	Numerous, as it can decide to offer variable amounts of the foreign currency on the foreign exchange market, up to the credit limit imposed by its foreign currency credit source, and choose various means of executing this and investing the speculative funds at home.

In stage 2 the firm evaluates these alternatives. When it has completed the evaluation and chosen one of the alternatives in Table 2, it has its second change in knowledge ahead. It now knows its chosen alternative. It has entered stage 3. Suppose it chose to hedge, ie an

alternative in category 2. Suppose that within this category it decided to hedge to a limited degree by borrowing half of the current value of the import bill in its own currency, converting this sum into the foreign currency for investment in the foreign country until payment for the imported item falls due.

In stage 3 the firm is waiting to learn whether its chosen alternative brings it luck. The alternative chosen brings it luck if it learns that its currency had depreciated at the time the import bill fell due. Stage 3 ends when the firm finally learns this exchange rate, ie has its third change of knowledge ahead. The firm has entered stage 4, the stage of living with the outcome of the risky / uncertain half hedge that it chose.

At the beginning of stage 4, the firm may learn it had luck, that its hedging reduced the cost of the imported good as its own currency indeed had depreciated. It may learn that it had bad luck, that its hedging increased its costs over the alternatives of doing nothing or speculating. After this third change in knowledge ahead its future is certain (as regards this issue). It has full knowledge ahead.

Table 3 summarises the evolution of the firm's knowledge ahead. It divides up the firm's future epistemically – in terms of its stages of knowledge ahead.

Table 3
Three Anticipated Changes in Knowledge Ahead ΔK_1, ΔK_2 and ΔK_3
(for a firm after deciding to import on credit)

	from	Pre-Choice Set	*Stage* 1: at best probabilistic knowledge of what inquiries and negotiations with banks etc might reveal is in the choice set
ΔK_1	to	Choice set identified	*New epistemic period starts, Stage 2*: now knows with a probability of 1 the choice set: do nothing, hedge or speculate, and the specific option details of each
	from	*pre-choice*	*Stage* 2: at best probabilistic knowledge about what the sub-acts of evaluating the alternatives will yield as a choice
ΔK_2	to	choice made: half hedge	*New epistemic period starts, Stage 3*: now knows with a probability of 1 that the choice is the half hedge and its specifics as regards risk, uncertainty of whether or not the hedge will turn out to have saved money
	from	*pre-outcome*	*Stage* 3: lasting until the exchange rate pertaining when the import payment falls due — only probabilistic knowledge of this future exchange rate and thus of which later segments of the outcome will be learned to be the chosen act's *actual* later segments of the outcome flow
ΔK_3	to	*post-outcome*	*New epistemic period starts*, *Stage 4*: now knows with a probability of 1 the exchange rate when the import bill falls due and thus the *actual* later segments of the outcome flow either saved money, or the half hedge increased the cost of the item imported on credit

2.3 Sure Alternatives

In Tables 1 and 3, all the alternatives in Table 2 are portrayed as involving uncertainty and risk. Here note that even hedging fully does not eliminate all uncertainties with respect to its profit making, customer retention and multiple other goals. Our firm under a full hedge still faces the uncertainties that it may have done better to do nothing or speculate as its home currency might appreciate – and of whether it will be at a cost disadvantage afterwards in deals it can offer its customers if it paid to fully hedge, whiles the other firms speculated, the home currency appreciated, and thus its competitors can under price it because of their better luck as regards which way the exchange rate moved. For any alternative in Table 2 to have been a sure alternative, our firm would have had to know with certainty the future exchange rate at the time when its import bill falls due for payment. As we shall see in Part 3, there does not seem to be any firm (or economist or central banker or government official) with a warranted belief in such certainty.

Suppose however that a firm believed it could predict this future exchange rate with certainty and also all the other features of the future pertinent to its half hedge. Then (even if its certainty is unwarranted), it would anticipate its future as containing one less stage and one less change in knowledge ahead than is presented in Tables 1 and 3. Since it has chosen a sure alternative, stage 3 of Table 1 does not exist (is degenerate – of zero duration), and in Table 3, ΔK_2 likewise does not exist – our firm upon choice has leapt from stage 2 to stage 4, experienced ΔK_3, full knowledge ahead. In summary, to choose a sure alternative is to skip stage 3. To choose a risky alternative – often done because there is no available sure one – is to go through stage 3, a period of positive duration, Pope (1985b).

2.4 Timing Consistency Issues

EUT embodies a false timing simultaneity in what the chooser knows. Thus the initial full axiomatisation of EUT, von Neumann and Morgenstern (1944, 1947, 1953, 1972) assumes that, upon having chosen an alternative, the chooser will have all the risk resolved simultaneously, at a single future date. This is correct if all the alternatives in the choice set are of a particular sub-set of simple risky acts. But EUT includes sure alternatives. In the case of choosing a sure act, the chooser knows everything earlier – not in the *future* that is *after* the point of choice, rather *simultaneously* with choice. This renders it infeasible to model risky and sure choices together in a theory that permits only a single epistemic period. Doing so introduces the contradiction of probabilities of the mutually exclusive set of outcomes (that comprise the outcomes space) being simultaneously known and not known. Yet epistemically, with one partial exception discussed in section 2.6 below, EUT's axiomatisation is atemporal.

This results in EUT's internally contradictory definition of risky alternatives, namely that a risky alternative is a probability mix of sure alternatives, Harsanyi (1977). This EUT definition mirrors the timing inconsistency in von Neumann and Morgenstern. EUT fails to discern the hallmark of risk – that its non-degenerate probabilities mean that the chooser

currently knows something only probabilistically that later the chooser anticipates knowing with full certainty. It is a contradiction in terms to have the concept of a sure alternative – one whose outcome is known at the point of choice – combined with the non-degenerate probabilities of a risky alternative, Pope (1985b). This timing inconsistency – this false simultaneity postulate – recurs in all standard rank dependent extensions of EUT such as cumulative prospect theory of Tversky and Kahneman (1992).

A prerequisite for avoiding such false simultaneity postulates is that at the point in time at which the modeling of the chooser's future begins, the chooser is aware that there is something that he does not know, but will learn at a future date.[2] In turn this implies a positive time interval prior to the resolution of that risk / uncertainty. It implies that the chooser's outcomes flow must begin *before* stage 4 when all the risk / uncertainty will have been resolved. In other words the model must be epistemically time-wise consistent and thus contain a minimum of two distinct *epistemic* periods.

Bear in mind the qualifiers *epistemic* and *epistemically consistent*. To be within the SKAT umbrella, it is not sufficient for a model to divide up the chooser's future into numerous *chronologically* distinct future periods. To be within SKAT, the periods must be *epistemically* distinct – demarcated by changes in knowledge. To be within SKAT, any probability distributions over pertinent outcome spaces must be *epistemically consistent*. To be epistemically consistent, the model must not violate other axioms (assumptions) in the system about what the chooser and other relevant parties know at distinct dates. In short, for models to be epistemically consistent, no chooser can hold or impute to other relevant parties simultaneously degenerate and non-degenerate distributions over an outcomes space.

There is a problem in using theories like EUT that lie outside the SKAT umbrella since they embed timing inconsistencies. The problem goes beyond the aesthetics of liking consistency. Timing inconsistencies cause such theories to miss out on key causal chains pertaining to the risks and uncertainties that rational reasonable choosers consider. The remaining sections of this part of the paper illustrate these, and efforts to include in EUT what that theory omits.

2.5 The EUT Outcome Segment

Why EUT embeds timing inconsistencies relates to the fact that it contains only one distinct epistemic period. Utilities (costs and benefits – satisfactions) are derived from outcomes that matter to the chooser. The chooser does not spring into existence in stage 4. The chooser has utilities from the beginning of stage 1. There is an outcome flow, with the first segment being in stage 1, the second in stage 2, the third in stage 3, and the fourth in stage 4. (Of course for some decision situations it is worthwhile to subdivide each of these epistemically distinct segments of the outcomes flow into smaller segments).

Its axiomatic base constrains EUT to include in its outcomes flow only the final stage of

[2] This is in the simplest risky / uncertain situations – in some more complicated ones, the chooser may merely anticipate in the future having a change in his degree of knowledge of the outcome, and not anticipate ever knowing it fully – eg in cases where the outcome is the truth of a hypothesis that the chooser, a scientist, is investigating, Pope (1988).

knowledge ahead, only stage 4 – only the last row of Tables 2 and 3, namely the outcome segments that will occur *after* all risk and uncertainty will be in the past. This is because EUT's axiomatic implications include: (i), a restriction of the outcome flow to those segments that occur *after* all risk is resolved, Samuelson (1952a); and (ii), a restriction that each of these post risk segments must be evaluated "as if certain", even though uncertain at the point of choice, Friedman and Savage (1948), Samuelson (1952a).[3] Restrictions (i) and (ii) hold also for most extensions of EUT such as cumulative prospect theory. Many scientists inadvertently violate the extreme epistemic constraints of EUT, and thus construct epistemically inconsistent models that they erroneously describe as within the framework of EUT. But in fact such models lie outside both SKAT and EUT.

EUT's omission of the three earlier stages implies that there are no satisfactions and dissatisfactions that should be considered by the chooser before the final era when all uncertainty is past. Thus EUT implies that there are no costs, no benefits in stage 1 of ascertaining the choice set, nor in stage 2 of evaluating each alternative in that choice set, nor in stage 3 of enduring or enjoying the period of risk / uncertainty after choosing and prior to learning whether the lucky outcome has ensued from the risky act chosen. (Stage 3 does not exist – is degenerate (ie of zero duration) – if a sure act is chosen.)

It might be thought that models within EUT can include all stage 4 effects. This however is not the case. The earlier stages 1, 2 and 3 all have historical legacies, ie effects on the chooser in stage 4. Table 4 illustrates.

Table 4

Historical Legacies in Stage 4 from the Earlier Three Stages

stage 1 that lasts until the chooser stops searching for new alternatives and declares his choice set.
The historical legacies in stage 4 of the chooser's sub-acts of searching in stage 1 can include being blamed (fired) for having failed to negotiate / discover or praised (promoted) for having succeeded in negotiating / discovering desirable alternatives. The chooser only experiences most of these historical legacies as late as stage 4 because it is only after the chooser and others notice that other alternatives not in the choice set would or might have been better or worse.

stage 2 that lasts until the chooser stops evaluating the alternatives and makes a choice
The historical legacies in stage 4 of the chooser's sub-acts of evaluating in stage 2 can include being blamed (fired) for having evaluated in a way that led to rejection of an alternative that subsequently (by stage 4) the chooser or other relevant parties learn would have been superior or praised (promoted if later alternatives rejected are learned to have been inferior.

stage 3 that lasts until the risk / uncertainty in the chosen act is resolved
The historical legacies in stage 4 of going through stage 3 of not knowing whether the chosen risky act's outcome will be good or bad can include repayment of loans with a risk premium. Lenders charge our firm interest on funds borrowed to hedge or speculate – interest inclusive of a risk premium as the lender does not know for sure that our firm will repay. Our firm will only contingently repay – repay provided it is not bankrupt. Without a stage 3, interest repaid in stage 4 if the outcome is good enough to enable repayment, would be less. It would be a risk-free interest rate. (Risk premia have to be exogenous "somethings" not connected to risk in EUT models.)[4]

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[3] See Pope (2004) on the alternative Ramsey version of EUT. His version has the like property of precluding attaching a different utility to an outcome depending on its degree of risk, uncertainty.

[4] There is a literature of EUT-inspired models seeking to endogenise risk premia and related phenomena. These are valuable contributions, but ones hampered (like the EUT-inspired search models) by a failure to notice that they in fact contradict the EUT axioms.

2.6 Models of Stage 3 Effects

As we noted in section 2.4, EUT fails to include even stage 3. EUT is instead as von Neumann and Morgenstern had observed a static, atemporal theory. Kreps and Porteus (1978, 1979) extended EUT to include some temporal features. Kreps and Porteus axiomatically derive a dated (temporal) version of the atemporal EUT property that lies outside SKAT since one of Kreps and Porteus' assumptions concerns a two-stage gamble that thus implies sequential unfolding of the two stages yet as they themselves note in their conclusions, they assume the two stages occur simultaneously. They obtain results that coincide with what a chooser employing SKAT might reasonably decide taking into account *one* of the stage 3 effects that EUT necessarily omits, namely planning difficulties. The Kreps and Porteus models succeed in making choices that coincide with those made under a rational model of SKAT for a limited sub-set of these planning difficulties. But in addition to the problem of its false simultaneity assumption, this dated version of EUT has the drawback that it has proved too complicated for general understanding or adoption. One recent extension of their approach is Klibanoff and Ozdenoren (2007).

Earlier, Keynes looked into stage 3 experiences of firms (1936, 1939). It resulted in his constructing a non-EUT theory based on the risky or uncertain stage 3 that a firm endures when it chooses the risky act of production for investment, and a firm avoids if instead it chooses the safe act (according to his theory), of production for consumption. Keynes' concern about stage 3 uncertainty effects has attracted a limited amount of interest, Walsh (1996, pp52-65), and there has been in addition an appreciation that the mainstream tradition sidesteps key implications of investor uncertainty, eg Davidson (1984, 1988, 1991, 1993, 1996, 2008).

Von Neumann and Morgenstern had wanted to include stage 3 so as to include a set of satisfactions that they termed by various names including the specific utility of gambling. However they encountered a contradiction that they were unable to solve on this "level", and so left the task to future researchers, (1947, 1953, 1972, pp628-32). Pope (1985b) shows that introducing stage 3 permits the analyst to discern that during this stage the alternative (mutually exclusive) outcomes interact in the mind of the chooser. This is permitted since in stage 3 the distribution is non-degenerate. That distribution of outcomes only becomes degenerate at the beginning of stage 4.

2.7 Models of Stage 1

Stage 1, identifying the choice set, has branched in three directions. One is into satisficing models – stop when a good enough alternative has been located, eg Simon (1955). A second is into aspiration-adaptation models, eg Sauermann and Selten (1962), Selten (1998), with an urgency order of improvements and a retreat variable. A third is inspired by EUT, but

violates the EUT axioms as it concerns a stage before all risk is past. These are models in which the search continues until the expected benefits of searching exceed the expected costs.

The EUT-inspired search model comprises a set of steps. Step 1 identifies some probabilistic benefits and costs of searching in a specified way. Step 2 identifies probabilistic benefits and costs of discovering with more confidence what those original probability distributions were, or of another way of search. …. This is an endless regress of evaluating more and more the benefits and costs of search, Simon (1991, 1993). It avoids being an endless regress in actual EUT-inspired search models of stage 1 because (somehow in the unconscious) the searcher is assumed to know that certain formulae correctly capture these expected benefits and costs – and do not themselves require further search, further evaluation.

All three approaches to stage 1, satisficing, aspiration-adaptation and EUT-inspired search models are alike in that their current batch of models assumes that stage 2 is non-existent, superfluous. All three assume that the chooser already has an evaluation of identified alternatives, of which to choose.

To see this, consider first the satisficing model of Simon (1955). It makes no distinction as regards the timing or the expense of identifying an alternative and being able to classify that alternative as either satisfactory or unsatisfactory. On locating an alternative, the satisficing firm thus has no need to evaluate it. On locating an alternative it has *simultaneously* and costlessly ascertained whether it is satisfactory.

Likewise in the path-dependent aspiration-adaptation model of Sauermann and Selten (1962) and Selten (1998), our firm would be assumed at every decision time point to have already an order of urgency as regards improvements and as regards a retreat variable. Thus each time a firm completes its search procedure of discovering what is feasible, it has no additional stage 2 evaluation to do. If it discovered that moving up is feasible, it already knows that if it has to choose between different upward directions, and already knows which upward directions are higher on its urgency scale. Again, if retreating is all that is feasible, and it does not have to retreat in all dimensions, our firm already knows its retreat variable. It has no need to do a stage 2 evaluation in order to discover its desired advance or retreat steps.

Similarly in the EUT-inspired search models, our firm already has its preference order. In these models often the alternatives are modeled as naturally uni-dimensional. Eg in the labour search theories, the alternatives may be net money amounts probabilistically received under each situation, simultaneously and costlessly evaluated by their expected utilities.

2.8 Literature on Stage 2

Research on stage 2, evaluating alternatives, includes learning, and whether choosers: 1, use integrated maximizing calculations and numerically weight the multiple dimensions of alternatives, eg Cyert and March (1963), Borcherding and Winterfeldt (1988), Weber and Borcherding (1993), Brandstätter, Gigerenzer and Hertwig (2006), Pope, Leitner and Leopold

(2006); 2, edit out common components of alternatives, eg Birnbaum and Navarreté (1998); 3, structure by dominance, eg Huber (1982); 4, form reference points related to some status quo, eg Inder and O'Brien (2003); 5, use prominent numbers (see section 3.8.2 below); 6, include anticipated risk and uncertainty effects from going through stages 2 and 3 prior to attaining the certainty of stage 4, eg Bell (1981), Pope (1983), Conlisk (1993), Pope (2001); Camille, Coricelli, Sallet, Pradat-Diehl, Duhamel and Sirigu (2004), Pope, Leitner and Leopold (2006).

2.9 Efforts to Include Stage 2 in EUT

With satisficing and aspiration-adaptation models, there is no bar on extending the approach forwards to stage 2, the evaluation procedure. It is merely a matter that research on this extension is largely in the "planned to be done" basket. By contrast, quite a deal of literature already exists on efforts to supplement or extend EUT so as to take account of stage 2.

As already explained in section 2.5 above, EUT cannot itself be extended backwards to include stage 2 since this would violate its axioms that restrict the outcomes flow to begin in stage 4. Such a backwards extension would be tantamount to elaborating or redefining the outcomes. Thereby the backwards extension would violate the axiomatic base given EUT's constraints (i) and (ii) listed in section 2.5 above, Pope (2000). Further, even if one ignores the axiomatic constraints, using an EUT-inspired approach to stage 2 would simply re-introduce – but in a more salient fashion – the difficulties of those EUT-inspired search models of stage 1 (that violate the EUT axioms, and thus lie outside EUT). This is because an EUT-inspired stage 2 would need to involve expected utilities of the costs and benefits of doing a better evaluation. But as already discussed in section 2.7, this is an endless regress. Each set of such expected costs and benefits rests on an earlier set.

In short EUT itself cannot be extended backwards to include stage 2. An outside EUT, but EUT-inspired stage 2 optimising model would be subject to the endless regress problem. Yet EUT's need for a complementary stage 2 model is acute. It is far less plausible to be without a stage 2 process under EUT than under the non-optimising approaches of satisficing and aspiration-adaptation models. This is because under EUT the required knowledge of preferences is more precise and comprehensive than under satisficing and aspiration-adaptation models. EUT's axiomatic base requires the evaluation of each alternative to be:

Condensable to a Single Utility Dimension;
Numerically Precise – mappable into a *single* utility *number*, with the set of numbers in most axiomatisations unique apart from scale and origin; and
Comprehensive in
extent – there must be an evaluation of every *conceivable* alternative, not merely of every *actual* alternative, and
depth – each alternative must comprise chronological sequences of alternatives *to the end of the chooser's life*.

The chronological depth condition stems from the admission of Samuelson and Savage that EUT gives implausible choices if repeat choices are permitted within a lifetime, Samuelson

(1952b), Savage (1952b, 1954). However the depth requirement itself violates the EUT axioms, Pope (2006).

The technicalities of how a chooser could already instantly costlessly know his preferences over any infinite set, let alone know these with a reduction of his multiple goals to a single dimension with such precision and chronological depth has been a matter of interest. Supporters of EUT resort to a black box hypothesis of saying that somehow this happens unconsciously in the brain. EUT critic, de Neufville (1983), describes this EUT assumption of instant costless access to preferences so that zero evaluation of alternatives is required, as "look in a book" utilities. Black (1986) demonstrates that such EUT preferences would be beyond the capacity of any academic, even if the academic's preferences to the end of his life simply pertained to ranking all the books in a small bookstore. Savage (1954, 1972) has admitted that EUT is too complex to use even for planning a picnic.

It has been easy to overlook how precise and comprehensive is the EUT preference condition, and thus to miss the force of the point being made by de Neufville, Black and Savage. It has been easy to overlook because economists typically formulate decision situations in which all the multiple dimensions of a book's appeal to an individual are ignored, all the multiple dimensions of a firm's goals (as regards long run profits, short-term customer retention, ….) rest unmodelled, and all the chronological depth complexity is non-existent. Instead economists have focused on situations in which the chooser's outcomes flow is assumed to be already a univariate net monetary amount and chronological depth is almost a non-issue either because the chooser lives to eternity in an ultra simple ergodic world,[5] or because the model ignores the EUT constraint of a single-for-life choice, and concerns a one-off choice over a small world segment of the future.

The possibility of a small world variant of EUT was introduced by Savage. He hoped that appeal to a small world would make EUT more practical. But he consigned operationalising the notion of a small world to future researchers. He reported that he had found the matter of defining a small world compatible with the axioms too difficult, Savage (1954, 1972).

Recently work on under which the representation of the world available to a boundedly rational decisionmaker, whose awareness increases over time, constitutes an adequate 'small world' in the sense of Savage (1954) for the assessment of a given decision, Grant and Quiggin (2008). They find the conditions required to be "quite stringent" and in effect unknowable to the non-omniscient decisionmaker. In short their investigations lend no support to the notion that Savage's small worlds can be operationalised in order to revive EUT.

The small world that has not become operational was not Savage's only effort to address the

[5] The term was developed by the Moscow School of Probability in 1935. Ergodicity implies that samples drawn from past and current data furnish statistically reliable forecasts since economic time series are stationary. For critiques of EUT usage of the ergodicity assumption, see Davidson (1984, 1988, 1991, 1993, 1996).

obvious need for EUT to have a stage 2, to have a procedure for evaluating alternatives. His other effort was to go outside EUT and complement it with a different stage 2 procedure. To this end he constructed what he described as an "extra logical loose" clarifying procedure, Savage (1954, 1972). He called it the sure thing principle.

The construction arose because at a Paris conference in 1952, Allais alerted him that complementing EUT with a stage 2 was essential if choosers were to conform to EUT. Savage was startled to discover that his joint pair of choices to simple questions from Allais violated EUT. Savage concluded that he wished to obey EUT, but that he had made an error in stage 2, and wrongly evaluated the alternatives. He constructed his unaxiomatised sure thing clarifying principle to supplement / precede use of EUT. Friedman and Savage (1952) found the principle so enlightening that "the Greeks must surely have had a name for it".

The authors of this paper however are unaware of evidence of its use in practice by firms. Nor is it not invariably "clarifying" in the manner that Savage anticipated, Hagen (1972). Whenever it does "clarify", it does so by truncating the probability distribution and generating an illusion of certainty. It clarifies by enticing the chooser to select an alternative because a modified variant on the alternative is guaranteed, when in fact the actual alternative itself is risky, Pope (1991). So the principle is irrational, something to be avoided by any sensible firm in its stage 2 evaluation process.

Indeed the sure thing principle is doubly irrational for one like Savage wishing to obey EUT, since those axioms impose the condition that a person is indifferent between whether an outcome is risky or sure. This is a bizarre counterintuitive feature of EUT. It can only seem a natural condition to impose when it is appreciated that under EUT the only segment of the outcome flow included is that segment that will occur after all risk will be passed. Thereby EUT excludes consideration of all the prior outcome segments when risk will still be present and thus matter, Pope (1991).

There is also the issue that the sure thing principle is at a level of generality that gives our firm no assistance in its particular evaluation task. Our firm has to evaluate exceedingly complex alternatives relative to the trivial social gambling alternatives that Allais posed to Savage. In Allais' pair of alternatives, already the exact probabilities of all the outcomes were known.

By contrast our firm, with the choice set of Table 2, has to choose between the three broad categories: 1, do nothing; 2, hedge; and 3 speculate. Our firm needs to consider whether it seems more likely that its own currency will significantly appreciate or more likely that it will significantly depreciate. This is a daunting part of reaching a decision, costly and dangerous. It lacks the props of Savage in 1952 in choosing amongst Allais' alternatives, the props of knowing *precisely* all the probabilities that are pertinent. Instead, in order to get to first base in its evaluation process, in stage 2 our firm has to *discover* what probabilities or qualitative likelihoods it should put on different directions and extents to which the exchange rate might

move. This difficult process mirrors many other decision situations in which, stage 2, the evaluation process, is costly in emotional and material resources, Janis and Mann (1977), Simon (1991, 1993).

3 Nominalism

Our firm has to evaluate. It has to evaluate in order to choose to do nothing, or to hedge, or to speculate. In this complex situation of needing to predict a future exchange rate in order to choose amongst its alternatives, what evaluation procedure might our firm adopt? We have shown in Part 2 that EUT cannot itself help, as stage 2, evaluating alternatives, lies outside its axioms. We have also shown that EUT-inspired approaches to stage 2 in the form of procedures that might complement EUT while distinct from EUT, namely the maximizing expected benefits minus costs approach to evaluation, and Savage's clarifying sure thing principle, would be positively harmful for our firm. In a sequel paper, Pope et al (2009), we have shown that our firm lacks a robust verified means of obtaining a probability distribution over the outcomes space of where the pertinent exchange rate might lie when its import bill falls due. What then might our firm do in forming this probability distribution, or in forming some qualitative counterpart of such a probability distribution in order to grapple with the unknown future exchange rate? It can resort to analyses for which in this paper we coin the term nominalism.

3.1 The Concept

Nominalism we define differently from money illusion. We define it as attention to one or more prominent numbers, indices or ratios. The prominence can arise from the numbers themselves, from historical events, or from the modelling abstraction process. Every theory abstracts, and in the case of most economic theories, this means that it pays less attention to some numbers, indices and ratios than would a less abstract theory that includes more of the cause-effect chains and more details on how each chain operates. Many instances of decision-making, including those of scientists in constructing, using, testing and estimating theories exhibit nominalism. We cannot have a theory of what causes what without abstracting. Since most economic modelling involves numbers, indices and ratios, what we term nominalism in this paper thus can also be termed economic modelling abstraction.

There is however a distinction in connotation. The term abstraction has no generally accepted connotation of praise or blame in economics. It has often a neutral connotation. It has often a positive connotation, eg when scientists assert that abstraction is the essence of good theoretical and empirical work. It can have a negative connotation, as when scientists find some particular piece of theorizing so abstract that it "throws out the baby with the bathwater". Einstein, quoted in Allais (1984) made such a criticism. Allais was quoting Einstein, since he wished to alert his EUT colleagues to the issue that EUT might be elegantly simple in its abstractness, but too simple to be useful for scientific purposes.

The term nominalism, in contrast to the term abstraction, has fairly *consistently* a negative

connotation. We economists use nominalism to refer to instances in which *we ourselves* (as superior decision makers) *look down* on others who abstract inappropriately – who failed to consider as many factors as we deem pertinent. We also use nominalism to refer to instances in which we know that *other economists* would *condemn* decision makers for having inappropriately abstracted – even if we ourselves refrain from judging whether the abstraction was inappropriate, or even praise it.

3.2 The Rationality Issue

Keynes in 1936 gave centre stage to one form of potential nominalism, namely trade union leaders' attention to the money wage number without equal attention to the associated cost of living number, in his *General Theory*. There are overtones of irrationality in Keynes terming this instance of nominalism "money illusion". He did however argue that it was a sensible strategy for the trade union leaders. It was sensible due to aggregation effects from the wage bargaining outcomes of its different trade unions. Ie he argued that trade union leaders' focus on nominal wages was not undue.

We likewise refrain from describing all abstraction in the form of restricting attention to prominent numbers, indices and ratios as an undue focus – as *necessarily* unreasonable or irrational. There may be the sorts of aggregation effects that Keynes identified. Further, restricting attention to prominent numbers, indices and ratios saves on evaluation costs in ways not accounted for yet in most of our theorizing. It is frequently infeasible to avoid restricting attention to prominent numbers, indices and ratios. We are "guilty" of it almost whenever we theorise in economics. No economic theory includes all relevant number relations. Any economic theory abstracts and assumes some numbers move together when in fact they do not. Sometimes such restricted attention to prominent numbers, indices and ratios captures the essential stylized features of the economy and renders understanding, robust predictions and policy advice. Sometimes it fails, and yields the reverse.

Nor can choosers making decisions outside economic research and policy work refrain from restricting their attention to prominent numbers, indices and ratios. Thus issues concerning rationality, concerning what we define as nominalist heuristics, can only be those of identifying when the focus is unduly restricted. The answers will depend on the specifics.

3.3 Nominalism in the "Real" Variable Concept

There are of course numerous instances in which restricted attention to a prominent number, index or ratio yields inferior decisions, understandings, and predictions. We give but two examples. Both have the irony that a nominalist short cut is given the positive connotation of being superior because paying attention to two numbers, not merely one, and as a consequence is called real, as distinct from nominal. Both however *in some situations* yield inferior decisions and inferior understandings.

3.3.1 The Real Interest Rate

The real interest rate is defined as the interest rate less the rate of inflation. It is a nominalist short-cut. There are numerous anticipated rates of inflation that might be used to deflate an interest rate. Each is highly controversial as it involves anticipations, and assumes that there is some particular set of prices whose future movement matters for all borrowers and lenders. The Australian Treasury for instance found on its investigations that introducing the nominalist short-cut of a real interest rate into economic incentives in taxation would be counter-efficient. But economists seeking the simplicity of tractable models, ignore such findings, ie ignore most of the variables and thus numbers that matter for borrowers and lenders, and rather routinely take the nominalist short-cut and analyse with “real” interest rates.

3.3.2 The Real Exchange Rate

The real exchange rate denotes the nominal exchange rate divided by either a traded goods price index; a consumer price index; a wage index; a wholesale price index, and also by various other domestic price indices. These diverse price indices typically move in markedly different ways. But it is quite common in both theoretical and empirical studies employing a “real” exchange rate to not even mention which particular price index was used to generate the “real” exchange rate. The nominalist practice of analyzing with “real” exchange rates thus ignores many other pertinent numbers. It ignores distinctions between prices for intermediate goods such as imports, exports, the prices for final consumer goods, and the price of labour, and the disproportionately high use of importable and exportables by a country’s import-competing sector.

As with “real” interest rate analyses, the defence is that the "real” exchange rate is less nominalist and thus more informative than simply using the nominal exchange rate. This however is not necessarily the case. The nominalist short-cut of analyzing the tradeable sector via a "real” exchange rate as if there were only one price deflator for all inputs and outputs of the import and export sector and the other complementary and competing sectors of the economy can yield false conclusions.

Analyses employing the nominalist “real” exchange rates yield the conclusion that the import competing local manufacturing sector benefits from exchange rate depreciations – and yield the IMF advice that countries seeking to expand local manufacturing ought depreciate. But for countries like Australia, and some developing countries, this depreciation decision arising out of nominalist real exchange rate modelling can be the wrong one to take. There is evidence suggesting that a depreciation can contract the local manufacturing sector, the reverse of the typical IMF goal, in countries where the export sector is primarily commodities (agricultural, mining and so forth) and exporters have expenditure-smoothing capacities. Commodities face wild price fluctuations and comprise primarily fixed costs. Expenditure

from the export sector accordingly conforms to the Smithies-Friedman theory of insensitivity to short run profit fluctuations, Smithies (1945), Friedman (1957). The net effect is that the import competing local manufacturing sector whose costs are primarily importables and exportables, can contract markedly with depreciations (which raise costs but not demand), expands markedly with appreciations, Pope (1981, 1985a, 1987), Pope and Selten (2002).

3.4 Money Illusion

As regards money illusion, there is qualitative field corroboration, eg Fisher (1929). There is econometric corroboration, eg estimates of the Australian consumption function, Johnston and Looker (1979). There is questionnaire corroboration over a range of hypothetical consumption and investment decisions, eg Shafir, Diamond and Tversky (1997). There is corroboration from laboratory experiments, eg Fehr and Tyran (2001), Mekvabishvili (2006).

3.5 Base Illusion

Some economists and financial analysts rank countries as having been more successful on the basis of growth rate number. They make no allowance for whether the country was in a recession or a boom in the earlier period taken as the base number. (Central Banks are also prone to present and analyse data in such a change format!) Such nominalism can yield copy-cat fluctuations in economic regimes. When one country is at the top of the league (often simply because in the base period it had been performing badly), the other countries try to copy its industrial structure, attributing all its growth success to these industrial features. Thus when corporatist continental Europe and Japan were growing faster than English speaking countries, there was interest in changing the business environment in English speaking countries toward in the longer term investment perspective and the less hierarchical workplace structures of these countries and their lower percentage of managers, especially a lower percentage of managers from non MBA-style backgrounds. When later the US and the UK had growth spurts (after severe slowdowns), interest heightened in deregulating Japan and continental Europe so as to mirror the business environment in English speaking countries.

Less nominalist economists warn against excessive copy-cat behaviour. They warn that undue attention is being paid to short-run growth rates in the countries growing fast. They warn that that ignores attention to other numbers, namely whether the base was temporarily unrepresentatively low due to a recession – low due to the country having been relatively undeveloped.

3.6 Inertia

Inertia after price incentives change is justifiable under assumptions of fully "rational" optimizing choosers who have costlessly precisely calculated all the costs of shifting to a new "equilibrium" and decided that the transactions and other costs exceed the benefits of responding, eg Constantanides (1979, 1986). But such assumptions are unrealistic: most inertia stems from nominal heuristics, from choosers who have limited recognition of the

price changes, little knowledge of the transition costs of response, and so forth. Inertia leads them to simply consider the current numbers and number ratios. A prime example is the popular optimal currency area model of Mundell (1961). Herein for countries outside the optimal currency area, after the equilibrating exchange rate change, people are assumed to never expect another exchange rate change. Failure to recognise the implausibility, indeed falsity, of this nominalist heuristic, has resulted in beggar-thy-neighbour usage of exchange rate changes, Pope (2008), and has aided in retention of multiple currencies, when there is evidence that a single currency would better maintain international competitiveness, Pope et al (2008).

3.7 Nominal Equality

When short of a means for progressing toward predictions, nominalism enters much of physics in the form of postulating symmetries in the behaviour of entities. In turn these postulated symmetries can involve giving numbers to other ratios and quantities entailed by those symmetries (typically not prominent numbers) when otherwise a wider range of values would need to be taken into account. Symmetries and related aesthetics issues (such as simplicity and elegance) enter formal economic theorizing. As Manne and Charnes (1952) and Allais (1984) observe critically, these postulated symmetries and aesthetics often result in a severe, even extreme restriction, on the number of relations and associated quantities that are considered.

Symmetries in the form of identity transforms – equality generators – are widespread in society where there is no clear fixed pie to divide up fairly, eg because of the irreducibly multi-dimensional nature of the pie. Civil, criminal and tax law often treats everyone identically in some dimensions. Organisations often impose identity on all employees as regards matters like working hours, holidays and sick leave. In negotiations, successful agents tend to structure their steps of retreat from their initial demands in a manner that, among other things, enables in effect a 1:1 exchange of concessions as both parties retreat from their basket of initial demands to the final solution.

Tietz (1972, 1982, 1997) formulates aspiration tiers that bargainers employ in conducting their retreats from initial positions to (when successful) an agreement. Tietz's conception of aspiration is not nominalist. However when actual bargainers formulate their aspiration tiers prominent numbers naturally they enter. A union for instance does not request a non-prominent percentage wage increase such as 3.7643% rise as its opening gambit, but rather a round number. Tietz is however explicit about the role of a prominent ratio appearing in the final step in achievement of agreement, namely that frequently in the final step there is an agreement on a fifty-fifty split of the difference between what the two parties offered in the preceding round.

3.8 Prominent Numbers

3.8.1 Historical Prominence

Decisive historical events lend prominence to some numbers and result in nominalist benchmarking. Eg typically the public has no precise notion of what prices were the previous week, month or year when inflation is mild and so operate for extended periods of time as if there were no inflation in their budget allocations and the resultant aggregate consumption flows, Johnston and Looker (1979). If however there is a change of currency, the public can remember prices vividly at the historically prominent date of the changeover. They benchmark inflation as the price increase since that changeover price number. The changeover date becomes progressively more distant.

This sort of nominalism has entered public perception of whether the Euro's introduction caused a price spurt. There indeed was such a spurt in the prices of some items. But the extent of the spurt and the range of items whose prices leapt (in those countries that failed to impose a price freeze) became exaggerated in people's perceptions, partly through a historical benchmarking form of nominalism. The public lacked comparable precision in their notions of how much prices had risen per week, year, triennium prior to the introduction of the Euro. Implicitly the public put that prior inflation rate number at zero in reaching their inference that the arrival of the Euro notes and coins has been inflationary. On Germany, see eg Brachinger (2006), and on other countries that introduced the Euro, see eg Cestari (2006), Marques (2006).

Memories tend to be short. In estimating inflation, this can lead to an overweighting of items more frequently paid for, since they will have been over-represented in the recent past out-payments. Even if memory is longer, in combining different prices together, people may weight their importance by how often they pay for such items, giving higher prominence to those for which historically they most often pay out money, not weighting items in proportion to their overall expenditure. Greater prominence to items paid for more frequently can be inferred from German perceptions of inflation, Brachinger (2006).

The benchmarking of inflation by the historically prominent numbers at the time of the Euro's introduction, and the over-weighting of frequently bought items in estimating inflation can be branded as cases of mistakes in the following sense. People seek to understand matters such as the introduction of the Euro and have less well understood its inflationary impact if they have inadvertently used misleading prominent numbers. If this caused enough anger, it could even upset macroeconomic management by undermining confidence in the Euro region, Brachinger (2006).

Some other usages of prominent numbers cannot so unambiguously be labelled as mistakes. Take cases when inflation is insufficiently prominent, and thus ignored. The historical benchmarks of prior price numbers may not be readily at hand. Provided that price changes do not show a dramatic systematic trend, there is evidence that firms look at prices in levels, not in rates of change, Pope (1981, 1985a, 1987). Firms however may do better not to

attempt to track small historical changes in inflation and project a continuation of these in formulating their own purchasing and price setting strategies. The costs of mistakes of overestimating any continuation of modest upward price trends may outweigh any benefits.

Historical rather than replacement cost accounting of inventories, equipment and buildings involves such nominalism. It economises on resources and when replacement costs can be transiently high as in a bubble, happen on occasion to serve the firm better than if it attempts to ascertain current prices. Of course, in high inflation eras, such nominalism can instead bankrupt the firm. In short, there is no facile rule of thumb, on when a nominalist heuristic is helpful, when damaging.

3.8.2 Prominence in the Numbers Themselves

Prominent numbers are those used more often than others. Which numbers are prominent depends (a) on culture, religion and scientific understanding as these determine which numbers are lucky, or sacred or have fiduciary power, (b) on the number system including whether it has a base of four, ten, or a unique reference value of the decision problem, and (c) on the range within which numerical responses are selected. The restriction of attention to prominent numbers and prominent ratios – ie ignoring other numbers and ratios – can yield constancies, propensities to hover around some numbers and ratios, and equilibria in systems unrelated to economic fundamentals.

From examining how participants used numbers in laboratory experiments, Albers (1998a) extended prominence theory to a theory of perception and evaluation of numerical responses when monetary amounts, probabilities and time is involved. He has devised a theory of the evaluation of lotteries, and a theory of fairness in two person conflicts. He and others have found experimental evidence supporting models within the framework of the Albers Prominence Theory. These explain some laboratory data better than prospect theory or standard game theory Albers (1998b, 2001), Keser and Vogt (2000). Futhermore Albers has located field evidence, the clustering of German stock market prices, Albers (2001).

Also in English-speaking countries, in lay usage, the prominence structure of responses predicted by the Albers Prominence Theory has been found to be widespread. A team from the universities of Nottingham and Birmingham, found that numbers in contingent market evaluations asked of the lay public exhibit choice of Albers prominent numbers, Whynes, Phillips and Frew (2005). Another team from the universities of East Anglia and Durham found that the tendency to choose the logarithmic Albers prominent numbers is more marked for health interventions and self-complete surveys than in face-to face interviews, Covey and Smith (2006). Joint work by the two teams, using questionnaires on students validated three key predictions of Albers' Prominence Theory, Whynes et al (2007).

4 Executive Summary

Decision makers need to evaluate alternatives. We have illustrated the difficulty of evaluation with the case of a firm that has decided to import an item for which it will have to

pay later a bill denominated in a foreign currency. The firm needs to anticipate the future exchange rate in order to decide whether to: 1) hedge; or 2) speculate; or 3) do nothing. This evaluation of its three alternatives is stage 2 in the four stages through which decision makers progress after encountering a problem. It is a stage that EUT, axiomatised expected utility theory, excludes, as traced in Part 2 of this paper. In Part 2 we also traced how, despite numerous efforts to find an evaluation principle complementary to EUT, including Savage's clarifying sure thing principle and his small worlds proposal, it has proven elusive to combine an evaluation stage with EUT. Prospect theory, and most other variants on EUT, likewise ignore stage 2.

This paper employed a consistent framework for integrating stage 2 into decision models, namely models within SKAT, the Stages of Knowledge Ahead Theory, Pope (1983, 1995) and Pope, Leitner and Leopold (2006). Within this theory, we could recognize the necessity for new decision models that incorporate the heuristics that economists themselves and others employ in performing stage 2. We have concentrated in this paper on nominalistic heuristics.

In Part 3 we have introduced this new theoretical construct of a nominalist heuristic and traced the use of nominalism in performing stage 2 by all decision makers, including academic economists. We illustrated with a focus on academic economists' analyses of exchange rate determination, noting the nominalist heuristic implicit in concepts of a real exchange rate and in theories such as that of an optimal currency area.

We showed that the matter is not one of nominal processes being avoided, because this is both impractical and contrary to the scientific spirit of abstracting in order to discern more major causal effects. As economists and psychologists, our job is rather to recognize the role of nominalist heuristics in *all* our analyses, whether descriptive or prescriptive. It is our task to discern when our own or other's nominalism is excessive for the purpose at hand, and should be replaced by a richer, less abstracted modelling of cause-effect chains.

In this paper we have pointed to evidence of excessive nominalism in academic economists' usage of real exchange rates in how it led to arguably erroneous economic advice concerning sectoral advantages from appreciations. We have also pointed to evidence of excessive nominalism in the form of optimal currency area theories, excessive as it has systematically and unintentionally biased economic advice on official variation in exchange rates to be of a beggar-thy-neighbour nature.

We have identified that nominal heuristics include prominent number ratios. If prominent number ratios enter exchange rate determination, this is essential to discern, since it constitutes an argument against the notion that multiple currencies beneficially equilibrate economic fundamentals. In a sequel paper, Pope et al (2009), we present field and experimental evidence that nominalist heuristics in the form of prominent number ratios do indeed affect exchange rates.

References

Albers, Wulf (2001), "Numerical Decision Processing Causing Stock Price Clustering", Homo Oeconomicus, 18 (2), 77-92.

Albers, Wulf, (1998a), "Foundations of a Theory of Prominence in the decimal System". Parts I-IV, Institute of Mathematical Economics, University of Bielefeld.

Albers, Wulf, (1998b), Prospect Theory and the Theory of Prominence as Solutions of the Same Stylised Facts., mimeo, Bielefeld

Allais, Maurice, (1952), 'Fondements d'une Théorie Positive des Choix Comportant un Risque et Critique des Postulats et Axiomes de L'Ecole Américaine', published in 1953 in *Econométrie*, 40, Colloques Internationaux du Centre National de la Recherche Scientifique, Paris, 127-140 and 257-332, translated into English as 'The Foundations of a Positive Theory of Choice Involving Risk and a Criticism of the Postulates and Axioms of the American School', in M. Allais and O. Hagen (eds), 1979, *Expected Utility Hypotheses and the Allais Paradox: Contemporary Discussions of Decisions under Uncertainty with Allais' Rejoinder,* Reidel, Dordrecht, 27-145.

Allais, Maurice, (1984), "The Foundations of the Theory of Utility and Risk. Some Central Points of the Discussions at the Oslo Conference", in O. Hagen and F. Wenstøp (eds), '*Progress in Utility and Risk Theory'*, Reidel, Dordrecht, 3-131.

Bell, David E., 1981, `Components of Risk Aversion', in J. Brans (ed.), Operational Research `81, North Holland, Amsterdam, 235-242.

Birnbaum, Michael H. and Juan B. Navarreté, 1998, "Testing Descriptive Utility Theories: "Violations of Stochastic Dominance and Cumulative Independence", *Journal of Risk and Uncertainty*, **17**, 49-78.

Black, Max, (1986), 'Some Questions About Bayesian Decision Theory', in L. Daboni, A. Montesano and M. Lines (eds), *Recent Developments in the Foundations of Utility and Risk Theory*, Reidel, Dordrecht, 57-66.

Borcherding, K. and D. von Winterfeldt, 1988. The effect of varying value trees on multiattribute evaluations. Acta Psychologica 68, 153-170.

Brachinger, Hans Wolfgang, (2006), "Euro or 'Teuro'?: The Euro-induced Perceived Inflation in Germany", DQE Working Papers 5, Department of Quantitative Economics, University of Freiburg/Fribourg Switzerland.

Brandstätter, E., G. Gigerenzer and R. Hertwig, 2006 The Priority Heuristic: Making Choices Without Trade-Offs. Psychological Review, 113, 409-432.

Camille, Nathalie, Giorgio Coricelli, Jerome Sallet, Pascale Pradat-Diehl, Jean-Rene Duhamel, Angela Sirigu, 2004, The Involvement of the Orbitofrontal Cortex in the Experience of Regret, Science, 304, 1167-1170.

Cestari, V, 2006: Memory of Prices and Inflation Perceptions: In the Case of the Changeover from the Lira to the Euro. IAREP – SABE Conference 5-8 July 2006 Paris, France

Conlisk, J., 1993. The Utility of Gambling. Journal of Risk and Uncertainty 6, 255-275.

Constantanides, George M, (1979) Multiperiod Consumption and Investment Behavior with Convex Transaction Costs. *Management Science*, 25(11), 1127-1137.

Constantanides, George M. (1986) Capital Market Equilibrium with Transaction costs. *The Journal of Political Economy*, 94(4), 842-862.

Covey, Judith and Richard D. Smith, (2006), How Common is the 'Prominence Effect' Additional Evidence to Whynes et al', Health Economics 15: 205-210.

Cyert, R. and J. March, (1963), The Behavioral Theory of the Firm, Prentice Hall.

Davidson, Paul (1984) "Reviving Keynes's revolution", Journal of Post Keynesian Economics, 4, 561-575.

Davidson, Paul (1988) "A technical definition of uncertainty and the long-run non-neutrality of money", Cambridge Journal of Economics, 12, 329-337.

Davidson, Paul (1991) "Is Probability Theory Relevant for Uncertainty? A Post Keynesian Perspective", Journal of Economic Perspectives, 5 (1), 129-143.

Davidson, Paul (1993), "The elephant and the butterfly – Or Hysteresis and Post Keynesian economics", Journal of Post Keynesian Economics, 15 (3), 309–322.

Davidson, Paul (1996) "Reality and economic theory", Journal of Post Keynesian Economics, 18 (4), 479-508.

Davidson, Paul (2008), "Is the current financial distress caused by the subprime mortgage crisis a Minsky moment? Or is it the result of attempting to securitize illiquid noncommercial mortgage loans?" *Journal of Post-Keynesian Economics*, 30 (4), 669-676

De Neufville, Richard and H. Munéra, (1983), "A Decision Analysis Model When the Substitution Principle is not Acceptable," in B. P. Stigum and F. Wenstøp, eds, Foundations of Utility and Risk Theory with Applications, , D. Reidel, Holland, 247-262.

Fehr, E; Tyran, J. R. (2001): Does Money Illusion Matter?. *American Economic Review*, 91, 1239-1262.

Fisher, Irving (1929): *The Money Illusion*

Friedman, Milton and L.J. Savage, 1952a, 'The Expected-Utility Hypothesis and the Measurability of Utility', *Journal of Political Economy*, **60** (6), 463-474.

Friedman, Milton, (1957), "*A Theory of the Consumption Function*" Princeton University Press, Princeton.

Friedman, Milton, and L.J. Savage, (1948), 'Utility Analysis of Choices Involving Risk', Journal of Political Economy, **56**(4), 279-304.

Grant, Simon and John Quiggin, 2008, Bounded rationality and small worlds, *mimeo*, Rice University and University of Queensland

Hagen, Ole, (1972), 'A New Axiomatization of Utility under Risk', *Teorie A Metoda*, **4** (2), 55-80.

Harsanyi, John C., 1977, *Rational Behavior and Bargaining Equilibrium in Games and Social Situations*, Cambridge University Press, New York.

Huber, Oswald, 1982, *Entscheiden als Problemloesen* (Making a decision as solving the Problem), Bern, Huber.

Inder, Brett and Terry O'Brien, 2003, The Endowment Effect and the Role of Uncertainty', *Bulletin of Economic Research*, **55** (3), 289-301.

Janis, Irving L. and Leon Mann, (1977), Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment, Free Press, New York.

Johnston, H.N. and J.C. Looker, (1979), "Comment on 'Household Saving and Consumption' by R. A. William", in Conference in Applied Economic Research, Reserve Bank of Australia, December.

Keser, Claudia, Bodo Vogt, 2000: Why Do Experimental Subjects Choose an Equilibrium which is Neither Payoff nor Risk Dominant? CHIRANO, Montreal 2000

Keynes, John Maynard, (1936): "The general Theory of Employment Interest and Money", New York, Harcourt, Brace.

Keynes, John Maynard, (1939): "Professor Tinbergen's Method", The Economic Journal, September, reprinted in 'The Collected Works of John Maynard Keynes', vol. 14, edited by D. Moggridge (1973), London, Macmillian

Klibanoff, Peter, Ozdenoren, Emre, 2007, "Subjective recursive expected utility", *Economic Theory*, 30 (1), 49-87.

Kreps, David M. and Evan L. Porteus (1978) 'Temporal Resolution of Uncertainty and Dynamic Choice Theory', Econometrica, 46 (1), 185-200.

Kreps, David M. and Evan L. Porteus, (1979) 'Temporal von Neumann-Morgenstern and Induced Preferences', Journal of Economic Theory, 20, 81-109.

Manne, Alan S. and A. Charnes, (1952), 'The Strong Independence Assumption--Gasoline Blends and Probability Mixtures', *Econometrica* **20** (4), 665-669.

Marques, J. F. (2006): Anchors Away? Price Knowledge and Anchoring Effects, IAREP – SABE Conference 5-8 July 2006 Paris, France

Mekvabishvili, Rati, 2006, Money Illusion and Coordination, mimeo, Nottingham University.
Mundell, R. (1961), "A Theory of Optimum Currency Areas," *American Economic Review*, Vol. 51, No. 4, 509-517.
Pascal, Blaise, 1670, *Pensées*, reprinted by Chez L Hachette, Paris, 1845.
Pope, R.E., 2001b 'Evidence of Deliberate Violations of Dominance due to Secondary Satisfactions — Attractions to Chance', *Homo Economicus* **XIV**(2) 47-76.
Pope, Robin E., 1981, *Revaluation: Help or Hindrance to Australian Manufacturing?* C.A.E.R. Paper No. 14, University of New South Wales, December, 1-84.
Pope, Robin (1983), "The Pre-Outcome Period and the Utility of Gambling", in B. Stigum and F. Wenstøp (eds), *Foundations of Utility and Risk Theory with Applications*, D. Reidel, Dordrecht, pp. 137–177.
Pope, Robin E., 1987, Revaluations: Help or Hindrance to Australian Manufacturing?". PhD Thesis, University of New South Wales, Sydney.
Pope, Robin (1988), The Bayesian Approach: Irreconcilable with Expected Utility Theory? in: B. Munier ed, Risk, Decision and Rationality, Reidel, 221-230
Pope, Robin (1991), 'The Delusion of Certainty in Savage's Sure-Thing Principle', *Journal of Economic Psychology,* 12 (2), June, 201-241.
Pope, Robin (1995), "Towards a More Precise Decision Framework, A Separation of the Negative Utility of Chance from Diminishing Marginal Utility and the Preference". *Theory and Decision*, 39 (3), pp. 241–265.
Pope, Robin (2000) "Reconciliation with the Utility of Chance by Elaborated Outcomes Destroys the Axiomatic Basis of Expected Utility Theory", Theory and Decision, 49, 223-234.
Pope, Robin (2004), "Biasses from Omitted Risk Effects in Standard Gamble Utilities", Journal of Health Economics, 25, 695–735.
Pope, Robin E., 1985a, "Revaluations: Help or Hindrance to Australian Manufacturers?", in W. F. Gossling, ed, *Western Pacific Trade*, Input-Output Publishing Company, Suffolk, 75-104.
Pope, Robin E., 1985b, "Timing Contradictions in von Neumann and Morgenstern's Axioms and in Savage's 'Sure-Thing' Proof", *Theory and Decision*, **18**, 229-261.
Pope, Robin E., 1996/7, 'Debates on the Utility of Chance: A Look Back to Move Forward', *Journal for Science of Research* (*Zeitschrift für Wissenschaftsforschung*), **11/12**, 43-92, reprinted in in J. Götschl ed, *On the Dynamics of Modern, Complex and Democratic Systems*, Theory and Decision Library, Series A: Philosophy and Methodology of the Social Sciences, Kluwer, Dordrecht, 273-351
Pope, Robin, 2008, Beggar Thy Neighbour: Exchange Rate Regime Misadvice from Misunderstandings of Mundell (1961), *World Economy*.
Pope, Robin and Reinhard Selten (2002): Local Manufacturing Hurt by Depreciations: A Theoretical Model reflecting the Australian Experience. *Pacific Economic Review,* 7(3), 403-464.
Pope, Robin, Reinhard Selten, Sebastian Kube and Jürgen von Hagen, 2008, "Experimental Evidence on the Benefits of Eliminating Exchange Rate Uncertainties and Why Expected Utility Theory causes Economists to Miss Them", *Indian Journal of Economics and Business* 7(1), 1-31.
Pope, Robin, Reinhard Selten, Sebastian Kube, and Jürgen von Hagen, 2009b, 'Prominent Numbers, Indices and Ratios in Exchange Rate Determination: Field and Laboratory Evidence'
Pope, Robin, Johannes Leitner and Ulrike Leopold-Wildburger (2006), The Knowledge Ahead Approach to Risk: Theory and Experimental Evidence, Springer Lecture Notes.
Pope, Robin, Johannes Leitner and Ulrike Leopold-Wildburger, 2009a "*Expected Utility versus Changes in Knowledge Ahead," European Journal of Operations Research*," 199 (3), 892-901.

Samuelson Paul (1952a), “Probability, Utility and the Independence Axiom”, Econometrica, 20, 670-678.

Samuelson, Paul, 1952b, letter to Wold mentioned in Wold 1952b.

Sauermann, H. and Selten, Reinhard, (1962), Anspruchsanpassungstheorie der Unternehmung (Aspiration-Adaptation Theory for the Firm), *Zeitschrift für die gesamte Staatswissenschaft* **118**, 577-97.

Savage, Leonard J., 1952, reply to Wold's rejoinder to Savage 1952a acknowledging the force of Wold's illustrative example and arguments, *Econometrica*, **20** (4), 664.

Savage, Leonard J., 1954 and 1972, *The Foundations of Statistics*, Wiley, New York.

Selten, Reinhard (1998), “Aspiration Adaptation Theory, Journal of Mathematical Psychology, 42, 191-214.

Shafir, Eldar, Peter Diamond and Amos Tversky, (1997), ‘Money Illusion’, Quarterly Journal of Economics 112 (2), 341-374.

Simon, Herbert A., (1955), "A Behavioral Model of Rational choice", *Quarterly Journal of Economics*, **69**, 99-118.

Simon, Herbert A., (1991), 'Problem Formulation and Alternative Generation in the Deciison Making Process, in A. Chikán (ed.), *Progress in Decision, Utility and Risk*, Kluwer, Dordrecht, 77-84.

Simon, Herbert A., (1993), *Models of My Life*, Basic Books, USA.

Smithies, Arthur, (1945), “Forecasting Postwar Demand: I”, in ‘Econometrica 13(1), 1-14.

Tietz, Reinhard (1972), ‘The Macroeconomic Experimental Game KRESKO – Experimental Design ands the Influence of Economic Knowledge on Decision Behavior’, in Heinz Sauermann ed, Contributions to Experimental Economics, volume 3, J.C.B. Mohr (Pasul Siebeck) Tübingen, 267-334.

Tietz, Reinhard, 1997, ‘Adaptation of Aspiration Levels – Theory and Experiment’, in Wulf Albers, Werner Güth, Peter Hammerstein, Benny Moldovanu, Eric van Damme eds, Understanding Strategic Interaction: Essays in Honor of Reinhard Selten, Springer.

Tietz, Reinhard, ed, (1982), Aspiration Levels in Bargaining and Economic Decision Making, Springer, Berlin.

Tversky, Amos and Daniel Kahneman, (1992) ‘Advances in Prospect Theory: Cumulative Representation of Uncertainty’, Journal of Risk and Uncertainty, 5, 297-323.

Von Neumann, John and Oskar Morgenstern, 1944, 1947, 1953 and 1972, *Theory of Games and Economic Behavior*, Princeton University Press, Princeton, New Jersey.

Walsh, Vivian (1996), Rationality, Allocation and Reproduction, Clarendon Press, Oxford.

Weber M. and Katrin Borcherding (1993), “Behavioral influences on weight judgments in multiattribute decision making”, *European Journal of Operational Research* 67, 1-12.

Whynes, David K., Zoë Philips, Emma Frew, (2005), “Think of a number *any* number?”, Health Economics Letter, 14, 1191 – 1195, published online 8 June in Wiley InterScience (www.interscience.wiley.com). DOI:10.1002/hec.1001.

Whynes, David K., Frew, Emma J., Philips, Zoë N., Covey, Judith, Smith, Rechard C., 2007, ‘On the Numerical form so contingent valuations responses’, Journal of Economic Psychology, 28 (4), 462-476.