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Abstract: "Rationality" is understood in the empirical sense of cognitive abilities of human brains for solving economic problems, and consequently recognized bounded in individually unequal ways. This is shown to require treating it as a unique scarce resource, used for deciding on its own uses. This uniqueness disturbs axiomatic economics by a tangled hierarchy, and implies that rationality-allocation can approach efficiency only by means of an institutionally shaped trial-and-error evolution. Applied to the markets vs. government issue, a comparative institutional analysis of rationality-allocation yields novel insights with non-standard policy implications, and thus demonstrates that rationality-allocation matters.

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1 Introduction

After the long time when nearly all economic theories were based on the idealizing assumption that all humans are perfectly rational, able to find optimal solutions to all their economic problems, however difficult, the pioneering work by Simon (1955, 1979) is increasingly bearing fruit. More and more economic theories now depart from this assumption, admitting that far from that perfect, human rationality is significantly bounded.[1]

But different theories depart differently far. Most of them limit attention to the rationality bounds of one typical human mind, without considering their possible individual differences, and thus only take the step from assuming everyone's rationality equally perfect to assuming it equally bounded. Less usual, although no longer entirely novel, is to recognize that human rationality is not only bounded, but moreover unequally so. Whether the inequalities stem from inborn talents ("nature") or from education and experience ("nurture"), the recognized fact is that the rationality of some individuals is bounded more, or differently, than the rationality of others.

This paper takes a third step: it shows that unequally bounded rationality must be treated as a scarce resource, but of a unique kind. Since rationality is needed for deciding on the uses of all scarce resources, it is also needed for deciding on its own uses. This uniqueness has important implications for both theory and policy. It disturbs all standard axiomatic theories of human capital and resource-allocation by a tangled hierarchy (Hofstadter, 1979), and implies that rationality-allocation can approach efficiency only by means of an trial-and-error evolution, and only if this is shaped by suitable institutions (in the sense of rules-constraints, or "rules-of-the-game").

Institutions thus turn out to have more effects on economies than usually considered, which increases their importance as factors of economic performance and growth, but also raises new problems for institutional economics. Applied to the markets vs. government issue, a comparative institutional analysis of rationality-allocation yields novel insights with non-standard policy implications, and thus demonstrates that rationality-allocation matters.

2 Unequally Bounded Rationality as a Unique Scarce Resource

To make it possible to take any of these steps, "rationality" must be defined in the empirical sense of actual cognitive abilities (competencies, "intelligence") of human brains – and not tautologically postulated perfect for everyone, regardless of how cognitively limited he or she

[1] Important examples are Sugden (1991), Holland (1995), Kahneman and Tversky (2000), and Vanberg (2004).

might be.[2]

DEFINITION 1. "Rationality" means the cognitive abilities of human brains for solving economic problems – that is, problems of how best to use given resources under given constraints for the pursuit of given objectives (preferences, objective function). It exists in different varieties, relevant to different kinds of economic problems – e.g., involving different types of resources, different time horizons, or different degrees of risk or uncertainty. A person's rationality is bounded if there are economic problems for which he/she is unable to find an optimal solution.[3] A person whose rationality relevant to a certain type of economic problems is less bounded than the rationality of another person will be said, for these problems, to be "more rational" and his/her rationality to be "higher."

What limits the uses of the tautological postulate is worth spelling out. To allow each person to be a perfectly rational optimizer, the trick is to include all of his/her cognitive limitations among the constraints of the optimizing (see, e.g., Boland, 1981). Everyone can then be said to be "perfectly rational" in the tautological sense of attaining a subjective optimum under these constrains, however severe they might be. But to do so may be reasonable only in one-person problems. When several individuals are involved – as is the case of all problems of resource-allocation in society – everyone can of course still be said to do *his* or *her* best, but this obscures the crucial fact that for the same objective function, the "best" of some individuals may be much better, or much worse, than the "best" of others.

A limitation of the present definition is that "rationality" means only a subset of the human cognitive abilities that may be said to belong to human rationality in a more general sense. But this subset is very special to economists. It is what most of their rationality debate has been about, and it is also perfection of at least a subset of these abilities that most of their theories need to assume. Note that this includes the theories of procedural rationality and rational irrationality: while they admit bounded rationality for certain economic problems, they assume perfect rationality for the highest-level problem of how best to use the bounded rationality at lower levels. In contrast, no such ultimate perfection is assumed here.

ASSUMPTION 1. Rationality of all varieties and all levels is both bounded and individually unequal.

Unequally bounded rationality raises the problem of its measuring. In principle, it

[2] The two ways of defining rationality correspond to Vanberg's (2004) distinction between refutable rationality hypotheses and the non-refutable rationality principle.

[3] As bounded rationality is sometimes confused with imperfect information about the state of the world, note that the two are here sharply distinguished: rationality only means the personal cognitive abilities to find, understand and use such information, but not the information itself. It is in the exploiting of the same imperfect information that some of the most important rationality differences often come to light.

could be measured by marking, in the entire set of the differently difficult problems that the agents of an economy might encounter, the subset of the sufficiently easy ones for which a given individual is able to find an optimal solution; or by estimating, for different problems of the entire set, the relative losses caused by the errors that the individual would likely commit if assigned to the task of solving them.

In practice, however, its measuring is limited to artificial experiments, intelligence tests, and problems in economic textbooks, which cannot yield more that rough and often not sufficiently relevant indications. For many real-world economic problems, especially the most complex ones, the relevant rationality cannot be objectively measured at all. It can only be subjectively estimated, with the risk of committing more or less large errors, on which, in a first approximation, it is reasonable to assume the following.

ASSUMPTION 2: The errors with which an individual's rationality is estimated depend on the rationality of the estimating individual: the more bounded this rationality, the larger the errors will likely be.

Importantly, this also includes the cases when individuals estimate their own rationality: those suffering from severe rationality bounds are likely to commit large errors also in such estimations, as they are typically unaware of how severe these bounds really are.[4]

It is sometimes important to consider that rationality can be improved by learning. Then, however, it is also important to consider that all learning requires pre-existing learning abilities, which limit what their owner can possibly learn in the most ideal learning environments. Note that this requirement is also valid for all meta-learning – the learning to learn – which requires corresponding meta-learning abilities. A simple recursive reasoning suffices to infer that all learning, regardless of the number of its meta-levels, must unfold from, and be ultimately limited by, some inborn learning abilities – commonly called "talents" – which must also be included among the cognitive abilities that may, and usually also do, differ across individuals. All this can be taken into account by splitting the rationality of each individual into *actual rationality*, which may vary over time by learning, and *talents*, determining the *potential rationality* that the individual could possibly attain in an ideal learning environment, which may be considered constant.[5]

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[4] In addition to casual observations of (and frequent irritation with) such individuals during personal encounters, their existence is now solidly documented in experimental psychology by Kruger and Dunning (1999), in their wittily titled article "Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessment." This evidence devalues all the standard models of allocation of abilities, including talents, that stand and fall with the assumption that all agents perfectly know the abilities of themselves.

[5] A deeper study of human cognitive abilities would moreover have to consider that learning is a path-dependent process during which some of the initially given talents may be neglected and lost, or even purposefully blocked

As the present argument will often omit to take the possibilities of rationality-learning into account, it is important to realize that this omission does not weaken any of its basic assumptions. Because of individual differences in talents, also rationality-learning remains ultimately bounded with different bounds for different individuals.[6] When talents are more important than actual rationality, the rationality endowments of individuals are even more difficult to estimate: recognizing talents requires indeed talents.

The presently taken third step of the departure from the perfect rationality assumption can now be clarified and justified. Unequally bounded rationality is a scarce resource because individuals possess it in different quantities and qualities, and both their personal achievements and the performance of the entire economy depend on its uses. This scarce resource is unique because it is needed for estimating its own states and for taking decisions on its own allocation and uses.

3 The Inescapable Incompleteness of Axiomatic Economics

Admitting rationality among scarce resources subverts all economic theories built as formal axiomatic systems, and thus also destroys what appears to be the dream of many mathematical economists: completely to master all the theoretically interesting and practically important problems of real-world economies by means of logically provable theorems derived from a limited set of axioms (postulates, assumptions). The reason is that the uniqueness of this resource causes in all such theories what Hofstadter (1979) calls "tangled hierarchy": a meta-mathematical difficulty related to the Gödel Theorem, which proves that no axiom-based theory can be both consistent and complete. While I have not yet found how to relate the uniqueness to the theorem formally, the intuition appears clear: axiomatic economics cannot be complete in the sense that it can consistently deal with *nearly* all kinds of scarcities, but – and this is its Gödelian blind spot – not with that of rationality, or, at least, as noted about the theories of procedural rationality and rational irrationality, with its highest level.

One illustration is human capital theory. In the standard classification of scarce resources, unequally bounded rationality is undoubtedly a kind of human capital. Like all the usual kinds, it is tied to individuals, who cannot obtain it by direct communication, but can

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– e.g., by ideological or religious conditioning ("brain-washing"). This would make it necessary further to distinguish the constant inborn talents from the actual state of learning abilities, which vary over time in function of the entire series of past inputs by which the inborn talents have been developed, or neglected, or blocked.

[6] Note that contrary to the wishful popular belief, learning is thus no reliable way of decreasing cognitive inequalities. Because of individual differences in talents, it may on the contrary increase them. The only way to decrease them is hindering the more talented individuals from learning more than the less talented ones, which would cause (and in some countries apparently has caused) enormous social losses.

only improve it by own learning from costly education and experience. This makes is legitimate to ask about it the key question of the theory: How much to invest in its learning?

It is only as long as the theory is incomplete by admitting the scarcity of *nearly* all kinds of human capital, but not that of rationality, that it can be consistent. All individuals can be assumed to use their abundant rationality for making optimal investment decisions in improvements of their currently imperfect human capital, given all the relevant costs and benefits of such investments over time. But attempts to make the theory complete by also admitting scarcity of rationality destroy its consistency: rationality is the kind of human capital that is needed for all investment decisions, including those on investing in human capital. The tangled hierarchy is easy to see: a little-rational investor who wants to optimize her *present* investment in improving her rationality may need much of the improved rationality that she is only considering to acquire *in the future* – for instance, by paying for studies of human capital theory.

But note that regarding rationality as a kind of human capital is nevertheless instructive. This makes it clear that in spite of its uniqueness in economics, it is only one among many kinds of human abilities and talents, with which individuals may be differently endowed. Moreover, as often appears to be the case, the different kinds may be far from correlated – for instance, highly talented sportsmen rarely appear to be highly talented musicians and both rarely appear to be highly talented (rational) investors. To see that the talent for becoming a highly rational economic agent is only one among many other human talents is useful for not overestimating its value. On the other hand, however, economic analysis of the allocation of talents, not to be misleading, cannot ignore how unique this talent is: it is needed for recognizing the value of *all* talents (including itself), investing in their development, and putting them to social uses.[7]

For present puposes, however, the most important is the case of axiomatic resource-allocation theories. Admitting rationality among scarce resources destroys there the conceptual barrier between the sphere of agents and the sphere of resources. To be consistent, these theories need to assume that the agents keep their initially given positions, use their assumedly abundant rationality for conducting economic calculus, and take decisions on the allocation of the resources, which then move around and are allocated to different uses

[7] Note that this puts in doubt all the standard models of allocation of talents, in which this special position of talents for economic decision-making is not recognized. An example is their prototype in Murphy, Shleifer and Vishny (1991) with the remarkable conclusion that using talents in engineering is more productive than using them in investment speculation. This conclusion misses the crucial point that engineers must know which of their many technically feasible projects are also economically sound, and that speculation on financial markets is an essential ingredient of what will be shown below to be the best feasible ways of finding this out.

according to these decisions. Intuitively, one may think of the barrier between the players of a game of cards and the cards.

The theories need this barrier to proceed in a consistent way from the agents' decisions to the allocation of resources. When this barrier is destroyed, rationality spreads into the sphere of scarce resources, where its differently bounded individual endowments pose the problem of their allocation to efficient uses, while scarcity spreads into the sphere of agents, as agents endowed with differently bounded rationality are differently scarce. Instead of keeping their positions, they may have to move to different uses, much like any other scarce resource. The game-of-cards comparison makes the tangled hierarchy particularly clear: this forces the players to became themselves cards of different values, and to include themselves among the cards with which they play.

This substantially increases the number of the unknowns that resource-allocation must determine. On top of the usual allocations of given resources to given investors and given producers through a given structure of markets and hierarchies, it must now also determine how this structure with all its individual jobs will be formed, and how the design of the jobs and the rationality of the individuals assigned to them will mutually be adjusted.

To be efficient, resource-allocation must therefore meet many more conditions. They include avoiding two opposite inefficiencies: assigning some highly rational individuals to too easy jobs, and thus wasting their scarce high rationality; and selecting insufficiently rational individuals for too difficult jobs – or, in Heiner's (1983) words, creating "competence-difficulty gaps" – and thus wasting resources because of the costly errors that these individuals are bound to commit.

Why the standard theories of mechanism-design and job-assignment cannot help is that each addresses only one half of the job-designing-and-assigning problem, while wishfully assuming an efficient solution of the other half together with the presence of at least one perfectly rational top agent. The job-assignment theories admit that the agents to be assigned to jobs are of different abilities, which may indeed include differently bounded rationality, but assume that the jobs have already been optimally designed and that there is at least one perfectly rational job-assigner. The mechanism-design theories are even more simplified, as they assume perfect rationality of everyone. In addition to a perfectly rational mechanism-designer, able to design an optimal network of jobs for all agents, they also assume all these agents to be perfectly rational, as no constraint on how difficult their jobs might be is taken into account. The tangled hierarchy that mars all attempts to put both job-designing and job-assigning into one consistent axiomatic theory is that the very jobs of job-designing and job-

assigning must also be included among the jobs to be designed by, and assigned to, differently rational individuals.

An additional difficulty appears in the dynamics of the possible ways towards efficiency: unequally rational individuals generate less thrust for moving from less efficient to more efficient allocations than the perfectly rational agents of standard theory, who always see and exploit all opportunities for efficiency-increasing transactions. In some inefficient rationality allocations the thrust may be zero, so that the inefficiency is perpetuated, or even negative, so that it will grow. This can happen if the rationality relevant to obtaining top jobs is not closely correlated with the one relevant to functioning in them. Individuals of low relevant rationality can then gain and retain key jobs from which they can keep misallocating the higher rationality of other agents.[8]

But even in the best case, rationality-allocation cannot be expected to move towards an efficient state straightforwardly. As it is made of steps taken by more or less boundedly rational individuals, many of these steps may be efficiency-decreasing errors that need to be discovered and corrected, while the possibly much fewer efficiency-increasing steps need to be recognized and selected. In other words, efficiency of rationality-allocation cannot be approached in any other way than by a time-consuming trial-and-error evolutionary process.

The multitude of ways that this process might possibly take raises the problem of its control: how to guide (shape) it, to make it take the one that would relatively best approach efficiency, or at least keep safely far from the worst inefficiencies? The difficulty is that standard control theory, which solves control problems by assuming a specific controlling agent and determining his optimal conduct is also of little use. Namely, it cannot be known in advance which of the economy's agents, if any, would be so highly rational as to be able to control this process reasonably well, let alone optimally. This leaves only one possibility: if the control cannot be entrusted to any a priori chosen person(s), its tools must be sought among impersonal institutions in the modern sense of rules-constraints ("rules of the game").

4 New Tasks for New Institutional Economics

"Institutions" defined as humanly devised constraints ("rules of the game") that shape human interactions, consisting of formal laws and informal social norms – and sharply distinguished

[8] Many insiders of the late socialist economies agree that that such rationality misallocations were a major reason why these economies had to collapse. For an excellent satirical description of a similar situation in a large private firm, see, in the classical book by Parkinson (1956), the chapter on "Injelitis" – an organizational disease caused by a combination of incompetence and jealousy that gets hold of the top management. But, as found below, similar situations are both more likely to occur and longer to last in government organizations.

from "organizations" as sets of individuals playing the game – have been in the center of new institutional economics following North (1990). In its actual state, however, this economics is not well prepared to deal with problems of rationality-allocation. In most of it, rationality is assumed equally perfect or equally bounded, both of which leave these problems aside.[9] Moreover, most of its attention has been limited to the impact of institutions on incentives, in particular transaction costs. These effects are undoubtedly important, as incentives strongly influence all economic processes, including rationality-allocation. But institutions also have many other, more specific effects on this allocation, which also need to be studied.

To identify these effects, it appears fruitful to split the inevitably trial-and-error rationality-allocation into the two basic types of steps: (A) generation of imperfectly informed, and therefore possibly erroneous (inefficient) "trials"; and (B) elimination of the committed "errors." The trials mean tentative designs of differently difficult jobs and their tentative assignments to differently rational individuals – including, as noted, the jobs of job-designing and job-assigning themselves. The errors mean those of the actually made trials that decrease efficiency in one of the two above-mentioned ways, and thus cause actual and/or opportunity losses – in contrast to the gains of efficiency-increasing successes.

A problem is that many individual trials are taking place within organizations – such as firms and government agencies – on which the economy's institutions may only have indirect effects. The trials-and-errors of rationality-allocation therefore need to be decomposed into at least two levels – inter-organization and intra-organization – with three key points to note.

(1) The performance of each organization strongly depends on its internal rationality-allocation, in which key roles are played by the rationality of certain top members – such as entrepreneurs, managers, and investors.

(2) The direct effects of the economy's institutions on the inter-organization level – e.g., through competition and bankruptcy laws – imply more or less hard constraints on the intra-organization level: the softer these constraints, the more inefficient the internal rationality-allocation within organizations may become.

(3) Some of the economy's institutions may moreover constrain the permissible variety of internal institutions of organizations – for instance, a corporate law may constrain the

[9] North (2005) and Eggertsson (2005) are important recent examples of institutional analysis where limitations of human cognition are considered. But these are only the limitations of different *political* actors on whom the form of institutions depend, and who are admitted to have mistaken mental models of what effects different institutions really have. These limitations are then seen to be a major reason why institutions may evolve towards, or remain blocked in, imperfect states. This leaves aside the rationality limitations of different *economic* actors, and the question of how different institutions are able to cope with the economic problems raised by *these* limitations. Yet the mistaken mental models cannot be corrected without this answer.

permissible variety of forms of corporate governance – and thus influence the internal rationality-allocation more directly.

How institutions shape the inter-organization rationality-allocation can roughly be described as follows. By effects A, they shape the generation of trials by more or less allowing or forbidding, and more or less encouraging or discouraging, the forming and developing of firms and other organizations. The institutions that do so include forms of property rights, entry regulations, tax law, and labor law. By effects B, they shape the elimination of errors by more or less rapidly and more or less sharply forcing underperforming (absolutely or relatively inefficient) organizations to reorganize or dissolve. The institutions that do so include competition law, bankruptcy law, and the formal and informal constraints on government possibilities to subsidize such organizations. But these examples are far from exhaustive; most institutions, both formal and informal, have more or less strong effects on both A and B.

A small but interesting increase of the powers of comparative institutional analysis immediately follows. Some important, but previously little noted merits and demerits of alternative institutions can be disclosed by simply comparing them for effects A, the variety of the trials that they allow and encourage to be generated, and for effects B, the precision and the speed with which they force the errors committed to be eliminated. As it is advantageous not to miss highly successful trials, some of which may be very rare, nor to leave wasteful errors uncorrected for a long time, it is possible to conclude, subject to certain qualifications, that institutions X are superior to institutions Y if they allow and encourage a greater variety of trials and enforce a sharper and faster elimination of errors.[10]

The problem of individual rationality-allocation can be brought in by considering that both the generation of trials and the elimination errors are run by specific individuals in specific jobs, of which some are much more important than others – such as those of innovators, entrepreneurs and investors. While the availability of relevant information is always limited, so that many trials can never avoid to be errors, the trials have more chance to succeed, and the relatively fewer errors have more chance to be rapidly discovered and eliminated, if the most important jobs are assigned to individuals with higher relevant rationality rather than lower. Namely, such individuals are better at discovering and using

[10] Applications of this simple analysis are in Pelikan (1988, 1992). They proved to be more informative about the weaknesses of different forms of socialism and the then widely admired Japanese industrial policies than the more complex mathematical models of that time, which were on the contrary proving that both could be optimal. That a simple analysis may be more informative than an artificially complex one is also illustrated by the findings of the strong correlation between growth and economic freedom, surveyed in Berggren (2003), which compares institutions only for a subset of effects A.

whatever limited information might be available. But, as even they may overestimate themselves, another important question about effects B is: how reliably can different institutions prevent lasting competence-difficulty gaps, in which such individuals let the complexity of their jobs exceed even their high rationality?

All this makes it clear that institutional economics is indeed *the* economics for handling the tangled hierarchy of rationality-allocation. But it also clearly appears that, to be up to this task, this economics must substantially extend its research agenda, to comprehend all the effects that different institutions may have on the trial-and-error selection processes of this allocation, both among and within organizations.

This, of course, is a tall order. Much time and effort will be needed before all these effects can be comprehensively identified and properly analyzed. What this paper may offer is only a rough indication of how to proceed, and a rough illustration of what outcomes such analysis may be expected to yield. This will be done by using a very elementary and far from comprehensive form of such an analysis to address a long-standing, still controversial issue.

5 Rationality-Allocation by Markets and by Government

There are several reasons why the markets vs. government issue is still controversial. Some are due to differences in ideologies, values, and even emotions: many people, including economists, appear to have much stronger feelings for one of the protagonists than for the other. But mistaken mental models and false beliefs about the true effects of both still also abound. While economic analysis has learnt much from its old failures to foresee even such major events as the collapse of European socialist economies and the deep structural crisis of Japanese economy, and has extensively compared markets and government for many of their aspects, it still leaves several questions of this comparison without answers – or can give them contradictory answers, depending on the initial assumption that it often too generously allows each analyst to choose.

Considering that all the so far analyzed aspects may be classified into "incentives," "information," and "knowledge," the present contribution can be described as adding "rationality." The question then is: what more can be learnt about the two protagonists by comparing their ways of allocating this unique scarce resource?

Much of this comparison must be divided into two branches: one for the economy's production side and one for its final consumption side. Namely, the two substantially differ in two respects: in the constraints under which they may allow rationality-allocation to work,

and in their dependence on value judgments.

Assuming a minimum of humaneness, the final consumption side constrains rationality-allocation by requiring that all individuals, regardless of their rationality differences, remain final consumers. This excludes the full-fledged Darwinian selection by which little-rational individuals would purposefully be starved to death. Changes in rationality-allocation must therefore be limited to individual learning by the differently rational consumers, helped by the information that they have the right to receive and/or search for, under the constraints of their unequal learning talents (potential rationality).

On the production side, in contrast, rationality-allocation can work much more freely: a great variety of differently difficult jobs can be there designed and redesigned or abolished, including the births and deaths of entire firms, and the differently rational individuals can be promoted to, or demoted from, all of them, without having to die.

Concerning value judgments, the crucial difference is that virtually all of them can be concentrated on the final consumption side, and thus make the comparison on the production side largely value-free. All that needs to be done is to make the formulation of the final demand *complete*, putting there all that the final consumers might individually and collectively demand from production – including demands for job creation, working conditions, and nature protection. The rationality-allocation within the production sector then has the value-free task of most efficiently (least wastefully) using the scarce rationality available – which includes avoiding the two above-mentioned types of inefficiencies – for meeting such a complete final demand, whatever this might be.

For the present elementary analysis, the institutional alternatives compared must be highly stylized – although, as considered below, they are more relevant to real-word economies are than may seem to be.

DEFINITION 2. The market alternatives are "primitive capitalism" (PC) and "financial capitalism" (FC) on the production side, and "individual consumption choices" (ICC) on the final consumption side. The government alternative is "democratic government" (DG) on both sides.

With the exception of ICC, under which everyone remains a final consumer, each alternative implies a subset of key jobs to which it will be possible to limit attention. How rationality is allocated to them will imply all that is necessary to know, for an unbiased comparison of the alternatives, about its allocation over the entire production side. It is indeed an advantage of comparative analysis that it may not be very precise about the absolute performance of each alternative: much imprecision may be tolerated as long as the relative

ranking of the alternatives remains unbiased.

DEFINITION 3. On the production side, the key jobs are always "entrepreneurs" and "investors." The former are defined as more or less rational bearers of projects which they try to realize by forming or reforming enterprises, where they start to design and assign other jobs (including, and possibly also stopping with, their own jobs). This sets the directions in which the intra-organization rationality-allocation will unfold. The investors are defined as more or less rational guardians of available capital, who decide on its allocation to specific entrepreneurs, and thus assign, and constrain the design of, the entrepreneurial jobs.

The alternatives differ as follows. PC requires the entrepreneurs to be their own investors, and makes their capital directly depend on the performance of their enterprises on product markets. FC makes it possible to separate the two jobs by allowing the entrepreneurs to compete for capital on financial markets, and the investors to select among the competing entrepreneurs those whom they entrust with their capital. It is still possible, but no longer necessary, that the same individual is assigned to both these jobs, thus acting as an investor who allocates a more or less large part of her capital to herself as an entrepreneur. The capital of the entrepreneurs depends both on their performance on product markets and on the decisions of their investors. The capital of the investors will grow or decrease in function of the performance of the entrepreneurs they have selected. Under both PC and FC, the investors are also the actual owners of the capital.

Under DG, the capital is owned collectively by all citizens, and the government investors are only its democratically elected more or less rational guardians. But much like their private counterparts, they decide on its allocation to government entrepreneurs, who are again more or less rational bearers of projects that they try to realize by creating government enterprises, where they start designing and assigning other jobs. Here, however, the term "government enterprises" must understood more broadly, including not only production firms, but also all the government bureaucracies that influence, in more or less rational ways, the output of the production side. Even such bureaucracies are seen to have their entrepreneurs and investors: the former are the politically selected top bureaucrats who started to organize them according to certain political projects, and the latter are the democratically elected politicians deciding on their budgets. While the output of government enterprises may or may not be exposed to market competition, the main feature of DG is to keep their capital, and therefore also all their gains and losses, collectively owned by all the citizens.

What makes these stylized alternatives relevant to the real world – although none of them is anywhere used in a pure form – is that the production sides of all economies can be

seen to combine, in different proportions, all three of them. PC, FC, and DG usually have more or less large sectors of their own, where rationality-allocation is shaped by their respective institutions. Their comparison may therefore usefully indicate what the relative performance of the three sectors will likely be, and thus what the economy stands to gain or lose by changing their relative sizes – e.g., by privatizing or nationalizing firms, or by increasing or restricting the room for financial markets.

DEFINITION 4. On the final consumption side, ICC accords all the individuals the right to decide, under their budgetary constraints, on their own consumption, and only on this consumption. Under DG, the key jobs are "government consumption experts," assigned and constrained by democratically elected politicians in the same way as the jobs of government entrepreneurs on the production side.

Note that the entrepreneurs of voluntary consumer cooperatives, where some decisions on others' consumption are also taken, are seen to belong to the production side, on a par with entrepreneurs in the retail business and consumer information. Note also that the government consumption experts must always decide on the consumption of public goods. The main task for comparative analysis is to see how rational they may be for helping the differently rational individuals with decisions on private consumption.

6 An Elementary Comparative Analysis

For all the main points of the present elementary analysis, the good old verbal logic suffices, and even appears best. But the readers who like mathematics will find the analysis illustrated by a simple mathematical model in the Appendix. Why the model is not in the center is that its strong simplifications and lack of quantitative realism, which I found necessary to accept, appear easy to misinterpret as weaknesses of the entire argument. Verbal logic can build on a broader and more plausible basis, and thus make the agument stronger.

ASSUMPTION 3. The rationality distribution over the economy's individuals is roughly normal (“the bell curve”), similar to the known distributions of most of human abilities: highest at “the average,” and dropping down to very few “economic champions” and very few “economic morons” in the tails.

But the precise shape of this distribution is not very important. The institutional alternatives are only to be compared, and not individually examined in any specific real-world situation. The distribution only serves as a test of their abilities to cope with rationality inequalities, and may thus be chosen quite freely: it must only be difficult enough not to let

poorly able institutions appear successful – which "roughly normal" distributions indeed are.[11]

As follows from Assumption 2, the individuals may know this distribution only imperfectly, the more imperfectly, the less rational they are, and they may not even know their own rationality. The few who may know it are not known to most of the others, and many more may believe to know it, but are mistaken – e.g., many may believe to be best, but only very few may be right.[12]

ASSUMPTION 4. Assume that the rationality distribution over the candidates for all the key jobs is also roughly normal, like the one over the entire population.

Also this distribution only needs to submit the rationality-allocation abilities of the alternatives to a sufficiently difficult test, without having to be very realistic. The assumed distribution does so, and moreover facilitates analysis.

On the production side, PC, FC, and DG are thus to be compared for how they shape the rationality-allocation to the investors and the entrepreneurs, and for what ultimate impact they will thus have on the performance of the economy's production. On the final consumption side, the rationality of the government consumption experts is to be compared with the rationality of all individual consumers, to assess how positively or negatively they may be able to influence the final consumption.

Time is important, especially on the production side. As will be found out, the ranking of PC, FC, and DG in the short run will substantially differ from their ranking in the long run. The final consumption side is more tranquil: all individual consumers stay put, possibly learning to increase their actual rationality up to its maximum potential level, and the relative rationality of the government consumption experts will turn out also to remain rather stable.

Discrete time will suffice (and may be the only one analytically manageable): the outcome of a long period will be understood as accumulating the outcomes of a series of short periods.

Following Assumption 4, the rationality-allocation on the production side always begins with an equal distribution of the economy's initial capital among the entire population, or a random sample of it. The initial inefficiency is that too much capital is in the hands of

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[11] It is the commonsense logic of technical engineers that only sufficiently difficult tests can reveal weaknesses of tested objects. But it may appear foreign in economics, where the habit of assuming easy conditions has been widespread. For instance, under the usually assumed flat distribution of rationality – be this perfect or bounded – all weaknesses of institutions in their coping with rationality inequalities are bound to remain hidden.

[12] When it is recognized that people tend to overestimate their abilities, as is now often done in management literature, the very few who do not, but are irritatingly right that their abilities *are* exceptionally high, are often ignored (might it be that the theorists envy them?). Yet, as will become clear below, it is they who deserve the greatest attention: to find them and give them the opportunities and the incentives to make a socially efficient use of their exceptional leadership is a prerequisite for the success of any economy.

little-rational investors and too little in the hands of the most rational ones, so that the economy initially performs less well than what its capital would allow it to do.

Each period starts with a certain rationality allocation to the investors, who will influence, through their investment choices, the rationality of the entrepreneurs, who will realize, in function of this rationality, certain capital gains or losses. The institutions will then imply how these gains and losses will be divided among the investors, and thus how the capital of each investor will increase or shrink, and how the rationality with which the capital is allocated will consequently be modified for the next period. The efficiency of this allocation, and thereby the performance of the entire production, will increase if the capital of highly rational investors increases, and the one of little-rational investors shrinks.

A complication that may appear annoying, but in fact proves helpful, is that none of the relations involved is strictly deterministic, but may strongly depend on chance. Good luck may allow a little-rational investor to select a highly rational entrepreneur, while this may have bad luck, and the enterprise may perform poorly. Why this complication does not harm the present argument is that most of such chance can be neutralized by double averaging, over both enterprises and time. It must only be kept in mind that what the entrepreneurs and the investors of a certain rationality will be found to achieve during one period concerns their average performance during an average period.

What helps rationality in the long run to prevail over chance is the asymmetry with which chance may affect little-rational and highly rational individuals. Bad luck can lastingly demote even the most rational individual, but good luck can seldom make a little-rational one successful more than temporarily. Thus, if the assignments to the key jobs depend on actual performance, not all of the most rational individuals are guaranteed to succeed, but all the insufficiently rational ones are sooner or later bound to fail.

Why chance proves helpful is that it can be averaged out only in the direction from rationality to performance, which is needed to allow the present analysis to proceed, but keeps disturbing the direction from individual performance to individual rationality, which is needed to preserve Assumption 2. Clearly, if the performance of each enterprise were a deterministic function of its entrepreneur's rationality, it could be easily inferred from observations of the performance, which would make the assumption hard to maintain. What requires high rationality, and thus preserves the assumption, is the usually high difficulty of distilling in each single case the merits of rationality from the sea of raw data influenced by chance. As noted, this difficulty further increases if estimating the talents of entrepreneurs and investors matters more, as it usually does, than estimating their actual rationality.

To make it possible to reach clear-cut results about FC and DG, Assumption 2 must be sharpened. This appears plausible to do as follows.

RECOGNIZING-RATIONALITY-BY-RATIONALITY (RRR) ASSUMPTION. When estimating the rationality of others, individuals safely recognize, and can therefore avoid choosing, all those whose rationality is lower than theirs, but are unable fully to appreciate the possibly subtle differences between their rationality and all the higher rationality, and may moreover have irrelevant prejudices that make them underestimate the rationality of a more or less large subset of such equally or more rational individuals. They may count in this subset themselves, if their prejudices include an inferiority complex.[13]

This assumption has the following consequence.

THE RATIONALITY-BOOSTING-BY-VOTING (RBV) THEOREM. Consider a set of voters and a set of candidates from which the voters are electing a subset. If the rationality distribution is the same over both sets, if each voter has an equal number of votes, and if it is rational for the voters to vote for the most rational candidates, then the average rationality of the elected candidates will somewhat exceed the average rationality of the voters.[14]

The proof is trivial. In the worst case, the least rational voters vote irrelevantly (randomly), and will thus in average vote for candidates of the average rationality. But the more rational the voters, the more their voting will be biased in favour of above-the-average-rational candidates. When all the votes are counted, the average rationality of the elected candidates will therefore be somewhat higher than the average rationality of the voters.[15]

The main lessons for the present analysis can be summarized in two points: (1) Voting has rationality-boosting effects, but only modest: while far from selecting the worst, it also remains far from selecting the best. (2) The more rational the voters – or, alternatively, the more votes are given to more rational voters and the fewer to less rational ones – the more

[13] While Assumption 2 is hardly controversial, details of RRR-Assumption may be. But virtually all of the colleagues and students who judged this assumption found it plausible. Moreover, even if some of its details had to be softened, the results of the following analysis would be little affected.

[14] A frequent objection against the RBV-theorem has been that people often vote not for the most rational candidates, but for candidates with all kinds of other, less relevant properties. But, provided that in the given voting, it is rational for the voters to vote for the most rational candidates, then using other criteria is only a sign of their own low rationality, which leaves the principle intact. Professor Mueller pointed to me that the RBV theorem is a kin of the Condorcet Jury theorem (Mueller, 2003), although not very close: while this theorem also assumes bounded rationality, as it expects all voters to make mistakes, this is equally bounded rationality, as it assumes the probability of doing so to be the same for everyone.

[15] Rationality analysis is thus more optimistic about democracy than Hayek (1944), who accused it of selecting the worst. But this optimism is subject to two qualifications. First, the rationality distribution over the candidates might be inferior to the one over the electorate, so that the elected candidates would be, in average, only somewhat more rational than the other candidates, but not necessarily the voters. Second – and this involves links to more traditional Public Choice arguments, on which more below – the candidates might be just ruthless rent-seekers, so that the most rational ones would indeed be the worst.

rational the elected candidates will be.

On the production side, where DG is to be compared with PC and FC, analysis can be conducted as follows. What matters most in the short run are the differences in the uses of the RBV theorem. PC does not use it at: as the investors and the entrepreneurs are there the same persons, the average rationality of both is the same. FC uses it at least once, when private investors are choosing private entrepreneurs. DG uses it at least twice, when voters are electing politicians, and when these are choosing government entrepreneurs.

To be sure, neither FC nor DG imposes a sharp limit to how many times the RBV theorem can be used. FC may use it more than once, by allowing markets for possibly several levels of financial intermediaries, such as investment banks, holding companies, and mutual funds. DG may use it more than twice, by adding between the elected politicians and the government entrepreneurs possibly several levels of expert committees and sub-committees. But this theorem is nevertheless likely to be used more times by DG than by FC, at least initially: financial markets, even when institutions define for them the widest space, need long time to emerge, develop and actually fill this space, whereas government expert committees can be established and convoked virtually overnight. Considering that FC uses it once and DG twice is a stylized expression of this difference.

What matter most in the long run are the differences in the allocation of the resulting gains and losses. Both PC and FC allocate them to the specific investors of the enterprises that have realized them. Thus, the more an enterprise gains, the more the capital of its investors will increase, and vice versa. As the gain depends on the rationality of the investors – under PC directly, as they are also the entrepreneurs, and under FC indirectly, through the rationality with which they select (or at least approve of) the entrepreneurs – rationality allocation will after each period move towards efficiency: the capital that is controlled with high rationality will grow, while the one that is controlled with low rationality will shrink. In contrast, DG keeps allocating all the capital gains and losses equally among all the citizens – in order to maintain, as it is obliged to do, the ultimate ownership of capital equally distributed – so that the rationality allocation to the control of capital will remain stationary.

On the final consumption side, DG remains to be the way of rationality-allocation to the government consumption experts, to be compared with the rationality of all individual consumers. The comparative analysis is thus much simpler for this side than for the production side: the rationality-allocation under both institutional alternatives remains stationary – at least, if rationality-learning is taken into account, in terms of potential rationality (talents).

7 The Results

On the production side, the results can be summarized as follows. PC starts worst. In the short run, under the plausible assumption that positive returns require entrepreneurs of an above-the-average relevant rationality, most of the initial entrepreneurs-investors will keep losing capital, so that the total capital of the economy will start by shrinking. But, as the insufficiently rational ones will have less and less to lose – their organizations will sooner or later go bust – their negative contributions to the economy's capital will taper off, while the positive contributions of the sufficiently rational investors-entrepreneurs are increasing and will eventually prevail. Moreover, as the capital of the most rational ones will in average be increasing faster than the capital of the others, the control of the economy's capital will tend to move towards the minority of the relevantly most rational individuals, or, more precisely, to that subset of theirs who have not been eliminated by bad luck. In the long run, the economy's growth rate will reach the maximum that its for capital ownership most rational individuals are able to achieve – but this may take long time indeed.

The long-term result of PC is trivial. It only corroborates the old arguments by Alchian (1950), Friedman (1953) and Winter (1971) that evolution by market competition selects for firms maximizing expected returns – that is, organized and run with the highest rationality – so that a highly developed market will eventually contain only such firms. The short-term result is more interesting: it suggests a new solution to the puzzle of why the growth of virtually all new market economies has followed the well-known J-curve: first dipping down (to the great joy of market opponents), and only with a more or less long delay gradually turning upwards: many emerging markets in such economies were indeed initially scourged by large numbers of little-rational investors-entrepreneurs who grossly overestimated their rationality.

FC starts a little better. While the initial average rationality of the investors is again assumed identical to the one of the entire population, the use of the RBV theorem somewhat improves the initial rationality of the entrepreneurs, so that the initial capital losses will be lower. But they may still be large enough to cause a negative growth of the economy, which may therefore again follow the J-curve. But the dip of this J will not be as deep and the upturn will come sooner. In a sense, however, FC cannot beat PC. They both converge to having all the economy's capital controlled by a subset of the minority of individuals with the highest relevant rationality available. FC only converges to this state faster and at lower

social costs: the number of insufficiently rational entrepreneurs, the length of their tenure, and their opportunities to waste capital, are all in average smaller under FC than under PC.

Note that the social value of financial markets is thus revealed to be much higher than usually believed. In addition to their usually considered function of allocating investment, they are found also to accelerate the selection of relevantly rational entrepreneurs and investors. Moreover, they offer the less rational investor opportunities for having her capital fructified by more rational entrepreneurs. Flock behavior and speculation bubbles, often accused of harming efficiency, prove on the contrary to promote it: as it is typically more rational investors who lead such flocks, and therefore gain more control over capital, and less rational ones who trail behind, and therefore lose this control, the efficiency of rationality allocation is indeed increased.

Concerning DG, it has the initial advantage of more uses of the RBV theorem, which allows it to start best. If the population's average rationality is sufficiently high, the average rationality of government entrepreneurs may rapidly exceed the threshold of positive returns, and the economy may thus start with a positive growth. In the long run, however, this initial advantage is of little help. The lasting scourge of DG is that the average rationality of the ultimate capital investors must remain to be the population's average rationality, which can only modestly be improved by everyone's learning, constrained by the unequally distributed learning talents. Thus, even with all the extra bits by which the average rationality of the government entrepreneurs may in the best case be lifted above the population's average, this rationality is bound to remain far from the one of the economic champions whom both PC and FC will eventually select. Of course, this does not exclude that some government entrepreneurs might also be champions, but they can never be more than rare exceptions.

Note that it would help little if the elected politicians or by them selected experts tried to recruit champions from private enterprises. Because of the likely insufficient relevant rationality with which such recruitment could be conducted, the true champions might not be recognized. And even if they were, they would be champions of the past, who might soon start to lose, if left in the private sector, to newly appearing champions of the future. Hiring them by government could thus extend their tenure beyond its efficient limit, and might even prevent some of the new, superior champions from appearing.

That this analysis concerns the economic rationality relevant to efficient organizing, managing, and investing in, production, and does not deny that government agents might be highly rational for other tasks, deserves emphasis. Politicians may, and indeed must, be highly rational for succeeding in elections, and public servants for making a successful career

within the government bureaucracy. But these are different kinds of rationality, which may not be, and often clearly are not, closely correlated with the rationality in question.[16]

In sum, the comparison of DG with both PC and FC can be condensed into one short sentence: DG may start best, but will end up far worst.

Corroborating evidence can be found in the history of Japanese and South Korean economies. For a couple of decades, their extensive uses of selective industrial policies and government imposed constraints on investment flows appeared to work so well that several distinguished US economists considered them worth imitating. But soon after both these economies unexpectedly fell into a deep crisis that proved to be structural, rather than cyclical, caused by many for a long time hidden, and therefore uncorrected entrepreneurial and investment errors. In the long run, the relatively transparent US financial markets have indeed proved superior – not necessarily for preventing such errors from being made, but for discovering them sooner and preventing them from lasting. As this history appears indeed to corroborate the present analysis, this analysis in turn appears to be a hopeful candidate for the still missing theoretical explanations of this history.[17]

For the dynamically less intricate final consumption side, the main result of the analysis can be stated much more shortly: the rationality of the government consumption experts, selected by similar uses of the RBV theorem as the government entrepreneurs, and therefore far from both the best, nevertheless surpasses the rationality of many – in the ideal political case, a majority – of individual consumers. Although so much shorter, this results is equally important: as found below, it has several non-standard policy implications.

8 Policy Implications

What the above results may imply for policy is limited to questions of the government economic agenda, asking which policy instruments government could, and which ones it could not, safely handle, to improve, and not worsen, the economy's performance in terms of given success criteria. As opposed to the more frequently studied questions about optimal uses of given policy instruments, which allow sophisticated quantitative analysis, these questions are mainly qualitative: for each policy instrument, the answer is in principle "yes" or "no," although some quantitative limits to its safe uses may also be added. But on the other

[16] As Gerhard Wegner pointed out to me, these rationality differences may be due more to learning environments than to talents. Even the most talented person, if she enters politics, will likely learn another kind of actual rationality than had she entered business. On the other hand, however, a self-recognized lack of talents for efficiently organizing and managing production may also be a strong motive for entering politics.

[17] Allow me to note that this history was roughly predicted by a similar elementary analysis in Pelikan (1992).

hand, these questions are more basic. To find an instrument unsafe to use makes the search for its optimal use superfluous, if not misleading: determining an optimal use of such an instrument in theory – which can, under suitable simplifying assumptions, always be done – might be, and sometimes indeed was, mistaken for supporting its use in practice.

Questions of the government economic agenda are directly connected to institutional economics, and more precisely to policies that may be termed "institutional" – that is, the legislation that forms and reforms the economy's formal institutions. Although, as emphasized by many writers from Hayek (1967) to North (2005), far from all effective economic institutions can be deliberately legislated, those defining the government economic agenda definitely can. In a well-ordered democratic state, it is the legislative branch of government that uses institutional policies to define and limit what operational policies its executive branch is allowed and/or required to conduct.[18]

8.1 Policy Implications for Production. These consist in part of warnings against policies and in part of demands for policies. Both follow from the result that after a certain initial period and under certain institutions, the scarce rationality relevant to organizing, managing, and investing in, production will be allocated far better by markets, especially when including financial markets, than by government. Both are also value-free, independent of what the policy objectives for private and public final consumption might be.

The warnings concern all policies by which government would try, even with the best intentions, to control, or selectively intervene in, such high rationality-demanding production activities – in particular national planning, selective industrial policies, and government ownership of enterprises, including commercial and investment banks.

Concerning national planning and selective industrial policies – in spite of some renewed interest for the former in parts of South America and some still surviving support for the latter in parts of Europe – little additional warning may be necessary. The crises of all of their practical applications, together with theoretical analyses of their incentive, information and knowledge problems, make them now unattractive to nearly everyone, with the exception of the economically least rational voters.[19]

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[18] In terms of German Ordo-liberalism, institutional policies correspond to "Ordnungspolitik," and operational policies to "Prozesspolitik." In Hayek's (1967) terms, the former correspond to "policies by general rules," and the latter to "specific measures." That government bureaucrats of the executives branch usually oppose, and often succeed in hindering, legislation decreasing the extent of their policy-making is a well-known public choice problem that is not examined here. But such legislation is more likely to succeed if supported by analytically solid arguments.

[19] To be precise, however, individuals who are aware of their poor economic rationality may find it politically rational to vote for such institutions, if they may expect to make a successful career as planners or industrial policy-makers, and thus gain personal advantages at the price of impoverishing others.

But the case of government-owned enterprises is still less clear. Although their privatization is now widely practised, the reasons are often more ideological than analytical. The problem is that none of the incentive, information and knowledge problems that prohibit national planning suffices to prohibit government ownership of firms. The supporting evidence appears to be that many managers appointed by private owners both know all that is needed to be known for making even a very large enterprise innovative and successful, and are provided with reasonably designed incentives to keep their private rent-seeking within tolerable limits. The question then is, what could hinder government from doing the same? Already Schumpeter (1942/1976) answered "nothing," and – in spite of the extensive empirical evidence that in average, government-owned firms do perform less well than comparable private firms – this answer has not yet been compellingly refuted. On the contrary, several standard models have formally proved that government ownership of firms *can* be optimal.

What the rationality-allocation analysis does more than Hayek's (1945) knowledge argument is that the latter excludes from the government agenda only the most difficult tasks than *no* single human mind can master, with the main example of national planning, whereas the former moreover excludes many less difficult tasks that *some* human minds demonstrably *can* master, in particular the organization and management of large firms. It only adds that these minds are so scarce that only lasting market competition and selection may find them and, equally importantly, keep them in such difficult tasks only as long as, or at least not much longer than, they continue to possess such an exceptionally high relevant rationality. As solving the incentive problems belongs to these difficult tasks, it also directly follows why capitalist firms are likely to solve them more successfully than firms owned by government.

Turning to the demands for policies, they concern the institutions that markets need in order to function as reasonably efficient agent-selection and rationality-allocation devices. Compared to their usually studied function of price-setting mechanisms, this substantially increases the importance of keeping them reasonably competitive, or at least reasonably contestable. In particular, it is important to keep all the actual champions exposed to challenges by new entrants, and make sure that winners are selected for high relevant rationality, and not for low ethical standards. Although many of the needed institutions may, and indeed must, be informal, evolved and supported by self-policing and reputation effects, they may not suffice. Reputation is not always easy to acquire even on developed markets, and is definitely unavailable on the emerging financial markets in new market economies. While uses of complementary institutional policies – such as competition law, bankruptcy laws,

protection of minority owners, and laws against insider trading – are still debated, with many arguments for and against, rationality-allocation analysis strengthens the case for them.[20]

As such policies are also difficult to design and implement, the demands for them may appear to conflict with the previous warnings against difficult policies. It is therefore important to realize that the two kinds of difficulties are of different magnitudes. Those of organizing, managing, and investing in, production are substantially higher, which is why they need the best relevant rationality of the rare industrial champions that only market competition may systematically discover and select. For the difficulties of institutional policies, in contrast, the needed rationality can be learnt from suitable sources by all sufficiently educated and logically thinking persons. Although all the needed sources may not yet be available, there is no fundamental reason why they could not. Their main ingredient is a good theory of how different institutions influence, in the short run and in the long run, the performance of economies, which should be possible to obtain by a suitably extended institutional analysis (of which this paper aspires to be part) and spread by literature and teaching.[21]

8.2 Policy Implications for Final Consumption. A distinctive feature of rationality-allocation analysis is that turning from production to final consumption changes the sign of many of its policy implications. Instead of warnings against government policies, it implies an increased potential for them. The reason is that the far from the best relevant rationality of government that is not good enough for top decisions concerning production, is nevertheless superior to that of many consumers, which implies a potential for helping them by paternalistic policies. But, while the warnings are analytically definite and value-free, the potential leaves open the issue of its actual exploitation, which is strongly value-dependent.

More precisely, the potential means that government is rational enough to help many consumers with certain difficult choices, and thus increase their well-being, in terms of their

[20] The harm caused by lack of institutional policies for financial markets can be illustrated by the setback that hit in 1996 and 1997 the until then highly successful transformation of Czech economy towards modern capitalism. A sophisticated voucher privatization of most of the formerly socialist enterprises first allowed all citizens to start trading on financial markets, either directly or through investment funds, which raised both hopes for personal success and enthusiasm for capitalism in general. But the neglect of the institutions for these markets, which could have been copied from any modern capitalist economy, allowed extensive asset-stripping by dishonest managers of investment funds. This crushed much of both the hopes and the enthusiasm, and moreover caused the average level of honesty of the successful Czech capitalists selected by such an unruly market to be low. Foreign investors started to avoid Prague and a large part of the electorate turned to capitalism-critical or even hostile parties. Although since then, the institutional framework has been largely mended and many foreign investors have returned, the political damage and the low level of honesty are still far from repaired – as illustrated by the high popularity of the old communist party and the low ranking of Czech economy in the international corruption league.

[21] In slightly different terms, these conditions and the possibilities of meeting them are discussed by Vanberg and Buchanan (1994). Intuitively, the two kinds of difficulties may perhaps be compared to those of becoming a chess master and those of organizing chess tournaments.

own preferences, above the level that they would be able to attain without this help. But there are several reasons why the actual exploitation of this potential may be limited. One is that all paternalism entails losses of individual freedom and personal dignity, which must not exceed the benefits of the improved consumption. The value-dependence is obvious: both the costs and the benefits depend on how they are subjectively valued.

More objectively, the losses also depend on the form of the policies. They appear lowest for what Thaler and Sunstein (2003) call "libertarian paternalism," which only helps consumers with their own learning. It entitles them to obtain certain information and obliges firms and/or government agencies to provide this information – e.g., about the contents and health effects of food and other consumer goods – but leaves the consumers free to decide.

In many societies, however, even less libertarians paternalism, for which the losses of freedom and dignity are much higher, may win strong democratic support – such as compulsory primary education, car insurance, health insurance, and retirement plans. The values on which the support depends concern in part compassion and in part the spillover effects of consumption. As long as little-rational consumers hurt only themselves, whether or not to help them by paternalistic policies depends on the former. But if their little-rational consumption has spillover effects that also hurt others – be it physically or only mentally – the decisive factor is the valuations of such effects by these others. As the values involved significantly differ between cultures and between countries – even between otherwise so close Europe and the USA – the limits to efficient paternalism must differ accordingly.[22]

Concerning the benefits, in addition to their subjective valuations by the consumers, they also depend on the incentives of government agents to help these consumers, rather than engage in own rent-seeing. As these incentives can never be as strong and as correctly targeted as the incentives of the consumers themselves, this may even be taken for a decisive reason why all paternalistic policies should be rejected. It is basically for this reason that Glaeser (2005) rejects even the most libertarian paternalism defended by Thaler and Sunstein (2003).

What rationality-allocation analysis points out is that the incentive reason may appear decisive only if rationality is assumed equally perfect or, as both Glaeser and Thaler with Sunstein assume, equally bounded. When it is recognized that government has certain rationality advantages over many consumers – as it appears natural to do when considering the difficulties of assessing complex pension plans, life insurance contracts, and bank loan

[22] In countries where extensive paternalism has a strong democratic support classical liberals face the difficult choice between defending political democracy and defending individual freedom and consumer sovereignty. The not always fully realized problem is that liberal values include the right of individuals to have values that make them subjectively enjoy, or suffer from, consumption of others.

conditions, together with the fact that even in the most developed countries, large segments of population are not very good at reading and calculating – the incentive argument only becomes part of a trade-off. The question then is, how much of the rationality superiority of government will actually be used for helping consumers, and how much for the rent-seeking of government agents.

The answer depends in part on the transparency of democracy, including the freedom of media, by which the rent-seeking may be kept within tolerable limits, and in part on the prevailing level of trust and honesty, by which it may voluntarily be mitigated by government agents themselves. This level is another value-related factor that may significantly differ between cultures and between countries.

Note that in countries with poorly working democracy and a low level of honesty, little-rational consumers can hardly escape suffering from the rent-seeking of some more rational individuals. With paternalistic policies, these are politicians and government bureaucrats, and without paternalistic policies, these are private producers, who may use many ways – such as false advertising and marketing of little effective, or even harmful products. Not even non-profit non-government organizations are guaranteed to help, as rent-seeking may be, and several times was indeed found to be, widespread also within them. The question then is not which alternative would help little-rational consumers most, but under which they would suffer least.

Rationality-allocation analysis also has policy implications for redistribution, but they are more mixed: they strengthen its case up to a certain limit, weaken it beyond that limit, and indicate what form of taxation may maximize that limit. What strengthens the case is that reducing poverty, in addition to all of its usually considered positive effects, is moreover implied to shrink the segment of population unable to enter, for lack of resources, the competition for high rationality. This decreases the efficiency losses from not exploiting the existing but hidden stocks of this scarce resource in this segment. It is moreover implied that taxing the rich, in certain forms and up to a certain limit, need not weaken incentives, and thus harm efficiency, as much as usually argued. The reason is that economic rewards are not the only incentives for efficient rationality allocation. As success in competition is a well-known human incentive by itself, individuals may at least sometimes strive to demonstrate the high rationality they believe to have to some extent independently of such rewards.[23]

The existence of a limit beyond which redistribution becomes grossly inefficient is implied by the fact that incomes and wealth, especially those from successful entrepreneurship

[23] For recognizing that this incentive may be powerful indeed, many theoretical economists appear to need nothing more than sincere introspection.

and investment, are not only ex ante incentives, but also ex post means of allocating capital from less rational to more rational entrepreneurs and investors. It is the need for allowing this allocation to work reasonably well towards reasonably efficient outcomes that sets the hardest limit on how, and how much, incomes and wealth can be redistributed. The form of taxation that maximizes this limit is indicated to be the one that concentrates on net final consumption (calculated as "income minus investments plus disinvestments"), while avoiding as much as possible working capital, investment, and profit of enterprises.

This also brings to light the important, but often forgotten difference between redistributing final consumption and redistributing the control over capital in production. While much of the former may be politically demanded and analytically justified, the latter always harms the economy. To see it clearly, recall the old egalitarian argument by Roemer (1987) that the unfortunate persons who were endowed with too little talents by nature should be economically compensated by society. Regardless of how much compassion for such persons one might feel, and for how high compensation one might consequently vote, rationality-allocation analysis makes it clear that this compensation should be limited to parts of final consumption. To let untalented persons gain control over capital in production would ruin the economy, leaving there little to be redistributed.[24]

9 Concluding Comments

The recognition that individuals may differ in all abilities – including those for using available information, conducting economic calculus, and deciding on the uses of scarce resources – *and* that these abilities are therefore scarce resources themselves, is undoubtedly realistic. By itself, however, realism does not guarantee a legitimate place in theories. Under the rule of Occam's razor, to which all modern sciences submit, theories should not be as realistic as possible, but as simplified as possible for correctly answering given questions. To legitimize the place of the recognition in economics, it is therefore necessary to have some important questions that cannot be correctly answered without it.

Such questions concern above all three topics: (i) the difficulty of the decision tasks that a reasonably efficient economy may allow individuals to perform; (ii) the selection processes by which differently rational individuals may be assigned to differently difficult

[24] Western social scientists often limit attention to redistribution of given goods, taking for granted that the goods are always there. This one-sided view may be due to their happy life in the abundance produced by relatively efficient capitalist firms, where low relevant rationality cannot last long, while lacking experience with chronic shortages caused by inefficient socialist production, where low relevant rationality can lastingly pervade all decision levels.

tasks; and (iii) the institutions by which the twin processes of task-designing and task-assigning are shaped.

It is easy to see what may go wrong without the recognition. Assuming rationality equally perfect makes analysis overlook all the difficulty limits, and ignore both the selection processes and the institutions. Telling examples are the optimal designs of resource-allocation mechanisms produced by standard mathematical analysis, in which all information and incentive problems are optimally solved – but only with imaginary individuals who are perfectly able to solve highly difficult optimization problems of their own and flawlessly communicate the solutions to others. Implementing such an optimal mechanism design with real-world individuals could hardly lead to anything else than bureaucratic confusion.

Assuming rationality equally bounded allows analysis to see some of the difficulty limits, but the selection processes and the institutions may continue to be ignored. Such analysis may imply the limits to be too low, adapted to the bounded rationality of an average person, and thus ignore the efficiency gains from allowing some tasks to be more difficult – such as organization and management of large firms that can realize important economies of scale – together with the institutions that could ensure that such above-the-average difficult tasks will eventually be assigned to some of the sufficiently above-the-average rational individuals, and prevented from being lastingly assigned to others.

Why these questions are important is that they are often in the center of policy issues. Their wrong answers may therefore lead to the wrong policy implications, and these may cause large social losses if believed and allowed to influence actual policies. In the above analysis, the recognition of the unequally distributed scarcity of rationality prevented indeed several policy-relevant questions from being given the wrong answers, and moreover allowed some puzzling questions to be answered at all – in particular the ones of why government-directed industrialization often starts well, but ends up in a structural crisis, and why market reforms often start poorly, but end up by lastingly improving the economy's performance.

The policy implications of the recognition may also be seen novel in their switch from strengthening market liberalism in production to increasing the potential for paternalism and redistribution in final consumption. Strictly speaking, however, this switch may be seen novel only from the standpoint of existing theories (and ideologies), while it has increasingly been made – and this may be seen as corroborating its soundness – in practical policies. As exemplified by New Labour and Compassionate Conservatism, the Left is increasingly recognizing that market competition and private enterprise are needed to have the goods produced, while the Right is increasingly recognizing that certain paternalism and

redistribution are needed to avoid social crises and political rejection.

That the necessity to recognize rationality as an unequally distributed scarce resource is limited only to some questions, while the perfect rationality assumption is admitted for other questions, is worth emphasis. This should make the present approach more acceptable to the still numerous users of that assumption – in comparison with the more radical bounded rationality approaches that call for rejecting it altogether. Examples of the questions for which it is admitted are the easy ones that may be answered reasonably well by most people, the more difficult normative examples, meant to teach people to be more rational than they actually are, and the questions about the behavior of successful participants of well-developed competitive markets, who may indeed plausibly be assumed, as long-time ago argued by Friedman (1953), not to be too irrational.[25] While all economic questions may thus peacefully be partitioned between those that can safely be handled under the perfect rationality assumption, and those that require recognizing rationality as an unequally distributed scarce resource, it must be recognized that many questions central to important policy issues belong to the latter.

Appendix: A simple mathematical illustration

As announced in Section 6, the purpose of the Appendix is to illustrate the rough, but robust verbal comparison of PC, FC and DG for their rationality-allocation over time, by a finer, but to doubts more exposed, mathematical model. To minimize the doubts, or, more precisely, to prevent the rightful doubts about its simplifying assumptions and its quantitatively unrealistic partial results from putting in doubt the final results, it is important to keep in mind that these concern the relative ranking of the alternatives, and not their absolute performance. All simplifications and lack of quantitative realism may therefore be admitted as long as the ranking, both in the short run and in the long run, remains undistorted.

The model is in principle computational, but no numerical computations are necessary. The ranking of the alternatives can be obtained by comparing the general expressions of their outcomes in the short run and in the long run – and must thus itself be considered general.[26]

The Givens. – Consider an economy during a series of periods separated by time points $t = 0, 1, 2, \ldots$. At time t its capital is K_t , starting with $K_0 = 1$, and its growth rate is $\rho_t = K_{t+1}/K_t$.

[25] In private correspondence, in which I expressed doubts about the uses of the perfect rationality assumption in theories of optimal socialist planning and government policymaking, Professor Friedman emphasized that he meant his evolutionary justification of this assumption only for analysis of developed market economies. But he did not specify what should be assumed about the rationality of agents in other types of economies.

[26] A similar model with a calculated numerical example and a graphical illustration is in Pelikan (1997).

Individual rationality is graded by integer $q \in [1, Q]$, with $q = Q$ denoting its highest grade ("economic champions"). Individual i has rationality q_i, but this is not known with certainty to anyone, not even to himself. The rationality distribution over the population is binomial, with probability function $P(q)$, distribution function $F(q)$, and average $\overline{q}$. All individuals are voters, of whom three possibly overlapping random samples are the candidates for the positions of entrepreneurs, capital owners, and politicians.

The performance of organizations is expressed as a growth coefficient, $\pi(q)$, a monotonically increasing function of q, showing how the entrepreneurs of rationality q multiply the capital they use, $K(q)$, during one period: $K(q)_{t+1} = \pi(q) \cdot K(q)_t$. The threshold for successful entrepreneurship, q_S, is defined as $\pi(q_S) = 1$. Depending on the severity of the conditions for entrepreneurship, q_S may be much higher or somewhat lower than $\overline{q}$. To recall, because of influences of chance and learning, $\pi(q)$ can only be used for inferring π from q for populations of organizations over time, but not q from π in single cases.

In consequence, the economy's growth rate at t, ρ_t, only depends upon the distribution at t of the uses of K_t among entrepreneurs of different q, $P_t(q)$:

$$\rho_t = \sum_{q=1}^{Q} \pi(q) \cdot P_t(q) .$$

The growth rate attains its maximum, $\rho^* = \pi(Q)$, if $P_t(Q) = 1$ and $P_t(q) = 0$ for all $q < Q$.

RRR-ASSUMPTION. Individuals of rationality q_i can safely recognize all individuals of $q < q_i$. Because of their irrelevant prejudices, they underestimate the rationality of a random subset of individuals of $q \geq q_i$ (possibly including themselves, if they suffer from an inferiority complex), and see the highest rationality equally distributed over the complementary subset of these individuals. The probability $Pr(q_i \rightarrow q)$, with which an individual of rationality q_i sees as the most rational an individual of rationality q is $P(q)/[1 - F(q_i - 1)]$ for $q \geq q_i$, and 0 for $q < q_i$.

LEMMA 1. If it is rational to vote for the most rational candidates, the average rationality of the ones voted for by individuals of rationality q_i will be:

$$\overline{q}(q_i) = \frac{1}{1 - F(q_i - 1)} \sum_{q=q_i}^{Q} q \cdot P(q) .$$

Nearly all individuals thus vote for candidates whose q is in average higher than their own, with the exception of the champions, who cannot do better than vote for their peers. And nearly all individuals vote in average for above-the-average candidates of $q > \overline{q}$, with the exception of

the least rational ones, who in average vote for average ones of $q = \bar{q}$.

LEMMA 2. If all voters cast an equal number of votes, the proportion of the votes cast for candidates of rationality q_i, and thus the likely weight of these candidates among all the elected candidates, will in consequence be

$$P_V(q_i) = P(q_i)\sum_{q=1}^{q_i}\frac{P(q)}{1-F(q-1)} \ ,$$

where $P_V(q)$ is the probability function with which q is distributed over the elected candidates. The distribution function $F_V(q)$ and the average $\bar{q}_V$ can be calculated in the usual way.

RBV-THEOREM. The rationality of the elected candidates, $P_V(q)$, is superior to the one of the voters, $P(q)$, as $P_V(1) < P(1)$, $P_V(Q) > P(Q)$, and $\bar{q}_V > \bar{q}$.

The Comparison. – PC starts with the capital distributed to entrepreneurs of different q according to $P(q)$. The short-run growth, at $t = 0$, will therefore be

$$\rho_{PC,0} = \sum_{q=1}^{Q}\pi(q)\cdot P(q)\,. \tag{1}$$

At time t, the capital used by entrepreneurs of rationality q will grow (decrease) to

$$K(q)_t = \pi(q)^t \cdot P(q) \tag{2}$$

The economy's capital will thus grow (decrease) to

$$K_{PC,t} = \sum_{q=1}^{Q}\pi(q)^t \cdot P(q) \tag{3}$$

and its growth rate at t will therefore be

$$\rho_{PC,t} = \frac{\sum_{q=1}^{Q}\pi(q)^{t+1}\cdot P(q)}{\sum_{q=1}^{Q}\pi(q)^t\cdot P(q)} \ . \tag{4}$$

For $q_S > \bar{q}$, the growth rate will at first be negative, as the losses of the majority of entrepreneurs of $q < q_S$ will initially exceed the gains of the minority of $q > q_S$, but in the long run, for $t \to \infty$, it will converge to the maximum, $\pi(Q)$, as the capital used by all the entrepreneurs of $q < Q$ will tend to become absolutely or relatively negligible.

Under FC, $P(q)$ determines the initial allocation of capital to owners. They make their initial investment choices according to Lemma 1, and thus determine the initial allocation of

capital to entrepreneurs according to Lemma 2. FC therefore starts with the initial capital distributed to entrepreneurs of different q according to $P_V(q)$, so that its initial growth rate is:

$$\rho_{FC,0} = \sum_{q=1}^{Q} \pi(q) \cdot P_V(q) . \tag{5}$$

For owners of rationality q_j, Lemma 1 implies that the initial growth rate of their portfolios is:

$$\kappa(q_j)_0 = \frac{1}{1 - F(q_j - 1)} \sum_{q=q_j}^{Q} \pi(q) \cdot P(q) . \tag{6}$$

What will happen next depends on the owners' q and moreover on their investment diligence. If they lazily stick to their initial investment choices – or, in nicer words, if they make long-term investments – the future growth rates both of their portfolios and of the entire economy will be different than if they frequently reinvest. But to follow these possibilities, the model needs a highly unrealistic assumption. As noted, observing the actual performance of entrepreneurs helps only little in assessing their rationality, for much depends on the rationality with which such observing is conducted and interpreted. This note now needs to be exaggerated into the assumption that such observing does not help at all.

But there are two reasons why this assumption, however unrealistic it might be, does not devalue the model's results. First, if such observing were taken into account, owners of higher q would be found to learn more from it than owners of low q, so that the comparative advantage of the former – which is the crucial point here – would persist. Second, this assumption does not help the main result – which will be that in the long run, it is just FC that performs best – but on the contrary works against it: FC would be found to perform even better if the owners of capital were considered to learn from such observing than when they are not.[27]

To take into account the difference between long-term ("lazy") and short-term ("diligent") investors, it suffices to consider the two extremes: all owners stick to their initial investment; and all owners reinvest after each period. All the intermediate cases, in which new investment decisions are taken only sometimes by some owners, yield intermediate outcomes.

The extremely diligent, short-term investors redistribute their portfolio according to Lemma 1 after each period, so that the growth rate of their portfolios will be constant, equal to

[27] This assumption appears to be least unrealistic for risk-capital markets, where investors are choosing among relatively new entrepreneurs with new ideas. But even on a standard stock-exchange, where data about the past performance and the current stock prices of firms abound, these data are neither sufficient nor easy to interpret for making good investment choices. The above-the-average returns go, in average, to those investors who have the extra knack for astutely combining these data with many other observations, often including personal qualities of the firms' CEOs.

the initial one: $\kappa_D(q) = \kappa_0(q)$ for all q and all t. At t, the portfolios of diligent investors of rationality q_j will thus grow (shrink) to

$$\kappa_D(q_j)_t = \kappa(q_j)^t = [\frac{1}{1-F(q_j-1)} \sum_{q=q_j}^{Q} \pi(q) \cdot P(q)]^t . \quad (6)$$

For the extremely lazy, long-term investors, the cumulative growth of their portfolios will consist of the cumulative growth of the capital used by the initially chosen entrepreneurs. At t, the portfolios of lazy investors of rationality q_j, will thus grow (shrink) to

$$\kappa_L(q_j)_t = \frac{1}{1-F(q_j-1)} \sum_{q=q_i}^{Q} \pi(q)^t \cdot P(q) . \quad (7)$$

Comparing the growth rates that owners of rationality q can achieve with their capital as own entrepreneurs, as diligent investors, and as lazy investors, yields the following result.

LEMMA 3: $\pi(q)_t < \kappa_D(q)_t < \kappa_L(q)_t$ for all $q < Q$ and all $t > 1$.

In plain words, nearly all owners, with the exception of economic champions, can make their capital grow faster (decrease slower) as investors than as entrepreneurs, and more so as long-term investors than as short-term investors. The reason is that little-rational owners, when reinvesting according to Lemma 1, transfer some of their capital, without realizing it, from the most rational entrepreneurs to some less rational ones.

The growth of the economy's capital under FC may consequently follow many different trajectories, depending on what the ratio of the two types of owners happens to be. But all these trajectories must be contained between two limits: the D-limit growth, in which all the owners of $q < Q$ reinvest after each period; and the L-limit growth, in which all such owners leave their initial investment unchanged. What helps to determine these two limits is that in this model, the economy's capital is always equal both to the sum of the capital used by all entrepreneurs and the sum of the portfolios of all investors.

For the D-limit growth, the outcomes can best be deduced from the portfolios of investors. As investors of abilities q are initially endowed with $P(q)$ of capital, which they make grow (decrease) by $\kappa(q)$ per period, the sum of all portfolios at t will be

$$K_{FCD,t} = \sum_{q=1}^{Q} \kappa(q_j)^t \cdot P(q) \quad (8)$$

and the growth rate

(9) $$\rho_{FCD,t} = \frac{\sum_{q=1}^{Q} \kappa(q_j)^{t+1} \cdot P(q)}{\sum_{q=1}^{Q} \kappa(q_j)^{t} \cdot P(q)}.$$

For the L-limit growth, the outcomes can best be deduced from the performance of the entrepreneurs with whom the owners invested once for all at $t = 0$ (with the exception of owners of $q = Q$, who may reinvest at will without slowing the growth). As the owners have chosen the entrepreneurs according to Lemma 1, the initial capital is distributed among the entrepreneurs according to Lemma 2, which sets the share of entrepreneurs of competence q to $P_V(q)$. This share will then grow (decrease) during each period by $\pi(q)$. The economy's capital at t will grow (decrease) to:

(10) $$K_{FCL,t} = \sum_{q=1}^{Q} \pi(q)^t \cdot P_V(q)$$

and its growth rate will then be:

(11) $$\rho_{FCL,t} = \frac{\sum_{q=1}^{Q} \pi(q)^t \cdot P_V(q)}{\sum_{q=1}^{Q} \pi(q)^t \cdot P_V(q)}.$$

For the earlier discussed reasons, DG is accorded the privilege of using the RV relation more times than FC, which in this model means twice: the voters elect politicians, who select entrepreneurs. Lemma 2 will thus boost the rationality of government entrepreneurs above $P(q)$ also twice. First from $P(q)$ to $P_V(q)$ for the elected politicians, and then from $P_V(q)$ to $P_{VV}(q)$ for the selected entrepreneurs. The economy's capital will thus start growing by

(12) $$\rho_{DG,0} = \sum_{q=1}^{Q} \pi(q) \cdot P_{VV}(q)$$

After that, however, not much will change. As the voters neither gain nor lose votes depending on how rationally or irrationally they vote – in contrast to the owners of capital who do so under FC – the elected politicians and the selected entrepreneurs may change after each elections, but the distribution of q over both of them will not. In consequence, the growth rate of the economy's capital will remain constant:

(13) $$\rho_{DG,t} = \rho_{DG,0} \quad \text{for all } t,$$

so that at t the economy's capital will grow (decrease) to

The Ranking. - According to the growth rates in the short run, expressions (1), (5) and (12) imply that at $t = 0$, DG is best, FC is second, and PC is last. If $\bar{q}_{VV} > q_S > \bar{q}_V$, DG would be the only one to realize a positive growth; both FC and PC would start growing negatively according to a J-curve, deeper for PC than for FC.

According to the growth rates in the long run, the limits of expressions (4), (9), (11) and (13) imply that for $t \to \infty$, those of both PC and FC converge to the maximum, $\pi(Q)$, while DG, with its only slightly above-the-average $\pi(\bar{q}_{VV})$, remains far behind.

To compare these alternatives for the total capital they will accumulate in the long run, it is necessary to determine the limits for $t \to \infty$ of the ratios of their respective K_t (in absolute values, all K_t become infinite, including $K_{DG,t}$, if $\bar{q}_{VV} > q_S$). Making these ratios from expressions (3), (8), (10), (14) and determining the limits discloses that FCL will grow to become the wealthiest, FCD and PC will share the second place, while DG will become infinitely poorer than any of the others. As infinite growth is in any case impossible, the most important result is this relative impoverishment.

That FCD and PC will converge to being equally less wealthy than FCL, although FCD starts better (or less badly) than PC, is interesting to note. The reason is, in essence (the mathematics of it is in Pelikan, 1997), that the losses of PC caused by little-rational entrepreneurs during a relatively short initial period turn out to equal the losses of FCD caused by little rational, but diligent investors during a longer period. When the entire growth trajectory is considered, however, FCD has the advantage that under it, the economy never gets as poor as, and remains for all finite t somewhat wealthier than, under PC.

The model thus indeed illustrates the results of the verbal analysis – with the additional fine point which the verbal analysis could not see, but which appears to make good sense, that little-rational investors will do better both for themselves and for the economy if they invest long-term, rather than spend effort on frequent portfolio changes.

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