SCIENTIFIC REPORT

Cognitive Microfoundations for the Economics of Nonrival Goods [*]

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ABSTRACT *- This paper shows that the economics of nonrival goods cannot be fully comprehended without taking into account the role of intelligence differences among economic agents. The analysis focuses on Paul Romer's contributions and explains that the study of the economics of ideas (memes) through an institutional lens alone misses the crucial economic implications of the interplay between genes and memes. Ideas appear to be nonrival if and only to the extent that we neglect wide individual differences in the capacity to appropriate ideas. Differences in intelligence among humans make the theoretically and politically appealing non-rivalry of ideas a practical falsehood*

KEY WORDS: *Paul Romer, innovation, imitation, nonrival goods, intelligence, creativity, knowledge spillovers, positive feedback loops*

Introduction

This paper assumes a readership fully familiar with recent developments in new growth theory (Helpman, 2004) in general, and with Paul Romer's path-breaking "Endogenous Technological Change" (henceforth ETC; 1990; see also Romer, 2007) in particular. Instead of joining the chorus of those who praise his contribution, I want to begin to outline the reasons that led me to believe that his theory fails to explain the totality of available evidence. I do not use "explanatory failure" loosely, but in the very precise sense deployed in epistemology (Lipton, 2004). Other things being equal, when assessing a number of competing explanations for a given set of phenomena, we have to rank higher that theory that best accounts for the whole set of phenomena to be explained. If a theory explains only part of the *explanandum,* we can say that it fails to explain, i.e. the *explanans* is incomplete. Very often, explanatory failure becomes apparent over time, as new scientific facts are uncovered. The addition of new facts to an old set of facts can dramatically change the kinds of inferences that can be drawn, a phenomenon known in meta-logic and the philosophy of reasoning as the non-monotonicity of induction. As it will become apparent from the references that I cite to support my argument, many of the facts that Romer's theory fails to explain have been uncovered since the publication of ETC. This means that my analysis should be read not so

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much as a critique, but as a challenge to Romer to adjust his theory to account for the new facts adduced against his hypothesis.

Factors of production

Instead of the old division of factors of production into labour, land, and capital, Romer prefers the trichotomy people-ideas-things. The advantage of this new classification is two-fold: on the one hand, it singles out ideas as crucial to productivity; on the other hand, it alerts us to beware of conflating people with ideas by means of some vague phrase such as "human capital". I think he could have gone farther than this, by appropriating Keith Stanovich's (2004) conceptual dissection of the human subject into genes, memes (i.e. ideas; see Heylighen & Chielens, 2008), and the vehicle. Each and every human being is best conceptualized as a vehicle, a carrier that both genes and memes use to spread themselves. The obvious advantage of this framework consists in the insight that what makes us human is the result of the interplay of genes and memes, i.e. of biology and culture. Its much less obvious advantage derives from the insight that ideas cannot be analysed separately from genes, that their impact depends crucially on their match or mismatch with the genes. Romer missed this latter insight in a way that profoundly undermines the quality and completeness of his account of economic growth.

Intelligence differences, social class, and education

Part of the reason why humans differ from one another is genetic. If we think of an infant's sex, eye colour, or hair colour, that much is unproblematic. Things become more political and more unpleasant when we add the mounting body of evidence (conveniently ignored by Heckman, 2008) from both behavioral genetics and molecular genetics that shows differences in IQ (Rushton & Jensen, 2005, Deary et al, 2006, Pol et al, 2006, Shaw, 2007, Manning, 2007, Miller & Penke, 2007, Plomin et al, 2007, Friedman et al, 2008) and creativity (Reuter et al, 2006, Simonton, 2007, 2008) among humans to be largely the result of different genetic endowments. To make things worse, IQ is significantly correlated with creativity (Kuncel et al, 2004, Preckel et al, 2006, Lubinski et al, 2006, Park et al, 2007, Simandan, 2008, Silvia, 2008), a correlation most probably explained by shared genetic factors (Chiappe & McDonald, 2005, Plomin et al, 2007, Cochran et al, 2007, Lynn & Kanazawa, 2008). Contrary to common prejudice among the social scientists, IQ is not a proxy for one's parents' social class (Gottfredson, 2009, in press; Simandan, 2009a). The correlation between a child's IQ and parent's social class found in most studies is less than 0.35, which means that 87.75% of variance in IQ cannot be explained by parent's social class (a most recent study by Gale et al (2009) found the correlation between IQ and parent's social class for two different British cohorts to be 0.25 and 0.29 only!). In other words, explanations of human inequality cannot simply ignore intelligence differentials by assuming that they are an epiphenomenon of the real cause – social class differentials.

It is wishful thinking to assume that IQ can be boosted through education or special training *both* reliably *and* substantively. The reason is four-fold.

First, scholars in the field have begun to make the distinction between IQ and rationality (Stanovich, 2009). The first term refers to the common source of inter-individual differences in the capacity to acquire capacity. It is a complex biological property of the brain having to do with total brain size (Miller & Penke, 2007; r = .40-.45), volume of gray matter (Colom et al, 2009), properties of the white matter (Fields, 2008, Ullen, 2008), the balance between neural inhibition and neural excitation (Fernandez & Garner, 2007), the relative proportion of the types of oligodendrocytes and neurons available (Mercado, 2008), the architecture of the cholinergic and dopaminergic pathways, etc. The second term, rationality, refers to what lay people usually mean by intelligence – common sense, sound judgment, maturity, knowledge. Although an average IQ is a necessary condition for the acquisition of rationality (i.e. a behavioral repertoire of far-sighted, mature, and efficient "if-then" situation-action pairs), IQ alone is not a sufficient cause for rational behavior to occur (Sternberg, 2002). The other ingredients include personality factors and good education. Whereas rationality (including knowledge) can be boosted through education (Stanovich, 2009), IQ (more technically the *g* factor) is a matter of genes, epigenetic perinatal and neonatal injuries, nutrition, and health (Lynn, 2009). In short, rationality is social, IQ is mainly biological.

Second, there is now convincing evidence from both third world and first world countries that clearly shows that: a) children's fluid intelligence (i.e. by and large, the *g* factor) grows at the same rate *regardless* of whether they go to school or not (the key reference is Brouwers et al, 2006), and b) verbal intelligence does not increase at all with the increase in the number of years of education (the key references are Nie et al, 2007, and Nie & Golde, 2008 for the data, and Jensen, 2001, for understanding why). One's knowledge base is the result of the interaction between one's IQ and one's opportunity to learn. Because increased schooling means increased opportunity to learn, the common misconception that schooling boosts IQ can be explained as the result of 1. the conflation of IQ with knowledge/rationality, and 2. the deliberate forgetting that schooling can increase knowledge not via the increased IQ causal pathway, but via the more prosaic increased-opportunity-to-learn causal pathway (see also Watkins et al, 2007, Simandan, 2009a).

Third, there is now a well-documented sad history of the failure of programs of early intervention for the low IQ children to generate sustained significant increases in IQ. They succeed in boosting IQ immediately after the end of the program, but when IQ is measured again several years later almost all the apparent gain is lost (the most recent serious analysis of these early interventions is in Murray, 2008; to be contrasted with Heckman, 2008 and his topic-related papers).

Fourth, after the recent media hype about the ability of working-memory training to improve IQ, a number of respected scholars have begun to publish new research as well as re-analyses of the data from the very studies that prompted that media hype. This new, more rigorous wave of scholarship, casts serious doubts on the hypothesis that working-memory training could improve IQ scores (see Moody, 2009; Colom et al, 2010; Lövdén et al, 2010).

The tradeoff between innovation and imitation

Why is this evidence damaging to Paul Romer's theory? It is damaging because he completely neglects the gene*meme interplay and chooses to study the economics of ideas through an institutional lens alone. For him, the problem of economic growth is reducible to the problem of how to best manage an inherent tension in the dynamics of ideas. On one hand, governments should encourage invention, innovation, and creativity, and the best way to do this is to provide institutional incentives to the innovators (patents, copyrights, etc). On the other hand, governments should encourage the wide propagation of good ideas, in order to maximise the economic returns from them and to spur further waves of innovation. But the second desideratum (henceforth referred to as the *imitation problem*) is undermined by the first desideratum (henceforth referred to as the *innovation problem*). How can one encourage innovation without damaging the rate and scope of imitation is Romer's central research puzzle and so far he has attacked it by a careful analysis of the divergent logic of two key institutions: the market and science. He does not have yet an answer, but he does have a meta-answer, i.e. an answer about how the answer should be like. More precisely, he insists on the role of meta-ideas, i.e. generating good ideas about *how best to manage* the innovation-imitation conundrum. And I emphasised in the text "how best to manage" to bring out the fact that Romer sees government intervention as fundamental to economic growth.

He also sees that the quality of the human stock is crucial, because he mentions the need for the government to invest in education and to give portable scholarships to *talented* youngsters interested in science and engineering. What he fails to see is that the quality of the (local) human stock is not a variable that governments can control via the right incentives. I adduced evidence showing that both creativity and IQ are largely under genetic control, and that they are positively correlated. Creativity is the key concept that maps into Romer's innovation problem, and IQ is the key concept that maps into Romer's imitation problem. Since both share common genetic variance, both of Romer's problems drive us to conclude that economic prosperity at the individual level critically depends on genes (for a dramatic demonstration see Murray's 2002 comparison of the incomes of siblings differing in IQ).

The cognitive microfoundation of innovation

Here is how Romer stumbles. Within the innovation problem, one cannot assume that more scholarships to science-inclined individuals will linearly increase the number and quality of innovations. The probability of significant discoveries increases with higher IQs, but higher IQs are very improbable. The work of Wai et al (2005), Benbow et al (2006), Lubinski et al (2006), and Park et al (2007) clearly shows that very high IQ individuals are more likely to generate patents, but very high IQs are very rare (e.g. for IQ 160, 1 in 10,000 individuals). It is very likely that they would easily obtain some of the scholarships already available anyways. By generating more opportunities for scientific research (more doctoral fellowships, etc) the government does nothing but move the bar of selection for scholarships from the far-right end of the normal distribution of intelligence toward its middle. As the quality of the researchers decline, so does the return on investment in scientific innovation (as an aside, this is also the reason why scientific progress cannot naively be measured by number of researchers or number of publications; see also Rescher, 2006). This is not to say that there is nothing that governments can do to increase the number of high IQ individuals available. Clever schemes of immigration policy (for Canada, see Simandan & Boggs, 2007) can and do silently select for intelligence, fact which begins to explain both the continuing growth of developed countries and the increasing gap between the rich and the poor countries. Given that a) the key constraint on innovation is high IQ (via the correlated high creativity), b) IQ is under genetic control (we have no idea whatsoever on how to increase one's IQ from 115 to 160), and c) high IQ individuals are very rare, it follows that the innovation problem at the international level is a zero-sum game. More to the point, those countries that have or will acquire the largest number of very smart individuals will lead in technological innovation, and those countries that don't have or lose their smart individuals will lag well behind. This is not a prophecy. It is what the actual data show (Dickerson, 2006, Jones & Schneider, 2006, Lynn & Vanhanen, 2006, Whetzel & McDaniel, 2006, Ram, 2007, Hunt & Wittmann, 2008, Rindermann, 2008, Gelade, 2008).

The cognitive microfoundation of imitation

But Romer stumbles when analysing the imitation problem as well. IQ is the single most important predictor of the ability to learn quickly (Duncan et al, 2008) and thoroughly (Kuncel et al, 2004, Deary et al, 2007). This is the same thing with the ability of a human vehicle (Stanovich, 2004) to download memes to her brain, or with the ability to profit from someone else's ideas by appropriating them. Romer gets it wrong because he focuses on the misleading presumption that ideas are non-rival goods. But the abstract theoretical point that nothing in principle can prevent one and the same idea/meme/theory to be lodged and used by different brains becomes a falsehood when seen in the context of the actual cast of characters that make and remake the economic world. Ideas are non-rival if and only if we neglect wide individual differences in the capacity to appropriate ideas. Even if anybody is free to read a statistics textbook at the local public library, not everybody will understand its contents. The good is free, but just as you can't load furniture on a bike, you can't load certain ideas on low intelligence brains. Differences in intelligence among humans make the theoretically appealing non-rivalry of ideas a practical falsehood. But the inability of low intelligence brains to appropriate difficult ideas is theoretically and politically significant not because it falsifies Romer's account but because it may well turn out to be the best explanation of human inequality we have. The crux of the matter is that the difficulty of a set of ideas is often correlated with its usefulness. Learning statistics is not only more difficult but also more socially and personally useful than learning the names of soccer players in the local team. The former might earn one a job, whereas the latter will at best earn one some cheers from ones' buddies. Difficult-to-master ideas/memes are more useful to those who master them either because a) they can be used to solve difficult real-life problems (e.g. statistics, see Simandan, 2010) or because b) their mastery is a difficult-to-fake indicator that their possessor is a smart individual (e.g. poststructuralist theory), or, more commonly because of a combination of the two factors (Arrow, 1973, Spence 1973, Gottfredson, 1985). Smart brains master difficult ideas, which means that by detecting such brains and hiring them one can acquire not only actual capacity (their knowledge of a set of difficult and useful ideas) but also potential capacity (their ability to quickly grasp and recombine other difficult and useful ideas).

Intelligence-driven geographical differentiation of economic wellbeing

Significantly, one of the best ways to gravitate towards complex ideas is to gravitate towards those who host those ideas, i.e. other great minds. Birds of a feather flock together

(Simandan, 2006, 2008, 2009a). Here we get into the geographical-economic problem of positive externalities of human capital, neighbourhood effects, the contagion of genius, knowledge spillovers – theorised by economists ever since Marshall, but in complete disregard of the literature on individual differences in intelligence and, even more relevant, of the literature of interaction effects between people of different IQs (Gordon, 1997, Day et al 2005, Simandan, 2006, 2008, Jeong & Chi, 2007).

Conversely, dull brains are unappealing, and therefore poorly paid, both because the kinds of things they know are not particularly difficult (and hence supply is abundant) and because they signal that one cannot rely on their acquiring of difficult ideas in a reasonable time (let alone on their creative recombination of these ideas). This is the gene*meme interplay problem I mentioned earlier: the best minds gravitate towards the complex ideas and the encounter generates further great ideas, whereas the average and below-average minds gravitate towards trivial ideas and the encounter generates further trivialities (e.g. belief in God in general and religious dogmatism in particular are negatively correlated with IQ across countries and within countries; see Lynn et al, 2009). The economic inequality that ensues is the dark side of these gravitational pulls (or, more exactly, of these positive feedback loops). Of relevance, this inequality becomes magnified across generations via geographical effects, in a path-dependent manner: the smart neighbourhoods or countries enter a virtuous spiral of high quality knowledge spillover and economic growth; the less smart neighbourhoods or countries become trapped in a vicious spiral of low quality knowledge spillover and economic stagnation. So much for Gerschenkron’s convergence debate.

Romer’s solution to economic development is to encourage innovation in developed countries and imitation of these innovations in third world countries. Developed countries can increase their innovation rate by stealing the bright brains of third world countries. What is left behind in the third world countries is low intelligence. The question is whether successful imitation can occur in these conditions (Clark, 2007, Simandan, 2009b). The majority of third world countries seem to have their average intelligence well below the Western mean (IQ 100; Rindermann, 2007). Not surprisingly, the severity of their economic situation is negatively correlated with their IQ (Rindermann, 2008) and Gelade’s (2008) analysis strongly suggests that IQ is a cause and not an effect of economic development.

Conclusion

I hope I have begun to sketch why Romer’s ETC is an explanatory failure and why economists cannot explain much about economic growth if they don’t engage with the scholarship on individual and national differences in intelligence. Both innovation and imitation are partly determined by IQ differentials both among individuals and among countries. Romer is to be praised for having analysed those factors other than IQ that matter; but he overlooked the single most important constraint to economic growth: human intelligence and its wide dispersion. The economics of nonrival goods must dwell on these cognitive microfoundations or else it will fail to deliver on its promises.

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