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Letter to the Editors

Chromosomes and the Slutsky Equation: Lessons from 21st Century Genetics for 20th Century Economics

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Synopsis: Reductionist scientific methodology has been at the forefront of economics research for much of the past 50 years. This short essay argues that recent discoveries in genetic engineering show that the study of complex phenomena might not be best served by such an approach, but rather by one that takes into consideration more evolutionary approaches. This provides a tremendous opportunity for the field of bioeconomics to establish itself as a major school of though, going into the future.

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In a recent *New York Times* commentary, Harvard biologist Stephen Jay Gould waxed lyrical about the recent breakthrough by geneticists in assembling the human genome.[1] Whatever opinions one may have concerning his learned conclusions concerning the origins of life, Professor Gould had several lessons in his article concerning the scientific method, and surprisingly enough, I found enough wisdom within the collection of biological terminology to draw parallels to the trend of economic thinking towards increasingly mathematical approaches.

One key lesson from the recent breakthroughs was that, despite the fact that the human body generates approximately 142 000 genetic messages, only something like 30 000 genes exist. Yet, these messages are undeniable, leading one to the necessary conclusion that the key to complexity lies not in the absolute number of genes but in the permutations and interactions between these fewer units of code. Even more importantly, these interactions can only be explained at the level of their appearance and, unfortunately, *cannot* be predicted from the separate underlying constituents. This turns reductionist scientific method on its head, and the conventional approach to analysis involved simplifications of complex systems into manageable explanatory variables.

What does this mean for economics? Exactly what Robert E. Lucas (1976) first so devastatingly demonstrated in his critique—that econometric analyses of economic systems are ultimately untenable. Any system of econometric equations, whether consisting of 20 variables or 2 000, attempt to postulate interactions between the variables, and, to paraphrase Gould, '[economic systems] must be explained as [economic systems], not as a summation of [economic variables]'. Likewise, we must recognize and accept that mathematical representations of economic phenomena can inherently be—and may very well be—either overly simplistic or just plain wrong. An economist, therefore, must content himself with either explaining general rules of thumb—what the Classical economists (incorrectly) called 'laws'—or resort to the wholly unscientific endeavor of reasoning in the light of history.

This final point brings us neatly into the second lesson highlighted by Gould: 'Unique contingencies of history, not the laws of physics, set many properties of complex biological systems. Our 30 000 genes make up only about 1 percent of our genome. The rest . . . originate more as accidents of history than as predictable necessities'.

For a modern economist brought up on a diet of equations and formulae, this departure from formality is especially difficult to swallow. Worse, economics has long aspired towards the mathematical rigor of physics (to the extent that economists have ever been labeled as physicist wannabes), and the seeming need to abandon what has been possibly a century of gradual mathematization (starting, arguably, from Marshall's first contribution in 1890) seems a drastic measure. Interestingly, mathematical biology itself has long been working with non-linear modeling and, more recently, chaos dynamics. To throw out such a vast legacy of intellectual capital is, to say the least, alarming.

Nonetheless, there is some cause for comfort. The failure of reductionism should, in the words of Gould again, be viewed as not a 'failure of science, but only the replacement of an ultimately unworkable set of assumptions by more appropriate styles of explanation, that study complexity at its own level, respecting the influences of unique history'. Hence, economists need not despair. Rather than attempting to fit the world into our deterministic models, we can instead acknowledge the importance of historical paths, accept that issues such as balance of payments crises or inflation-unemployment relationships need not rest in *the* 7 parameters present in this third-generation model or that expectations-augmented Phillips curve, and make our best effort in trying to distil the complexities of economic systems by observing that actual effects of particular events as opposed to fitting them into our abstract models. In the same manner, the puzzling deviations from rationality in experimental tests of economic behavior might eventually be treated with less contempt and more respect for their empirical value, rather than violations of microeconomic optimization when seen in the light of theories such as the Slutsky equation.

There is much to be learnt from this, and the echoes of these lessons would reverberate not just in the field of economics, but for the whole of reductionist science. A paradigm shift is required, and for all their academic brilliance, economists remain human, and as a consequence, resistant to change. It is in this area that the field of bioeconomics has the most to offer. By acknowledging and embracing the interface between biology and economics, the field has the potential to emerge as an entirely independent and influential school of thought, going into the future. Similarly, those schools of thought have resisted the mathematization route—one thinks of the Austrian and Institutional school in particular—and are in better stead to forge forward with this new approach. Others will need to undergo some cerebral 'creative destruction'.

Where does that leave the profession? There is a need to recognize that analysis by decomposition does yield its own payoffs. As Krugman (forthcoming) has argued, not unconvincingly, that simplification by reduction allows the analysis of complex phenomena, which would otherwise not be amenable to analysis, and it might also raise issues that would have been hidden in the absence of the math. Indeed, it is not uncommon for findings that have been put forth in a formal model to be counter-intuitive. Neoclassical models can also been extended to discuss issues of complexity and evolution. In a sense, then, formal modeling does contribute to the state of knowledge in the profession, and on the occasion that it is transmitted on to policy, economic welfare.

Yet, to insist that formal methods are the only methodology available, or to deride *a priori* studies based on non-mathematical, non-reductionist thinking would be to close the door to an entire wealth of knowledge on the basis of a method that has its own shortcomings. And whilst mathematical models will continue to proliferate in published economic literature, there can no longer be a strong argument made for the dismissal of theories that attempt to explain phenomena in less reductionist terms. Ideally, harmony can be found between the application of these two approaches, as economists such as Gordon Tullock and Jack Hirshleifer have shown. A holistic approach, which incorporates the tools used in biology and economics, should be the basis for future research.

And once again, all this would have been foreseen by Marshall (1890). In *Principles*, he argued that the 'Mecca of the economist lies not in comparative statics, nor even in dynamic analysis, but rather in "economic biology"... the study of the economic system as an organism evolving in historical time'. A visionary statement, spoken from beyond the grave.

Note

1. The successful draft sequencing of the human genome enjoyed comprehensive coverage in Science, 16 Feb 2001.

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