

The Knowledge Economy: A Critique of the Dominant View

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The knowledge economy is the science- and technology-intensive practice of production, devoted to perpetual innovation, that has begun to assume a commanding role in all the major economies of the world. It is present in every sector of these economies—in services and even agriculture, as well as in advanced manufacturing. In each sector, however, it remains a fringe, excluding the vast majority of workers and firms.

The insular character of this new vanguard of production has become a powerful driver both of economic stagnation, seen in slowing productivity growth, and of economic inequality, aggravated by the increasing distance between advanced and backward parts of the production system. It matters to the future of the United States, and of every country in the world today, that we understand both what the knowledge economy is now and what it can become. We have a stake in its deepening and dissemination: in the development of an inclusive productive vanguardism.

Paul Romer authored two papers, published in 1986 and 1990, that laid out what became—and what has remained—the most influential account of the knowledge economy within economics.¹ Charles Jones has recently presented an elucidation and defense of Romer’s approach.² An analysis of Jones’s spirited case helps reveal the deficiencies of Romer’s view as a basis for understanding the knowledge economy and its possible futures. These deficiencies speak to the inadequacy of the ways in which contemporary economics has addressed economic growth. They go more broadly to the limitations of neo-marginalist economic theory, which arose from late nine-

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teenth-century marginalism and remains at the heart of economics today. We need an alternative account of the knowledge economy, one that will have significant implications for economics and its methods.³

Economics and legal thought are the two major disciplines of power. When they misrepresent both how the market economy works under established institutional arrangements, and how it might work under alternative arrangements, they become enemies of prosperity and democracy, as they are now.

THE DOMINANT VIEW OF THE KNOWLEDGE ECONOMY

The dominant approach to the knowledge economy, inspired by Romer's early work, consists of three elements. The first element begins with the seemingly uncontroversial claim that, unlike all previous forms of production, whether advanced or not, the knowledge economy is organized around ideas. Ideas, unlike the inputs and products of past forms of production, are "nonrivalrous": their consumption fails to deplete them. When a new computer code or a new treatment for malaria is used by some people, it does not become any less usable by others (unless, that is, intellectual property law intervenes to limit access to its use).

The nonrivalrous character of ideas, which are supposedly the main object of the knowledge economy, in turn explains the possibility of increasing returns to scale. Without increasing returns to scale, the possibility of continued breakthroughs in productivity and growth remains doomed, as it is under the theories of economic growth that were most influential when Romer made his proposals.

The second element in Romer's treatment of the knowledge economy is the role of profit-maximizing entrepreneurs and imperfect competition. Although ideas and their resulting material benefits may be nonrivalrous, the law of intellectual property may intervene to limit or discipline access to their use and make them, under certain conditions, "excludable." Because ideas—or the goods and services in which they are embodied—are partly excludable and thus are not pure public goods, there is a place for private economic incentives and self-interested entrepreneurs in their development. There is also room for policies and arrangements that can bridge the gap between what private gains support and what social gains recommend.

The third element of Romer's account is its statement in a form that allows it to be adapted to the familiar formulas and equations of the production function: the economic concept describing the relationship between the quantity of output and the different quantities of inputs used in the production process. To fit the new protagonist—idea-based production—into the linear production function of growth theory, it suffices to substitute knowledge for physical capital in the respective equations. In the revised formula, the productivity parameter, as reshaped by the knowledge-based potential for increasing returns to scale, the amount of human capital in the economy, and the equilibrium fraction of human capital allocated to research (the expansion of knowledge) determine the path and rate of economic growth.

In this way, what seemed to be a fresh approach, focused on the importance of ideas to the new economy and on their nonrivalrous character, could be taken up without disturbing the settled habits of mind and the accepted methods of the discipline. Substantive novelty could be achieved without methodological disruption.

Of these three elements, the first plays the decisive role: it makes a claim about what is distinctive to the knowledge economy and why this difference matters. The second element builds a bridge to the incentive-based workings of a real-world, imperfectly competitive market order. The third element reconciles this story of the knowledge economy with what the economics departments of the leading American research universities regard as the hallmark of the field: its diversification of mathematical models, defined by the specification of new variables and of their values, against the background of a consistent theoretical conception of economic phenomena—indeed, a background that has barely changed, in its essentials, since the late nineteenth century.

It follows from this understanding of the structure of Romer's view that any criticism must focus on the first and most consequential of its three elements. Romer's account of the knowledge economy stands or falls on the merits of his description of what is distinctive about the knowledge economy.

IDEAS AND THE KNOWLEDGE ECONOMY

Is there—or can there be—a practice of production that, alone among all practices of production, gives a commanding role to ideas and

exhibits in its development the consequences of their nonrivalry? And does that practice lie at the heart of today's knowledge economy? The answer to both of these questions must be no.

On the one hand, there has never been a practice of production that fails to rely on ideas, and to translate them into a way of combining technology and labor. Consider the immediate precursor to today's knowledge economy as the most advanced productive practice of its time: mechanized manufacturing and its development into industrial mass-production. The mechanical inventions and organizational innovations that sustained nineteenth- and twentieth-century industry relied on the science of the time. Like every technology before or since, industrial production connected a way of mobilizing nature (in the form of energy) with a way of organizing work (in the technical division of labor). And like every technology before or since, it developed formulaic devices and work practices aiming at increasing efficiency by having machines perform many repetitive tasks.

If mechanized manufacturing and industrial mass-production failed to achieve their full potential to improve productivity, part of the reason may have been that they evolved in ways that consigned workers to a narrow stock of repetitious movements, leading the workers to work as if they themselves were machines. The shortfall from potential productivity had more to do with the distribution of property and power than with the intrinsic limitations of the technology of the time, or of the science on which it depended.

There are no ideiless practices of production. But it is equally true that there is no practice of production that traffics in disembodied ideas and their nonrivalrous, and thus potentially inexhaustible, use. Neither is today's knowledge economy such a practice; it is not an economic equivalent to nature without friction.

Those who claim that the knowledge economy represents a jump into such a world argue that, because ideas (such as a computer code or a treatment for disease) can be used without depletion, they yield increasing returns to scale and consequently lay the basis for exponential growth. Jones makes such an argument when he distinguishes production under the knowledge economy from production as it previously evolved and was studied in the literature of economics: "Solow had constant returns to scale and therefore diminishing returns to capital, and this is what dooms growth in the neoclassical

model. Now that we have increasing returns to objects and ideas together, it is not clear that diminishing returns . . . dooms us in the same way.”⁴ There should be no diminishing returns to the use of ideas in the way that, under the Solow growth model, there were diminishing returns to capital against the background of constant returns to scale.

Of course, the need to reconcile the economic consequences of nonrivalrous ideas with the logic of economic incentives remains: the law of intellectual property will have to allow certain economic agents to control, in their own interest, access to otherwise inexhaustible ideas. By being made excludable, the ideas—or the products in which they result—become objects of an economic interest and even the sources of a rent. There is always the danger that the legal logic of excludability will interfere with the advantage of nonrivalry and with its promise of increasing returns to scale. In this narrative, however, the risk of such interference is a price that we must pay to bring the revolutionary advantage enjoyed by nonrivalrous ideas down to the earth of interests and incentives.

Before exploring the confusions and fallacies that lie at the heart of this narrative, it is important to pause on a prior point: the conception of the knowledge economy as a practice of production that is not only organized around ideas but that also shares in the attributes of ideas. Because it shares in their attributes, it differs from all previous forms of production, which had no such internal and intimate relation to ideas.

Today’s knowledge economy does differ from earlier practices of production, but it is no easy matter to settle on an accurate view of what distinguishes it. In each sector in which the knowledge economy has taken hold, it remains an insular vanguard, underdeveloped and even elusive. A practice of production reveals its deepest features and higher potential only as it spreads across a wide range of forms of economic activity, but the knowledge economy has yet to do that. We cannot do justice to its nature—in the arrested version that it now takes or in the deeper and widespread form that it might take in the future—by representing it as an economy of ideas that happens to be given material expression and to intersect with economic arrangements and incentives. Just as no practice of production has ever been idealess, no practice of production can ever work, or be understood, as bodiless—if by the body we mean the detailed ways in which we

bring together our discoveries of the workings of nature, our mechanical devices, and our regimes of cooperation.

Consider the example of the application of artificial intelligence to the task of organizing the way in which high-skill workers use 3-D printers and other numerically controlled and adjustable machine tools in advanced manufacturing. Among the tasks to be addressed is the allocation of machine and labor time among three main tasks: (1) the manufacture of variable batches of relatively standardized products; (2) the occasional development, by analogical extension, of new variants of these standardized products; and (3) exploratory tinkering with the goal of creating products that no one ever envisioned before but that people working with advanced machines discover that they can make. This third category evokes the difference between a national defense strategy that is organized around foreseeable combat situations (for example, a conventional war on a particular frontier or an asymmetrical proxy war against a distant power manipulating a troublesome neighbor) and a strategy that is built around military capabilities and their alternative uses. The allocation of resources and time among these three tasks is a problem that must rank high in the concerns of a contemporary knowledge economy. As in the role of algorithm-based investment decisions in finance, the division of labor between machines replacing human minds and minds monitoring and using machines remains open to experience and experiment.

How can the development of artificial intelligence in computer science and mechanical or electrical engineering be driven by attempts to accomplish these three tasks? How can production be set up so that it becomes part of the process of perpetual innovation rather than a passive, occasional beneficiary of scientific discoveries and technological breakthroughs external to itself? What kind of worker, educated in what way, can rise to this challenge? What way of organizing work can make the most of technical and economic opportunities? And under what legally defined institutional arrangements and cultural impulses is such a way of organizing work most likely to prevail and flourish?

None of these questions speaks to the conventional account of the knowledge economy as a practice of production organized around disembodied, nonrivalrous ideas that the law of intellectual property allows profit-seeking entrepreneurs to turn into sources of rents. All these questions concern the nature of innovation—its episodic or

perpetual character, the extent to which it is or is not integrated into productive activity, and the degree to which experimentation is favored or inhibited by established institutions and culture. It is there, rather than in the specious contrast between production-as-ideas and idealess production, that we must look for what makes—or can make—the knowledge economy distinctive. And the distinctiveness is likely to show and to count only as the knowledge economy begins to break out of the insular vanguards to which it has thus far remained confined.

INCREASING RETURNS TO SCALE AND DIMINISHING MARGINAL RETURNS

If the first basis of Romer's view is an untenable contrast between a practice of production centered on ideas (supposedly today's knowledge economy) and all earlier productive practices, the second basis is a thesis about the potential of the knowledge economy to yield increasing returns to scale. To understand the content of this thesis and the mistake that it makes, we need to address an unrecognized source of confusion in standard economic theory: the relation between constant returns to scale and diminishing marginal returns. The confusion is all the more significant and influential—yet largely disregarded—because it forms part of the basic education of economists (as well as that of the much larger number of young people who are exposed to introductory courses in the discipline but go on to specialize in other fields). One can often find this confusion, misrepresented as simple logic, in an early chapter of many textbooks.

Begin by recalling and distinguishing the two concepts: constant (or increasing or diminishing) returns to scale and diminishing marginal returns. The concept of returns to scale refers to the relation between two quantities. The first quantity is the increase or decrease in factors or inputs committed to the production of a good or service when all factors or inputs are increased or decreased in the same proportion. The second quantity is the resulting rise or decline of output, registered over the long term. Returns are constant when output rises or falls proportionately to the increase or decrease of inputs.

The occurrence of constant returns to scale is a defeasible, default assumption. Its function resembles that of constant motion in Newtonian mechanics. Any number of real-world conditions, including

prejudicial or beneficial interactions among the inputs to production, can (and frequently do) cause departures from constant returns. A larger factory can be (and often is) more or less efficient than a smaller one. The default assumption of constant returns to scale is useful because, like so much of economic analysis, it facilitates revealing simplification. But it remains simply a convenient supposition, holding true only in the absence of any of the factors that may (and perennially do) negate it.

Diminishing marginal returns refers to something altogether different. Increase one of the inputs to a process of production, and the returns in output to the increase of that input will rise, plateau, and then fall at the margin. Why?

Diminishing marginal returns has been the closest thing in economic life to a universal law, yet its basis remains obscure. Its significance was obfuscated rather than elucidated in the economic theories that resulted from the marginalist turn of the late nineteenth century and that subsequently became dominant.

Both in standard introductions to economics and in major theoretical projects, such as the theories of economic growth that formed the immediate background to Romer's view of the knowledge economy, diminishing marginal returns are presented as a straightforward implication of the default principle of constant returns to scale. If there is an increase in the commitment of an input or factor, that increasingly committed input or factor must be subject to diminishing marginal returns. Otherwise, the condition of constant returns to scale would be violated. This thesis plays an important role in, for example, Solow's growth theory. Jones observes, "what Solow showed is that the accumulation of objects in a neoclassical setting runs into diminishing returns and cannot, by itself, sustain exponential growth."⁵ The tenacity of diminishing marginal returns is presumed to require no further explanation; it is simply a logical consequence of the default principle of constant returns to scale.

There are two objections to this way of combining these concepts, however. The first is that it gives a fundamental, explanatory status to an assumption—constant returns to scale—that has never been, or deserved to be, more than a convenient and conventional stipulation, frequently violated in reality. It is in no sense an economic law. It is not a settled regularity of economic life. It describes no causal force in the workings of an economy. It consequently lacks any explanatory

power of its own, except insofar as it may play a role in a set of ideas that draws such power from other sources.

The second objection is that it infers the closest thing that the economy has to a law—diminishing marginal returns—from one of the economic concepts that is furthest from such lawlike status. It presents diminishing marginal returns as a logical consequence of constant returns to scale: if there is an increase in the commitment of an input or a factor, with other factors or inputs held constant, the pseudo-law of constant returns to scale will be violated unless returns to the increased input or factor fall off quickly. But, as noted, constant returns to scale was never a rule to begin with and so cannot help explain the phenomenon of diminishing marginal returns.

The pre-marginalist or “classical” economists were fascinated and puzzled by the phenomenon of diminishing marginal returns. They sensed its importance but lacked the ideas with which to explain it. The marginalist economists and their successors found a way of presenting it that accorded with the nature of marginalist economics as a quasi-logical inquiry more than an empirical science. The result, however, was to put a specious explanation in the place of no explanation at all.

We can look for the beginning of an explanation of diminishing marginal returns in the nature of innovation—whether technological, organizational, institutional, or conceptual—in the forms that innovation takes, and in the relation of these different forms to the production system and to economic growth. What resists, avoids, or postpones the eventual fall in the return to an input or factor in production is innovation. Any given way of using an input or a factor will have limited potential. That this potential, after having been exploited, will eventually be exhausted is the heart of the intuition supporting the concept of diminishing marginal returns. The only way to escape such exhaustion of potential is to innovate again.

If innovation consists of a set of discrete, discontinuous episodes, however, it will not defeat—although it can postpone or alleviate—diminishing marginal returns. The innovation will enhance the forced accumulation of inputs or factors with a onetime boost to productivity. Each innovation will itself be equivalent to an input under the law of diminishing marginal returns.

Innovation is more likely to be episodic rather than perpetual if it is external to the production system, imported from the independent

evolution of science and technology rather than anchored in production itself. It is more likely to be internal to the production system if the cooperative regime at work is one that empowers all participants in production and mitigates the tension between cooperating and innovating. And this result is more likely under some models of organizing power and property than it is under others. The roots of the law of diminishing marginal returns, as well as the prospect for loosening or reversing it, lie in the specific form that innovation takes, in its relation to production and cooperation, and in the institutional arrangements of the economy.

I have already referred to the role that diminishing marginal returns, as well as its supposed premise of constant returns to scale, play in Solow's growth theory, dooming the possibility of exponential growth. We can now add (with Jones's help) the place of these conceptual connections in Romer's view of the knowledge economy. According to this view, because ideas are nonrivalrous, they make possible increasing returns to scale. The same idea-based instructions—to produce a new antibiotic or computer code, for example—can be used again and again. As Jones remarks: "Once the instructions have been invented, they can be used in one lab, two labs, or any number of labs simultaneously. This means that, as long as more knowledge is useful, if we double the objects and double the knowledge as well, we will more than double the output. . . . That is, production is characterized by increasing returns to scale."⁶

Thus, the nonrivalry of ideas overcomes the bar that constant returns to scale (supposedly and illogically) impose on exponential growth. The loosening of the constraint of diminishing marginal returns—the real prize in this story, given its status as the heretofore most unyielding and universal regularity in economic life—appears as a secondary and often unmentioned by-product of the transgression of a principle that never had a well-founded claim to explanatory force, universality, or even persistence, in the first place.

The excludability imposed by the law of property in general, and by the law of intellectual property in particular, completes the argument. At the cost of qualifying the promise of increasing returns to scale, it makes the indispensable connection with real-world economic incentives and profit-seeking businesses. The consequent divergence of social and private gains opens up space for the familiar

repertoire of policy, regulation, and retrospective redistribution designed to bridge the gap between private and social returns.

The connected fallacies in this sequence of reasoning, which Romer's view inherited from the marginalist tradition and the "neo-classical synthesis," divert attention from a question of vital theoretical and practical importance: the specific conditions under which the real constraint of diminishing marginal returns (as distinguished from the bogus one of constant returns to scale) might be lifted or even reversed. Those conditions have to do with the forms of innovation and with the links among innovation, cooperation, and production, both at the level of the firm and at the level of the economy as a whole, as well as with the political and economic setting of economic activity. They come into focus only after we have discarded the contrast, which Romer takes as his point of departure, between a practice of production centered on ideas (i.e., today's knowledge economy) and everything that came before.

RUNNING OUT OF IDEAS IN AN IDEA-BASED ECONOMY

There is a more direct and tangible objection to the view that the contemporary knowledge economy has brought us, thanks to the non-rivalry of ideas, to the threshold of a world of increasing returns. The objection is that we observe no such generalized advance toward increasing returns to scale or toward the exponential growth that it would make possible.

In fact, something close to the opposite of the prediction of a generalized increase in returns to scale has come to pass. In the United States, a period of high productivity growth from 1947 to 1972 has been followed by much more sluggish growth in the decades since, interrupted only by a productivity spike from 1994 to 2005. We can attribute this spike most persuasively to a onetime boost afforded by the introduction of information technology in a range of large firms, which were disproportionately able to benefit from this technology and to finance it. The performance of the economy before and since this spike prompted Solow's quip that "you can see the computer age everywhere but in the productivity statistics."⁷

This disappointing growth has been so widely experienced, even in some of the most advanced parts of the economy, and it has gone on for so long, that it has inspired the resurrection of Alvin Hansen's old doctrine of "secular stagnation."⁸ But the theory is now also enhanced

by a species of technological pessimism that was alien to Hansen's view: the claim that today's technological innovations are both less useful and less revolutionary than the technological innovations of the past century (although it seems that no technology could be more revolutionary than artificial intelligence).

The effect of the discourse of secular stagnation is to cast an undeserved halo of naturalness and necessity on a contingent historical development. The characteristic practices of the knowledge economy are present at the vanguard of every sector of production: in intellectually dense services, in scientific agriculture, and in advanced manufacturing. A relative effacement of the distinctions among sectors has accompanied the emergence of these practices; advanced manufacturing now consists largely of crystallized intellectual services. Today's knowledge economy is multisectoral, and the border separating it from the rest of the production system remains porous. It nevertheless continues to consist of a series of insular vanguards, excluding the vast majority of firms and workers. The widespread use of its products and services has failed to result in the propagation of its distinctive practices.

The confinement of the knowledge economy to the exclusive fringes in which it now flourishes has decisive consequences for economic stagnation as well as for economic inequality. The widening chasm between advanced and backward parts of the production system generates inequalities that redistributive policies such as progressive taxation, entitlements, and transfer payments are insufficient to correct. The degree of corrective redistribution would need to be massive to meet the challenge. Long before it crossed that threshold, it would begin to distort established economic incentives and arrangements and to exact an unacceptable cost in diminished output.

Nothing more is needed to explain the productivity slowdown than the denial, to the vast majority of business and workers, of the productive practices that—more than the centrality of ideas—distinguish the knowledge economy. If most people and firms are denied access to the most advanced practice of production, how could the growth of productivity fail to slow down? It is an explanation that dispenses with the special pleading of the secular-stagnation discourse and its counterintuitive claims about the limited potential of contemporary technological innovations. Unlike that discourse, with its fatalistic message, it directs attention to a practical concern of immense

importance: the educational, social, and legal-institutional requirements for the dissemination of the knowledge economy beyond the insular vanguards in which it remains arrested.

The failure to observe any generalized occurrence of increasing returns to scale, and of the exponential growth to which such occurrence would lead, motivates a defensive maneuver that goes one step beyond the technological pessimism of the updated secular-stagnation narrative. After referring to studies that purport to show the declining productivity of research, Jones concludes, “it could be easy to find ideas for a while and then harder, or vice versa. Or it could become ever easier over time until we suddenly run out of new ideas.”⁹

In other words, while the knowledge economy is all about ideas, nothing guarantees that we will find them—or find the right and most useful ones. We can call the spirits but they may not come. Ideas, supposedly the opposite of objects, may in some respects be like metals in the ground, buried so deep that they become too difficult, or not worthwhile, to retrieve.

The desperate suggestion that we may be running out of ideas in the age of the idea-based knowledge economy seems contrary to what we ordinarily assume about how ideas develop: that the more ideas we have, the more new ideas we can come up with, if only by analogical extension, or by what Charles Sanders Peirce called “abduction” from the ideas that we already possess. Nevertheless, the claim that research may be declining in productivity and ideas may be getting harder to find, even as they become more central to production, serves the purpose of reconciling the triumphalism of the doctrine of generalized increasing returns to scale with the inconvenient fact of declining productivity growth.

THE PLATFORM OLIGOPOLIES

There is one part of the knowledge economy that does lend itself to increasing returns to scale. It is the part most often identified in the public imagination with the knowledge economy as a whole: the high-technology platform oligopolies. Because it includes some of the most valuable businesses in the United States by market capitalization, and because it exerts worldwide influence on social life and culture, this segment can easily be mistaken for the concentrated expression of the newest and most advanced practice of production or

the most revealing harbinger of its next future. In fact, it represents a context-dependent anomaly.

In this corner of the production system, we do find increasing returns to scale. We do not, however, find them there for the reasons emphasized in Romer's or Jones's account. They are the effect of a unique combination of context-specific facts: technological opportunities, institutional arrangements, legal rules, and business models. We could never infer the content of that combination from any general and abstract conception, such as the conception of an economy organized around nonrivalrous ideas.

Four context-specific facts play a major role in defining the platform oligopolies. Although the first of the four may have overriding importance, all four matter to the result.

The first fact is the existence of what have conventionally been dubbed network effects in the business of the platform companies. Much of the appeal, and consequently of the economic value, of the platforms lies in the size, inclusiveness, or universality of their user base. As a consequence, antitrust law is an inadequate instrument for taming their abuses. Breaking these companies up would destroy a large part of their social value. Innovations in the regimes of governance and property hold more promise.

The second fact is the advantage that very large firms enjoy in exploiting the information and communication technologies of the knowledge economy. Such firms can most easily absorb the high fixed costs of these technologies and put them to most rewarding use in the management of complex information and social connections.

Large firms are able to increase their advantage by relying on the third attribute of this field of economic activity: near-zero marginal cost in admitting new users to the platform. A press of the button may be enough to add the next customer, with no corresponding need to add anything to the network other than expanded monitoring and data harvesting—itsself a source of profit. Low marginal cost is the most immediate and tangible basis of increasing returns to scale, which becomes a matter of pure accounting. It demands no reference to ideas—like new computer codes, new antibiotics, or even new works of art. All that it requires is a service rendered through intangible and easily expanded electronic connections. To describe such a service as a traffic in nonrivalrous ideas would be to miss the point and to put a philosophical abstraction in the place of a prosaic reality.

The fourth fact is the adoption by the platform companies of a business model dependent on the unremunerated exploitation and sale, especially to advertisers, of personal data. Notice that this fourth characteristic represents the indispensable link to economic incentives and profit-making entrepreneurs. But it is not based on what Romer's view takes to be the link: legal excludability supported by exclusive ownership. Exactly the opposite happens: it is possible for the platform businesses to get something—the valuable data in which they traffic—for nothing, because a legal lacuna places this something beyond the purview of property and intellectual property law. The source of the advantage is a species of nonexcludability.

This explanation of the increasing returns exacted by the mega-platforms requires no magic. It is an explanation that need not rely on an empyrean in which nonrivalrous ideas open the way to exponential growth. Instead, it deals with a sublunary world in which ingenious businesspeople discover how contemporary information and communication technologies can be wedded to loopholes in the law of intellectual property to get a great deal for almost nothing.

In Romer's account of the knowledge economy, increasing returns to scale are a natural result of the difference between ideas and objects; the loosening of diminishing marginal returns occurs as a by-product. There is no need to do any of the hard work—changing how people use machines and reconciling cooperation and innovation, or how they teach and learn, or how they decentralize access to productive resources and opportunities—that would be needed to increase productivity and loosen or reverse the genuine law (if there is any law in economic life) of diminishing marginal returns. Here, in the real world of the platform oligopolies, the possibility of achieving increasing returns to scale without doing that hard work finds partial, unexpected, and disturbing vindication. This kind of increasing returns to scale used to be called a rent.

ROMER'S VIEW RESTATED: ITS MAJOR FAILINGS

We can now look back and see how the deficiencies in Romer's view of the knowledge economy connect. We can also appreciate why, despite these defects, his approach has proved appealing. And we can find the source of these mistakes in the way of thinking that has prevailed in economics ever since the marginalist turn of the late nineteenth century.

The first and most fundamental theme in Romer's view is the thesis that, unlike all earlier practices of production, today's knowledge economy is organized around ideas and benefits from their most important economic feature, their nonrivalry. To use them is not to deplete them. The centrality of ideas in this practice of production opens the way to exponential economic growth.

The contrast between an economy organized around ideas and everything that existed before in economic history is false. There never has been a form of production that failed to depend on ideas. Moreover, the knowledge economy cannot be adequately understood as a march of ideas, discoveries, and inventions that happen to have economic consequences and happen to be pursued under the pressure of economic incentives.

Rather, the knowledge economy is distinguished by a set of practices at the level of the firm or the workplace. It combines capability for production at scale with destandardization of products and services, and it unites decentralization of initiative with the preservation of coherence and momentum in the process of production. Its characteristic technologies have coevolved with these practices.

What chiefly distinguishes the knowledge economy beyond these relatively superficial traits are certain deeper attributes or potential lines of development that it reveals only imperfectly in its present, confined form. The most basic of these undeveloped powers is movement in the direction of making innovation perpetual rather than episodic and anchoring it within production as well as importing it from the external progress of science and technology. Such accelerated innovation holds the promise of loosening or even reversing what has until now been the most constant and unyielding constraint in economic life: diminishing marginal returns.

The second deeper faculty of the knowledge economy is its promise to bring the practice of production closer to the work of the imagination and to change the relation between workers and machines. The ideal limit of this change is partnership between the machine—which does everything that we have learned how to repeat—and the anti-machine, the human being, who can transgress established methods and presuppositions and can develop retrospectively the ideas that make sense of what we have discovered.

The third promising characteristic of the knowledge economy is that it requires a change in the moral culture of production, the better

to exploit the potential of new productive practices. The forms of production and industrial organization that preceded the knowledge economy were marked by the generalization of low trust among strangers. Low-trust production and exchange were formalized in the characteristic organizational structures and legal arrangements of market economies: command and control within the firm and traditional contracts—arm’s-length bargains exhausted in an instantaneous performance—among firms.

Everything in the development of the knowledge economy depends on raising the level of trust and discretionary initiative allowed to and demanded of all participants in the productive process. Everything calls for higher forms of innovation-friendly cooperation. These practices may require legal instruments that differ from the legal devices of low-trust production and exchange, such as the arm’s-length, short-lived, fully articulated contract, or the unified property right, vesting all the component powers of property together in a single right holder, the owner.

By presenting the problem of the knowledge economy in this way, an alternative view of the knowledge economy begins to emerge. Central to this view is insight into the suppressed potential of this practice of production. The knowledge economy deepens by spreading and changing; insofar as it remains restricted to the fringes in which it now prospers, it reveals only fitfully its deeper traits and greater possibilities. But the changes that are needed for this potential to be actualized cannot spontaneously occur in market economies as they are now organized.

Some of these changes are cognitive or educational. They demand, for example, not just more investment in research and in the formation of technical personnel but a remaking of both technical and general education: a way of teaching and learning that prioritizes capabilities over content, prefers selective depth to encyclopedic superficiality, rejects the juxtaposition of authoritarianism and individualism in the classroom in favor of cooperation among students, teachers, and schools, and deals with every subject from multiple and contrasting points of view.

Other changes are social or moral. The knowledge economy thrives on the basis of a heightening of trust and discretion and an accumulation of social capital. It therefore depends on a multiplication of forms of collective action—people doing many things togeth-

er—in politics and social life as well as in the economy. The most important and complex changes have to do with the legal and institutional arrangements of the market order: those that shape the terms of decentralized access to productive resources and opportunities, including contract and property regimes. They encompass as well the ways in which private and public entities can interact and cooperate legally and economically in order to deepen and disseminate the most advanced practice of production.

The institutional and legal innovations useful to the deepening and dissemination of the knowledge economy are not about regulating the market (to the extent that regulation differs from reorganization) or about alleviating market-generated inequalities through retrospective and compensatory tax-and-transfer schemes. They are about changing the legal constitution of the market order. The debate that they concern is not about how much market (*vis-à-vis* government); it is about which market. They may begin modestly, for example in the development of a system of industrial extension that would parallel the agricultural extension that played such a large part in the advance of family-scale entrepreneurial agriculture in the nineteenth century. But they would advance by creating alternative regimes of property and contract that would coexist experimentally in the same market order.

It would not be enough to create the institutional machinery to give a much wider range of firms access to advanced practice, technology, and knowledge, as well as to credit. It would also be necessary to do the same for the growing number of workers who have tenuous or no connections to firms. The place to begin is the hollowed-out middle part of the job structure: helping to turn machine repair technicians or nurse practitioners, for example, into technologically equipped artisans.

This understanding of what the knowledge economy requires to grow invokes no blueprint or system; it marks a direction and signals initial steps suitable to the circumstances of a contemporary economy such as that of the United States. It also points to broader features of culture and politics that make it more or less likely that a society will be able to fulfill these requirements. The cultural basis for a deepened and widespread knowledge economy is the radicalization of an experimentalist impulse in every part of social life. The political basis is a high-energy democracy that makes change less dependent on crisis because it increases the level of organized popular engagement in

political life, resolves impasses quickly (repudiating the conservative principle of slowing down politics while reaffirming the liberal principle of fragmenting power), and combines the possibility for decisive action on the part of central government with opportunities for radical devolution to states and towns—the creation, in different parts of a country, of countermodels of the national future.

A second theme in Romer's approach to the knowledge economy is its development of the thesis that production organized around ideas achieves exponential growth by making possible increasing returns to scale. A premise of this thesis is that constant returns to scale prevent such growth. I have argued that the unreliable and defeasible assumption of constant returns to scale—regularly violated in every aspect of economic life—cannot bear this weight.

What excludes the possibility of exponential growth is the constraint of diminishing marginal returns. And what loosens or even reverses this constraint is the quickening of innovation—technological, organizational, institutional, or conceptual. More precisely, it is the development of a practice of innovation that is perpetual rather than episodic and that is internal to the process of production as well as imported from the independent evolution of science and technology. It then becomes crucial to identify the features of a cooperative regime—at the level of the firm, among firms, and in the economy as whole—that favor perpetual and endogenous innovation.

The confusion about the relation between constant or increasing returns to scale and diminishing marginal returns that plagues this second aspect of Romer's account results, foreseeably, in mistaken descriptions and predictions. Nothing in that account helps explain its most startling discrepancy from the facts of the matter: productivity slowdown rather than exponential growth in the midst of the revolutionary changes initiated by the knowledge economy.

The third theme in Romer's account is largely undeveloped. It is significant more for what it does not say, but only assumes, than for what it explicitly claims. It is the view that the economic potential of the knowledge economy will go wasted if the opportunities for exponential growth that it opens up fail to be connected to the interests and incentives of profit-making entrepreneurs. Here is where the law of property and intellectual property matters, with its ability to make nonrivalrous ideas, embodied in goods and services, excludable.

Romer and his followers have little to say about the legal and institutional content of this third part of their account, other than to acknowledge its indispensability to the success of the knowledge economy. Their silence here reaffirms the inclination of almost all practical economics over the last century and a half to accept the proposition that the decentralized, free enterprise economy has a more or less predetermined legal and institutional architecture: a market is a market, a contract is a contract, and property is property. There is, according to this view, room for only modest variation in the arrangements shaping the relation of government to firms and other private economic agents and, to a lesser extent, of labor to capital. There is even less room for variation in the basic terms of economic decentralization, expressed in the private law of property (including intellectual property), contract law, and the law of juridical personality (corporations, partnerships, and other private entities established to make a profit).

Romer's formulaic reference to excludability represents a gesture to the traditional law of property and intellectual property. This established law, however, is inimical to the deepening and dissemination of the knowledge economy. Thus, the gesture amounts to an abdication. It is characteristic of a view of the knowledge economy as a practice of production that has sprung fully grown, like Athena, the goddess of ideas, from the head of Zeus, the guarantor of time-tested rules and established order.

Yet a hundred and fifty years of legal analysis have demolished the idea that a market order has a predetermined institutional shape. In the legal design of such an order, at every step from abstraction toward greater detail, there are choices to be made among alternative institutional designs and how they are expressed in law. Such choices matter to the organization of production and exchange as well as to the distribution of advantage and opportunity. We cannot hope to answer these questions by inferring the answers from the abstract idea of a market system. We can answer them only by taking a stand on conflicts of interest and of vision.

The last great moment of institutional and ideological refoundation in the rich North Atlantic world was the social-democratic or social-liberal settlement of the mid-twentieth century, known in the United States as the New Deal. Under this settlement, a new body of public law was superimposed on a largely unchanged body of private

law—the law shaping the basic forms and terms of decentralized economic initiative and therefore also of decentralized access to productive resources and opportunities.

The institutional and legal details are all important. We cannot derive them from abstractions. To see the knowledge economy as a set of unfinished practices confined to insular vanguards rather than as an economy of ideas that happen to have economic consequences is to grasp the importance of such details. For the knowledge economy to flourish, we need to experiment with alternatives to the institutional and legal arrangements that currently determine the form of market economies.

The traditional unified property right concentrates the constituent powers of property—those that the civil-law tradition distinguished as use, usufruct, and alienation—in a single owner. The developed knowledge economy needs the multiplication of derivative, fragmentary, temporary, and conditional forms of property. This fragmentation and diversification of property make it possible for different tiers of right holders—workers, local governments, and communities, as well as investors—to hold distinct claims simultaneously on the same productive resources.

The established law of intellectual property—much of it an invention of the late nineteenth century—also favors the exclusive and long-standing, albeit temporary, prerogative of a single right owner: the patent, copyright, or trademark holder. But the knowledge economy needs a proliferation of alternative ways to reward innovation, without allowing the rewarded to impose exclusive control on their inventions and to charge unshared rents for their use.

Classical contract law—the counterpart to the traditional law of property—is organized around the idea of an all-or-nothing, fully articulated bargain, which fails to be valid if any of its major terms are left open and which has as its goal an instantaneous performance or exchange of benefits. It is suited to the conception of a market order as a regime of simplified and largely arm's-length collaboration, based on the generalization of a low amount of trust among strangers. Such an order is impossible when there is no trust and unnecessary when there is high trust. The evolution of the knowledge economy, even in its present truncated form, demands an expanding practice of collaboration—including collaboration among firms that remain competitors even as they also become partners. It makes increasing use of

incomplete, relational contracts that leave crucial terms open and have a practice of shared innovation as their aim, rather than a discrete and momentary performance.

The conventional form of regulation assumes a stark contrast between regulation and reorganization. Its premise is the existence of a localized flaw in the market order—some failure of competition or of symmetrical information—that creates an advantage detrimental to competitors or to the public interest. The goal is to restore the market order or to compensate for the flaw, preventing opportunistic action from taking advantage of the market failure for private gain. The knowledge economy requires a way of regulating that treats regulation as an experimental, piecemeal, context-bound form of reorganization. Such an approach splits the difference between the top-down creation of rules and the bottom-up development of methods of cooperation. It features both cooperative competition among private agents and experimental collaboration between private and public agents.

In each of these areas, what matter are the direction and the legal-institutional details. The desired outcome is to reconcile, in each domain of economic and social experience, the need to cooperate and the need to innovate. Cooperation and innovation need each other. They also conflict: every innovation threatens to disturb the expectations and rights of each group—capital vis-à-vis labor and each segment of the labor force in relation to every other—supported by the established regime of cooperation.

The best cooperative regime is the one that does the most to mitigate this conflict. It begins to do so by distinguishing the safeguards, endowments, and equipment that render the individual worker and citizen capable and secure in the midst of change from the arrangements and practices that open up the economic order to wider experiment and disruption. It is the regime that organizes the storm of innovation and competition, while providing the individual agent, in his haven, with the means with which to move in that storm. It is the regime that does the most to turn him into Milton's seraph Abdiel, who was unshaken, unseduced, unterrified.

A fourth theme in Romer's account is its expression of its claims in the familiar model-making language of neo-marginalist economics and, in particular, of the linear production function equations of the received theories of economic growth. Jones marvels at how easy it is

to fit Romer's approach seamlessly into these equations by adding a new variable (knowledge) here and an index (the level of technology) there. We simply write the production equations to suit ideas rather than objects.

The facility suggests how completely Romer's methods and proposals are assimilable to the standard analytic practice of the economics that resulted from the marginalist turn and that has ever since defined the main line of the discipline. It does not occur to Jones that this ease may be disturbing rather than reassuring. It sounds as the thirteenth of a clock, which casts doubt on the previous twelve chimes. The weaknesses of the marginalist tradition, the main source of contemporary economics, help explain the deficiencies of Romer's treatment of the knowledge economy. We cannot do justice to the knowledge economy—or indeed to any major problem in the understanding of contemporary economies—without rebelling against this tradition.

THE LIMITATIONS OF NEO-MARGINALIST ECONOMICS

The limitations of what has been the principal direction taken by economics since the 1870s help explain both the defects and the influence of Romer's approach to the knowledge economy. That approach fits readily into the production-function equations of the earlier generation of growth theories because it shares the fundamental assumptions and methods of those theories. These assumptions and methods were originally set by Léon Walras, William Stanley Jevons, Carl Menger, and their contemporaries.

The marginalists represented the economy as a set of connected markets. In the pursuit of their desires, individual economic agents make decisions about the comparative use of scarce resources. Each such decision influences, at the margin, relative prices, the explanation of which became the exemplary task of the new economics. In this way, the marginalists freed the analysis of relative prices from the fruitless discussion of a substrate of value. Moreover, they attempted, with consequences that they and their successors failed fully to grasp, to develop a style of economic analysis that would escape the causal as well as the ideological and normative controversies that had seemed to compromise the scientific pretensions of social and economic thought. They did so by exploiting the extent to which their central

topic—maximizing choice in a market under the constraint of scarcity—lent itself to deductive reasoning.

The economic theory originating from the marginalist turn has never been the only way of doing economics. Even at the time of its appearance and on one of its home grounds—England—it had rivals (such as Alfred Marshall’s conception of economics as a context-bound empirical science, in the spirit of natural history, like the study of weather or of the tides, or Francis Edgeworth’s view of economics as a psychological science best developed through distinctive mathematical methods). But although these and other departures from the marginalist template have enriched the practice of economics over the last century and a half, they have never undermined the hegemony of what we might call neo-marginalist economics or what has more often been labeled the neoclassical synthesis.

Keynes’s limited heresy was soon reduced by his followers to the theory of fiscal and economic policy. Renamed “macroeconomics,” it was superimposed on the economics created by the marginalists that had come to be labeled “microeconomics”—the core of the discipline. Thus, what had begun as a contest between two ways of thinking was soon reduced to a division between two parts of the same textbook. The economics formed in this mold suffers from four major flaws. They help make Romer’s account of the knowledge economy what it is.

A first flaw is the dissociation of formal analysis from causal explanation. The Austrian economists were at once the most clear-sighted and intransigent defenders of the new economics. They understood that it was closer to being a species of logic than a causal science. Its analytic apparatus operated only with the help of causal ideas, factual stipulations, and normative commitments supplied to it from outside. When it was rigorous, it was empty. It worked by multiplying models stated in mathematical form.

It might be objected that there is at least a foreshadowing of causality in the idealized image of an economic agent who chooses among different ways to satisfy his preferences, or achieve his goals, in a setting of scarcity and of more or less competitive markets. In fact, this image amounts to a simulacrum of causal thinking rather than to the initial step in the making of a causal theory. The proof that it does not represent such a step is that there is no way to develop, challenge, and revise it other than by treating it as an empty vessel

into which we can pour causal ideas that we import from another discipline, like psychology, or formulate on the spot.

If a model fails to fit the facts, the economist replaces it with another one by changing its elements, their values, or both. The substitution of models, driven by an accumulation of empirical findings, never brings the background theory into question, however, because that theory was never a contentious causal vision to begin with. Thus, neutrality and invulnerability have been purchased at the cost of sacrificing the dialectic, indispensable to every real science, between theory and fact. Austere theory and plentiful empiricism coexist in this way of doing economics. But they have little to do with each other.

Facility in disposing of empirical trouble by switching models, rather than by changing theory, is not an advantage; it is a condemnation. It threatens to condemn economics to an eternal infancy. And it helps explain why this mathematics-worshipping discipline rarely uses any mathematics developed after the middle of the nineteenth century: only relatively primitive mathematics is needed to express the varieties of deductive reasoning that such a practice of economic analysis needs.

Romer's view bears the imprint of this false advantage. It cannot be understood without appreciating that it has no rich background of causal disputes about the workings, and possible transformations, of contemporary economies on which to draw. The existing models seemed not to work. Create a new one with an additional element—ideas, as distinguished from objects—modified by an additional index—the level of technology. And compensate for the absence of a developed causal view by deductively inferring the behavior of this additional element from its most notable intrinsic property, nonrivalry. If the facts of the matter fail to confirm the expected results—generalized increasing returns to scale—make up a reason for the discrepancy: ideas are becoming harder to find.

A second flaw of this theoretical tradition is its deficit of institutional imagination. This deficit is manifest in the coexistence, in neo-marginalist economics, of three ways of avoiding or misrepresenting economic institutions.

There is pure economics, represented by the original marginalism as well as by the general-equilibrium analysis of the mid-twentieth century. It is empty of institutional commitments and implications.

There is fundamentalist economics, exemplified most starkly by Hayek and his school. It views the market economy as having a single natural and necessary legal form: if Robinson Crusoe traded long enough on his island, he would eventually recreate the system of nineteenth-century German private law. And then there is equivocating economics, of which one example is the macroeconomics practiced by the American followers of Keynes in the closing decades of the twentieth century. It seeks to find lawlike relations among large-scale economic aggregates such as those among the levels of inflation and employment (e.g., the Phillips curve). The equivocating economist may concede that the supposed regularities depend on a particular legal and institutional background—as detailed, for example, as the provisions for unemployment insurance and for the powers that labor enjoys vis-à-vis capital. In a historical circumstance in which such arrangements are in fact left largely unchallenged, however, the equivocating economist can go on to disregard this theoretical concession in his analytic and argumentative practice and go back to equating institutional stagnation with lawlike regularity. The cumulative effect of these three ways of evading the imperative of institutional vision in economic thought—pure, fundamentalist, and equivocating economics—is to deprive the discipline of any adequate way of dealing with the relation of its propositions and models to the institutional form of the market order.

Romer's treatment of the market economy veers between pure and fundamentalist economics. In his characterization of the knowledge economy as a march of ideas graced with economic benefits, he writes in the spirit of pure economics, as if this form of production had a nature, an essence, and attributes that can be specified apart from its institutional setting and forms. When, however, he comes to the discussion of excludability and its legal basis, he switches, in the spirit of fundamentalist economics, to the view that property is property. He gives no consideration to the possibility that the development and spread of the knowledge economy may require cooperative practices and shared rewards to a degree irreconcilable with the traditional property and intellectual property regimes. A knowledge economy for the many cannot flourish within the limits imposed by the inherited legal framework of the market order.

A third flaw of neo-marginalist economics is its lack of any proper account of production. It views the production system as a shadowy

extension of the system of exchange. A contingent feature of the economies with which it deals—that in them labor can be bought and sold, allowing the relation between labor and capital to be seen under the lens of relative prices—facilitates this move. If you open almost any general introduction to economics to the chapter titled the theory of production, you will be surprised to find that it contains little or nothing about the emergence, history, forms, and consequences of the most advanced practice of production and its predecessors. Instead, it discusses the comparative positions and pricing of different factors of production and the consequences of their possible substitution for one another.

In the economics that preceded marginalism, including the teachings of the two most important thinkers in the history of economics—Adam Smith and Karl Marx—the theory of production and the theory of exchange enjoyed equivalent and independent weight; neither was reduced to the other. Smith and Marx recognized that the best way to understand the workings of the economy, and to explore its alternative futures, is to study the most advanced practice of production—mechanized manufacturing then, as it is the knowledge economy now—because it is the practice that most fully reveals our present powers and most clearly shows the direction that the development of those powers can take.

A central topic in the study of production is the relation of the most advanced productive practice to the rest of the economy. The deepening of that practice and its dissemination are not two separate phenomena; they are two sides of the same process. The extent to which the advanced practice remains restricted to parts of the production system or spreads, and consequently the extent to which it develops or fails to develop, has decisive implications for both economic growth and economic inequality.

Working within an economics profession that has closer ties to hedge funds than to factories and that has demoted the study of production to an afterthought, Romer and his followers have little or nothing to say about these matters of vital theoretical and practical importance. Because they draw on no body of ideas or intellectual tradition capable of doing justice to the variety and history of productive practices, their conception of the knowledge economy is static and disengaged from context. They fail to see the knowledge economy for what it is in the settings in which it has taken hold, and

for what it might become if it broke out of those settings. They deny its historical reality and place it in a timeless typology organized around the contrast of ideas to objects. No wonder they are unable to understand it.

A fourth flaw of the neo-marginalist tradition is its lack of any account of the diversity of the material available to competitive, market-based selection. The fecundity of a method of competitive selection depends on the richness of the material to which the method applies. Not to have a way of thinking about the making of that diversity is to be left with half of a theory. It is to place neo-marginalist economics in the position in which the life sciences would find themselves if they could count only on the part of the neo-Darwinian synthesis about natural selection, without the other part, about genetic mutation and recombination.

The result for Romer's approach is inattention to a central feature of the knowledge economy: its practical experimentalism as it widens—at the cost of redundancies, dead ends, and failures—the range of what there is from which to select. That experimentalism is its most constant theme. The theme appears at the level of the shop floor, in the reconciliation of customization with scale and the combination of decentralized initiative with a coherent plan of production. It shows up in the importance of making the cooperative arrangements of productive activity within and among firms more closely resemble those of experimental science. It emerges in the way businesses and government must work together to develop arrangements that open access to key resources and organize experimentalism without suppressing it. It has implications for the broader culture and the national politics that sustain movement in this direction.

A successful knowledge economy does not take experimental diversity—including diversity of its own forms—for granted. It treats the creation of that diversity as one of its major goals and measures of success. A style of analysis deficient in the methods and ideas needed to explore these problems, as neo-marginalist economics is, leaves the knowledge economy unexplained and denies it the help of any vision that can guide it on its path forward.

Romer's view of the knowledge economy appeals to those whose understanding of how economies work and of how they can change was formed in the tradition that the late nineteenth-century marginalists inaugurated. According to that view, we can carry out the pro-

ductivity revolution promised, but not yet delivered, by the knowledge economy, without having to reimagine and remake our institutions, including the institutions defining the market. And we can understand this revolution without having to revise the practice of economic analysis.

This attempt to explain how we can move toward rapid and sustained growth, through increasing returns to scale, without reorganizing the market economy, and how we can understand the economic changes of our time without changing anything important about economics, must be judged a dangerous failure.^{AA}

NOTES

- ¹ Paul M. Romer, "Increasing Returns and Long-Run Growth," *Journal of Political Economy* 94, no. 5 (October 1986): 1002–37; Paul M. Romer, "Endogenous Technological Change," *Journal of Political Economy* 98, no. 5, (October 1990): 71–102.
- ² Charles I. Jones, "Paul Romer: Ideas, Nonrivalry, and Endogenous Growth," *Scandinavian Journal of Economics* 121, no. 3 (July 2019): 859–83.
- ³ I develop an alternative view of the knowledge economy and its possible futures and explore the relation of that view to economics in my book, *The Knowledge Economy* (London: Verso, 2019).
- ⁴ Jones, "Paul Romer," 867.
- ⁵ Jones, "Paul Romer," 865.
- ⁶ Jones, "Paul Romer," 866.
- ⁷ Robert Solow, "We'd Better Watch Out," review of *Manufacturing Matters: The Myth of the Post-Industrial Economy*, by Stephen S. Cohen and John Zysman, *New York Times Book Review*, July 12, 1987.
- ⁸ Alvin H. Hansen, "Economic Progress and Declining Population Growth," *American Economic Review* 29, no. 1 (March 1939): 1–15.
- ⁹ Jones, "Paul Romer," 879.