Piketty’s *Capital* in a Medieval Farming Village*

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Abstract

In the voluminous literature aimed at understanding *Capital in the Twenty-First Century*, what appears to be missing is an example that is both manageable and reasonably true to the book’s principles. I provide such an example, based on Piketty’s own account of a farming village in medieval times. A primary lesson is that the focus on $r > g$ is at least a bit misleading. Increasing concentration of wealth and income is largely the result of differential savings rates among wealth classes.

**KEYWORDS**: Inequality, capital

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After winning his Nobel, the great American physicist Richard Feynman was asked by a reporter to provide an explanation of quantum electrodynamics for the average person. “If I could explain it to the average person,” he is said to have replied, “it wouldn’t have been worth the Nobel prize.” The story may be apocryphal, but it is apt when considering Thomas Piketty’s *Capital in the Twenty-First Century*. How to explain it to the average person? For a work of such enormous breadth and depth, as with quantum electrodynamics this is evidently no easy task.

Piketty’s contribution can be divided into two parts. One is the presentation and explanation of an amazing set of historical data on economic inequality and wealth, going back centuries. Compiling the data, a monumental and ongoing effort, is the work of Piketty and a team of collaborators, most notably Emmanuel Saez of UC-Berkeley and Anthony Atkinson of Oxford. Their World Top Incomes Database is free and publicly available. It is the rare professional economist, on the right or on the left, who seems inclined to quarrel in earnest with Piketty’s data. Greg Mankiw, for example, writes of the empirical contribution, “I like this part of the book a lot.”

The other is the interpretation of the data and what they foretell about future inequality. For this purpose Piketty must surely have in mind an organizing conceptual framework, a model. Understanding his model is not straightforward, and the most capable observers disagree profoundly about what to make of it. Without describing a model himself, while praising the book Paul Krugman asserts that “underlying [Piketty’s] discussion is a tour de force of economic modeling.” Kenneth Rogoff criticizes both *Capital* and Piketty’s earlier work with Saez, writing “Piketty and Saez do not really offer a model; nor does this new book.”

What is the average person to make of these competing claims? Either the book is based upon a tour de force of a model, or it is based upon no model at all. It’s as if one prominent engineer rose to assure the public that the piers supporting a new bridge rest directly upon bedrock, while another engineer, almost as prominent, warns that a terrible mistake has been made and they rest upon quicksand. How is the average person to decide whether to venture onto this bridge?

It is certainly the case that Piketty’s analysis is built up from a collection of mathematical relationships, which he describes as fundamental laws of capitalism. The first fundamental law is the equality $\alpha = r \times \beta$, which says that the share $\alpha$ of national income captured each year by owners of capital is the rate of return to capital $r$ multiplied by the capital/income ratio $\beta$. The second fundamental law holds that, in the long run, $\beta = s/g$. That is, the capital/income ratio must equal the aggregate savings rate $s$ divided by the growth rate $g$ of national income. (In fact, this $g$ incorporates growth in population as well.) Reviews that describe and interpret these laws, and the ways in which Piketty’s measures are just a bit unorthodox, are now legion.

The third fundamental law, which on p. 571 Piketty calls the “central contradiction of capitalism,” is a beguiling inequality that lies at the heart of a matched pair of if-then
statements. If \( r > g \), Piketty says, then owners of capital will secure an ever-rising share of national income and inequality will tend to increase. If, on the other hand, \( r < g \), then capital’s share moves in the other direction and inequality will decrease. In his own words, again on p. 571, “The entrepreneur inevitably tends to become a rentier, more and more dominant over those who own nothing but their labor.”

If a couple of sentences can summarize the book, perhaps they run along these lines: Except for a few decades during the twentieth century, the evidence shows that \( r > g \) has been true throughout history and extraordinary inequality has been the resulting norm. After a brief respite it is once again true that \( r > g \). This state of affairs, he says, is likely to continue and so rising inequality will persist into the indefinite future unless significant steps are taken to restrain it.

In the months since the book appeared, something in the nature of a pitched battle among economists has emerged over this inequality, so that one almost feels a measure of sympathy for those three little symbols. The battle is being waged on two main fronts, interrelated but subtly different. The first is whether Piketty’s claim regarding the logical implication of \( r > g \), that it leads inevitably to higher inequality, is correct. The other is whether, in fact, it is possible at all for \( r > g \) to be true over long stretches. Given the stakes, this argument is unlikely to be resolved any time soon.

Piketty’s equations, though elegantly described, do not add up to a comprehensive model of economic growth that can be compared easily to other models more familiar to economists. This leaves an opening for qualified observers to argue about what he must be saying. In a magisterial review in The New Republic, Robert Solow, the father of the modern theory of economic growth, describes Piketty’s book approvingly. He appears to be convinced that Piketty is in the right of it with respect to the first front of the battle: \( r > g \) over sustained periods will indeed lead to unacceptably high levels of inequality. As an explanation of Piketty’s analysis for the average person, Solow carries away the prize.

Others are more critical, including Matt Rognlie, whose argument is not exactly accessible to the average person. Rognlie lays down the gauntlet on the second front, explaining in mathematical detail why he believes \( r > g \) cannot be true over long periods of time. The series of required empirical relationships, he says, is implausible. Per Krusell and Tony Smith quarrel with Piketty’s second law, arguing that it implies savings behavior that is implausible conceptually and incorrect empirically. The attack mounted by Krusell and Smith has attracted the ire of Brad DeLong, who cries, “I don’t understand!” And Marshall Steinbaum also leaps to Piketty’s defense, explaining why Rognlie and Krusell and Smith are all wide of the mark. Indeed, there is no shortage of technical critiques, from all sides. Larry Summers on the left and Tyler Cowen on the right are both unconvinced by Piketty’s mathematical arguments. The nonspecialist should be forewarned: the question hinges partly on whether the elasticity of substitution between labor and capital is greater than or less than one, depending crucially on whether capital is measured before or after accounting for depreciation. Piketty is sure it’s greater than one; several critics disagree. I will leave this argument to others.
Elsewhere Delong has produced a model that endeavors to capture what Piketty is saying and to explain how he could be right on both fronts. It is a very nice model, showing both how $r > g$ can hold over long periods of time and also why, possibly, that condition can lead to rising concentrations of wealth and rising inequality. But perhaps DeLong would not complain too loudly were one to observe that his model is likely to surpass the understanding of the average person. And for all that he praises the book, the fact that he was moved to devise his own model to explain it is good evidence that Piketty’s model is at least imperfectly clear.

**The search for an example Piketty economy**

I am a teacher of economics, and no spring chicken. I learned long ago the value of condensing complicated problems down to the simplest example that still captures the essence of the argument in question. When recently I had occasion to deliver a public lecture whose purpose was to explain *Capital* to an audience of Minnesotans, all naturally above average, I determined to create such an example: a toy economy that obeys and illuminates the Piketty principles.

I discovered that the creation of such an example is deceptively difficult. Any version that appeared to adhere to the principles quickly became too complicated, more likely to confuse than to enlighten even the above-average person. Any version that remained simple seemed to miss some fundamental elements of the argument.

And then, to my delight, I came across David Leonhardt’s review article in the *New York Times Magazine*. In a favorable review of *Capital*, Leonhardt confesses that “For all of the clarity of Piketty’s historical analysis, I emerged from the book not quite grasping the mechanics of rising inequality.” He decided to call the source and ask some questions. Piketty’s explanation contained just the example I sought, or so at first it seemed. It is worth quoting Leonhardt at some length, bearing in mind that this is Piketty’s own example, offered up to a leading economics reporter at the *Times*. For those keeping score at home, the example is a dramatic simplification of a passage that starts on p. 213 of the book. There, labor figures prominently. Here’s Leonhardt speaking:

>Piketty] suggested imagining a hypothetical village from centuries ago in which neither the population nor the economy was growing. Every year, the village produced the same amount of goods for the same number of people to divide—a reality that was typical before the Enlightenment, when material living standards and human longevity barely rose. (The peasants of the 15th century were not better off than peasants in ancient Rome.) Even in a zero-growth society, however, assets that helped people produce goods—also known as capital—had value.

In our hypothetical village, a large farm might produce $10,000 worth of crops in a year and yield $1,000 in profit for its owner. A small farm might have the
same 10 percent rate of return: $1,000 in annual crop sales, yielding $100 in profit. If the large farmer and small farmer each spent all of their money every year, the situation could continue ad infinitum, Piketty said, and the rate of inequality in the village would not change.

But one of capital’s great advantages is that its owners can make enough income to spend some of their money and sock the rest of it away. If the large farmer saved $500 of that $1,000 profit, he could buy more capital, which would bring more profit. Perhaps a few owners of smaller farms had debts to pay, and one of the large farmers bought them out. Eventually, the owner of the expanding farm might find himself owning land that yielded $1,500 or $2,000 in annual profit, allowing him to put aside more and more for future capital acquisitions. Less-stylized versions of this story have been playing out for centuries.

Straightaway, I set about adapting my toy model to capture what I thought Leonhardt was saying. New challenges presented themselves immediately. The very thing that makes this example attractive, that it describes a little closed community, leads to grave difficulties. Set aside the question of why, at the start, one farmer owns ten times as much land as another. Most economists are happy to make four or five assumptions more heroic than this before breakfast. We need to start somewhere, and perfect equality is too rare to be interesting. Set aside also the question of who is buying all that wheat. This is a model, remember. If it’s to remain simple it can’t account for everything.

No, the first problem is to say what happens to the little guy after he sells his land. Perhaps Piketty means that he becomes a peasant, working for the big farmer who bought him out. But what shall he be paid for his labor? The correct way to answer this question is to specify an equilibrium condition in the labor market, a wage rate set anew each year as the economy evolves, so that the demand for labor always equals the supply. I could see that this might lead to a changing wage over time as more small farmers are bought out and enter the labor market. Or not. Hmm, this is exactly the kind of problem I’d already faced repeatedly: mounting complexity. And Leonhardt’s account doesn’t mention a market for hired farm laborers.

A related problem is what the seller is to do with the money received in payment for his small farm. Putting the cash under a mattress will doubtless lead to heartache, for although the farmer can live a life of leisure while it lasts, the day will come when it runs out. What then? Either he dies, along with his family, which is heartache for them. Or he enters the labor market and I need to solve the equilibrium-wage problem, which is heartache for me. While he owns his land, the little guy is a capitalist, however small. He might well prefer to remain in that class. Without a place to invest the proceeds of the land sale, a decision to sell is ultimately a decision to become a peasant.

Finally, and most troubling, what price should be paid for the land? In a textbook land market with many buyers and many sellers and no uncertainty, the price of an acre of
land today is simply the present value of the discounted stream of returns that it will generate annually into the infinite future. We shall see this formula shortly, but it cannot be employed unless we know the interest rate. The temptation might be strong to follow Leohnardt’s lead and call the round 10% ratio of profit to farm revenue, $100/$1,000, a “rate of return.” One is wise to resist this temptation. It’s a profit margin, nothing more, and cannot serve as anything like what in the book Piketty calls $r$, the annual return to capital.

The land price must be high enough to leave the seller no worse off than before, or he will refuse to sell. Piketty’s small farmer makes a secure if modest income as owner, $100 per year, and if he refuses to sell he can continue doing so indefinitely. Absent both a labor market and a place to invest the money, one simply cannot determine the minimum price that will induce the little guy to sell. And having the big farmer pay him $100 each year forever, in lieu of a single cash payment, is no solution because then nothing has changed at all. In what sense does the large farmer own the land, in what sense has he invested his savings, if the profits are perpetually handed over to the seller?

If we suppose that Leonhardt conveyed it accurately, as I’m happy to do, the surprising thing about this story is that it is presumably Piketty’s grade-A example, and yet it does not appear to work as advertised. Given the enormous amount of care that went into his book, one might expect him to have worked out an airtight illustrative example, for precisely such moments as the Leonhardt phone call. One that is clear to the nonspecialist but that holds together technically. The example Leonhardt describes is too stylized to hold together well. Quantum electrodynamics, anyone?

In what follows I develop and explain an example economy based upon the Times village story. Perhaps it has some value for those seeking to understand Capital, or who wish to explain it to others in simple terms. But some new ingredients must be added in order to keep things working in something like the way Leonhardt described. In the simple model I develop below, two goals guide the choice of extensions. One is to preserve as much of the spirit of the Times example as possible. The other is to keep the model as simple as possible, but no simpler. Here, then, is Capital in a medieval farming village.

**Life in a medieval village with** $r > g$

First, let us be a little more precise about the inhabitants of our village and how they make a living. Suppose that 100 people live there; think of them as single-earner households if you wish. As in Piketty’s story, population never changes. Half of these people, the bottom 50, own no land and earn a living as peasants. Each works two acres of land every year, tilling and planting and harvesting. For their effort, the owner of the land they work pays $100 per acre or $200 per year. We’ll assume that this is strictly a subsistence wage; anyone making $199 per year will perish. Labor’s claim on the value of village income starts out at 50%. The introduction of a labor class is one of the two main liberties I’ve taken with Piketty’s Times story.
Another 40 are small landholders, the “Forty,” each of whom owns and works his own two acres of farmland. Every acre, regardless of who owns it, produces $1,000 in gross revenue per year. This is the market value of an acre’s output of wheat. It is fixed for all time, so that the agricultural economy never grows. Neither does land ever depreciate. After subtracting all costs, including the cost of labor, profit per acre is precisely $100. Our Forty, who work their own land and thus do not need to pay for labor, enjoy an annual income of $400, of which $200 is the return on their own labor and $200 is the return to their capital. As in Piketty’s story, for the moment we’ll say that the Forty spend every penny, saving nothing. Thus, their standard of living is twice that of their peasant brethren.

The next 9 villagers, the near rich or “Nine,” own 8 acres each. A Nine never works, instead hiring 4 peasants to work his land. He receives profit of $800 per year, which is enough to support quite a comfortable lifestyle. In fact, let’s assume that a Nine is able to live happily on 75% of his income, saving and investing $200 annually and spending the remaining $600. This level of expenditure, while not exactly sumptuous, is still thrice the subsistence level. And think of all the leisure time!

Finally, we have our top villager, who makes up exactly 1% of the population. Call him the “Noble,” and assume he starts with 28 acres. He hires the remaining 14 peasants and, like the Nine, never lifts a finger in labor. The Noble’s capital base generates an annual income of $2,800, of which we’ll follow Piketty and say 50% is saved and invested. Relative to his neighbors, the Noble lives in luxury, spending $1,400 per year and driving the most glorious team in the village.

The total land area owned by the village is 180 acres. Of the total, in the beginning 80 acres (44%) are owned by the Forty, 72 acres (40%) are owned by the Nine, and 28 acres (16%) are owned by the Noble. This is the situation as the years begin to roll past. The details are summarized in Table 1.

Now we start the clock running and watch things change over time, so that capital accumulates as in the story. For this purpose we need to specify what the Nine and the Noble do with their savings each year, and also what the sellers of land do with the payment

<table>
<thead>
<tr>
<th></th>
<th>Bottom 50%</th>
<th>Forty 51–90%</th>
<th>Nine 91–99%</th>
<th>Noble 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres/capita</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>Acres by group</td>
<td>0</td>
<td>80</td>
<td>72</td>
<td>28</td>
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<tr>
<td>Acres share</td>
<td>0</td>
<td>44.4%</td>
<td>40.0%</td>
<td>15.6%</td>
</tr>
<tr>
<td>Net income/capita</td>
<td>$200</td>
<td>$400</td>
<td>$800</td>
<td>$2,800</td>
</tr>
<tr>
<td>Savings rate</td>
<td>0%</td>
<td>0%</td>
<td>25%</td>
<td>50%</td>
</tr>
<tr>
<td>Spending/capita</td>
<td>$200</td>
<td>$400</td>
<td>$600</td>
<td>$1,400</td>
</tr>
</tbody>
</table>

Table 1: Initial village situation, $t = 0$
received. The first part is easy: in the beginning the Nine and the Noble buy land from smaller landholders, namely the Forty. These ambitious souls continue to work the land they’ve sold, receiving the same $100 per acre for their labor as before, but now in the form of an annual paycheck.

The second is the hard part. In order to address it I’ve taken a second and more courageous liberty with Piketty’s story. I add a bank, the Republican Bank of Paris, which plays the role of a large external capital market. Bank deposits are paid a sure 5% in interest per year, a number that never changes as our villagers increase their deposits. Even taken together, they are tiny compared to the bank.

This bank, while foreign to Piketty’s story, has the great merit of resolving two of the big questions that the story leaves open. It gives the seller of land a home for his money, guaranteeing him a steady 5% return on his capital. It also allows us to determine the price of land. How does this come about?

The key is that, in equilibrium, the return to land must equal the return to bank deposits. If the return to land is higher, people will withdraw money from the bank in order to buy land. The effect will be to drive the price of land up and the return down until investors are indifferent between the two. Likewise, if the return to land is lower, people will sell land and deposit the money in the bank. The effect will be to drive the price of land down and the return up until investors are again indifferent. In our simple village economy with no uncertainty, all capital must yield the same return.

Now the pieces are in place to calculate the price of an acre of land. The relevant formula is

\[
P = \sum_{t=1}^{\infty} \frac{\pi_t}{(1+r)^t} = \frac{\$100}{0.05} = \$2,000.
\]

In this formula \(P\) is the price of land per acre, the value we’re after, and the index \(t\) refers to years stretching from now (\(t = 1\)) forever into the future. The less adventurous reader may wish to skip the second bit and continue on to the third, where we compute the land price by dividing annual profit, the constant \(\pi_t = \$100\), by \(r = 0.05\), which here is more properly called a “discount rate.” We can say with certainty that the value of an acre of land is a never-changing $2,000.

Knowing its price, we can now figure out how much land the Nine and the Noble buy at the end of the first year. Between them, in the first year the Nine save and invest $1,800, enough to buy 0.9 acres from the Forty. The Noble saves and invests $1,400, enough to buy 0.7 acres. The Forty are happy enough to sell, knowing that the return they’ll earn on their bank deposits is exactly the same as the return they now earn on their land. They’re also happy to continue working the land they’ve just sold, so long as they receive the labor payment of $100 per acre. Building my example so that bigger landowners buy from smaller landowners maintains the spirit of the Piketty example, but is not essential. The results would be the same if the Forty kept their land and the savers simply deposited their money in the bank from the start.
In succeeding years, this pattern continues. The Nine and the Noble continue to save 25% or 50% of their growing income. They continue to buy land from the Forty, who remain compliant and continue to sell, continue to work the land they once owned, continue to spend their $400 year in and year out. As their land holdings grow, though, the Nine and the Noble are able to secure an increasing level of income each year.

At some point the Forty will no longer own any land. Instead, between them they’ll own bank deposits equaling exactly $160,000. When this moment arrives, let’s say that the Noble begins to buy the landholdings of the Nine, who are every bit as willing to sell as were the Forty before them. As always in the village, owning land is precisely as attractive as owning bank deposits. The Nine deposit the money from their land sales, and also now their savings on all their income, in the bank, where it too earns a rock-solid 5%. This pattern continues, until at last our Noble owns every acre. He continues to save 50% of all his income, farm and interest income alike, but now he puts that unspent half into the bank, just as his lesser villagers have done before him. And he too, of course, earns 5% per year on his deposits, no more and no less.

Figure 1 depicts the evolution of land ownership over a time horizon of 100 years. The Forty have sold all of their land after 35 years. That is when the Nine begin to sell to the Noble. After 77 years have passed, he is the only landowner in the village. What happens to per capita income by class? The pattern may be seen in Figure 2, where the lines for the Bottom and the Forty are almost indistinguishable from the horizontal axis. In 100 years time, though, our Noble’s annual income has risen from $2,800 to more than $33,000. Sure enough, inequality is racing skyward in the village.

With the bank, our village economy grows over time, though the agricultural economy
does not. Capital accumulation very much favors the Noble, who is happy to watch his bank account mount as the years wind past. Capital shares among the three capitalist groups are shown in Figure 3. The Forty might well lament the way their fixed capital and their income lag ever further behind those of the Nine and the Noble, but this is strictly a relative comparison. Their absolute wealth, their absolute income, and their standard of living all hold perfectly steady.

**Savings rates, not \( r > g \), are the key**

My example appears to confirm what so many have taken away from Piketty’s book, that capital inevitably begets more capital and ever higher income in a dizzying upward spiral. But look again at the Leonhardt passage, in particular this bit: “If the large farmer and small farmer each spent all of their money every year, the situation could continue ad infinitum, and the rate of inequality in the village would not change.” Yes, that is true. But we know that the wealthy save more of their income than do the poor. Emmanuel Saez and Gabriel Zucman estimate that savings rates are 0%, 15%, and 38% for U.S. households in the bottom 90% of the income distribution, the top 10 to 1%, and the top 1% respectively. These numbers are not far from the values I’ve used.

The village example allows us to explore how things would turn out if this were not true. Let us now ask what if, against all available evidence, savings rates were equal for all owners of capital? Not at zero, as in the quote, but at something higher, say 25%. We can run the clock again on our village example and see how the future would unfold if this
Figure 3: Capital shares by group, different savings rates.

were true. Of course, in order to save 25% the Forty would need to live on $300 per year initially. That is close to the subsistence level and would entail real hardship. Assume they are willing to suffer, expecting better days in the future. Likewise, if the Noble saves only 25% of his income he will increase his initial expenditures by half. Profligate, yes, but perhaps there have been such nobles in the past.

With the Noble saving less of his income each year, it takes longer for things to play out than it did in the previous section. Now we must run our little model for two centuries to get interesting results. Figure 4, showing the change in land ownership for the three groups, is similar to Figure 1. The only difference is that it takes longer, 151 years, for the Noble to gobble up all of the farmland.

The results depicted in Figure 5 are more different and more interesting. The big surprise is that now the Forty eventually overtake the Noble in annual income per capita. It takes a while, but although the forces at work grind slow they also grind exceedingly fine. What explains the fact that our small farmers eventually run ahead of even the top 1%? It’s that in addition to owning capital, they also continue to work the fields, saving a quarter of all that income over many decades. Two lessons are to be taken from this exercise. One is that differential savings rates, and not \( r > g \), do the heavy lifting in my example. Equalize the savings rates and things change dramatically. The other is that capital owners who also continue to earn labor income are the most successful creatures of all, in line with Piketty’s observation about entrepreneurs becoming rentiers.

In Figure 6 we see just how powerful the combination of capital and labor among our Forty really are, so long as savings rates are equal. Compare this figure to Figure 3. Now
Figure 4: Acres owned by group, equal savings rates.

Figure 5: Income per capita by group, equal savings rates.
it is the profligate Noble who is left behind in the race to acquire capital.

The lesson of the example might well be surprising to those whose main impression of *Capital* is $r > g$, that one famous inequality. My point is that $r > g$ is something of a side issue. It is necessary for the richest capitalists to pull away from everyone else, but it is not sufficient. This argument may be found in many places, including in a lovely essay by Debraj Ray, who I find to be the most effective critic of Piketty’s overall analysis. Ray showers praise upon the book, especially the quality of the data that Piketty brings to bear. But he also cautions against believing certain elements of the analytical work. And Ray is emphatic about the predominant importance of savings rates:

> [T]he owners of capital income also happen to be richer than average, and richer people can afford to (and do) save more than poorer people. But that has to do with the savings propensities of the rich, and not the form in which they save their income. A poor subsistence farmer with a small plot of land (surely capital too) would consume all the income from that capital asset. It may well be that the return on that land asset exceeds the overall rate of growth, but that farmer’s capital income would not be growing at all.

Capital is not the villain, says Ray, and I concur. Rather, capital is the “vehicle” by which accumulation takes place. It is a more effective, a more reliable means of growing a fortune than is an outsized salary. I would add that, to the extent high savings rates among the wealthy are the underlying cause of growing concentrations of wealth and income, Piketty’s proposed solution would appear to be the right medicine. He proposes an internationally harmonized progressive tax on capital. I’ll leave a deeper discussion of that point for another day, but his tax would certainly cut into the savings rate of the wealthi-
The steady state

I will be the first to admit to the dramatic shortcomings of my village model. The leading
shortcoming is the use of the bank, which is able to inject capital into our village at a fixed
rate and without limit. No growth economist would ever stand for such a thing. And
yet, perhaps there is a lesson even here. Many commentators and observers have focused
on the dynamics of Piketty’s argument, how we get from where we are to where he says
we’re going. But that focus, though useful, may be somewhat misplaced. Here is Robert
Solow again, this time at a panel discussion devoted to the implications of Capital for the
United States. At the 11:25 mark in the video he says:

I think there’s a lot of misunderstanding about what’s actually in the book. Piketty does not assert that income from wealth will grow faster than income
from labor. Not at all. He’s talking always about a steady state in which the
share of wealth in national income is constant and the share of work in national
income is constant.

That is true, and it is well to bear it in mind. And yet, Piketty seems also to be interested
in the forces that take us back to that steady state when we’re knocked off it, as happened
in the 1930’s and 40’s. He certainly appears to care about that path, as when he write on
p. 361:

[I]f the fortunes of wealthy individuals grow more rapidly than average in-

Figure 7: Capital/income ratio converges to 1/r.

est members of society.
come, the capital/income ratio will rise indefinitely, which in the long run should lead to a decrease in the rate of return on capital. Nevertheless, this mechanism can take decades to operate, especially in an open economy in which wealthy individuals accumulate foreign assets. In principle, this process always comes to an end (when those who own foreign assets take possession of the entire planet), but this can obviously take time.

One can think of my village as an open economy and the bank as a source of foreign investment opportunities. Given enough time, the 50 capital owners in the village would indeed come to overwhelm the bank, though they started out small. Piketty’s point, that the rate return on capital will fall before the small economy can swallow the world, applies to my village. But even there, with \( r \) fixed, the capital/income ratio does not grow indefinitely. Rather, it rises asymptotically toward 20, which is simply the inverse of \( r \), the return to capital. In Figure 7 we see the trajectories, over 200 years, of this ratio in the two cases, with different and with equal savings rates. Whether savings rates are different or equal for the classes of capitalists, \( \beta \) rises not indefinitely but asymptotically toward \( 1/r \). It gets there more quickly when everyone saves 25%. Figure 8 shows the share of village income claimed each year by owners of capital. The two curves start at 50%, reflecting the fact that in the beginning each acre pays $100 to labor and $100 to capital. As capital grows, though, and continues to earn a return of 5%, capital’s share rises toward 100%. Note the similarity between the two curves for \( \beta \) in Figure 7 and for \( \alpha \) in Figure 8.

Finally, the village example gives us a glimpse into the distinction between a steady state and the path we take to get there. What is the relationship between \( r \) and \( g \) in the village? Well, the return to capital is \( r = 0.05 \) regardless of the savings rate. And growth in the
agricultural economy is zero. But growth in the village economy isn’t so straightforward, and it isn’t constant either. Figure 9 shows the 200-year trajectory of $g$ in the two versions of the example, with different and with equal savings rates. Here I’ve simply computed $g$ according to the second fundamental law, $g = \tilde{s}/\beta$, with $\tilde{s}$ the effective savings rate, given by the total dollars saved each year as a fraction of all income in the village.

When savings rates differ, the Noble’s rate comes to dominate and the growth rate of the village economy rises toward a steady-state rate of $g = 2.5\%$, or one half of $r$, the return to capital. That one half is precisely the Noble’s savings rate. When savings rates are all equal to one quarter, the growth rate falls toward a steady-state rate of $g = 1.25\%$, or one quarter of $r$. Only in the very long run, here a matter of centuries, does the economy actually get to the steady state that Solow mentions. Until then, the rate of growth is always changing. The same can be said for the effective savings rate $\tilde{s}$. Figure 10 shows how this rate changes over time in the two versions of our example. In both cases the rate converges toward the largest savings rate. And notice that although the rate of savings is constant for individuals, the economy-wide rate of effective savings moves toward its steady state.

Finally, we can look at how inequality in the village, the accumulation of capital and income, relates to that fundamental contradiction, $r > g$. In both versions of the example, the return to capital is a constant $r = 0.05$. This is much higher than $g$ in both versions and at all times. My simple example does give us some insight into Ray’s observation that savings rates, not the difference between $r$ and $g$, drive growing inequality. The Noble starts out with the lion’s share of capital in both versions. In the first, where he also saves much more of his income than others do, his advantage in wealth and income
Figure 10: Effective savings rate converges to largest $s$.

grows. In the second, where everyone saves at the same rate, his advantage in wealth and income recedes. The third law, $r > g$, is necessary for the increasing inequality and accumulation of wealth and income, but it is not sufficient.

Piketty has written an astonishing book. His mastery of the empirical side of economic history is remarkable. I believe we should heed his warning about a future in which wealth and income are ever more concentrated in the hands of a few. I would be sorry if my heirs found themselves living in that future. But the wide emphasis on the relationship between $r$ and $g$ may be less helpful than many appear to believe.
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