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To summarize the summary of the summary: people are a problem.

Douglas Adams, *The Restaurant at the End of the Universe* (1980)

I need to drive screws in some wood furniture I'm assembling. I open an app on my smart phone and tell the app "rent drill." A car – I don't know where it is and I don't need to – picks up a drill that matches my pre-programmed preferences from a hardware store. The car delivers it to a security-coded pod outside my apartment. My phone vibrates: "drill delivered." I assemble the furniture and return the drill to the pod. The pod is smart: its software is connected through the "Internet of Things," and the pod tells another car – no particular car, just whomever is nearby, according to the software – that there is a pick-up.

The rental costs me \$2.50 and no more than a minute spent shopping, obtaining, and retrieving the drill. I got brief access (but that's all I needed!) to a commercial quality power tool. It could have been a saw, a fruit dehydrator, a bread machine, a deep fryer, a sausage grinder, or a collapsible bar to serve drinks at a party. There are few cupboards or closets in my apartment and no parking spaces on the street outside. All the space is used for people, instead of stuff. I own almost nothing, yet have immediate access to everything. Amazon is now a *software* company; Uber is now the main provider of rental services, delivered by *software*-directed driverless cars. The work week is only two days long. But many people have no "job," in the traditional sense, at all. Wages have fallen dramatically, for most people. On the other hand, prices have fallen by even more, and many prices are near zero because society now shares so many products.

What happened? This is Tomorrow, 3.0. It's what the economy looks like after the third great economic revolution. The first was the

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Neolithic; the second was the Industrial Revolution. Look around you. The third revolution has already begun.

THE TRANSACTION COST REVOLUTION

People own stuff. In the developed world, they own *so much* stuff. The self-storage industry in the US has nearly 50,000 facilities, with more than 15 billion cubic feet of space cluttered with stuff (Clark, 2014). We store bicycles, furniture, appliances, and electronics in metal boxes that are more solidly constructed, and more expensive, than the average *human* habitation in many developing nations.

Why? Fifty years from now people will look back on this era and be amazed at our selfishness. Why would we *store* stuff rather than let other people *use* it? Why would we store that stuff in our houses, or in parking garages, or spaces on busy streets? It would seem that our own selfishness should have led us to want less stuff so we could have more space.

The answer is surprisingly simple: what looks like selfishness is just a consequence of *transaction costs*.¹ In the next chapter, I'll explain in more detail what that means. But for now, the important thing is just that we have stuff, and we store stuff, because doing anything else is more trouble than it's worth. If I own something, I control it. If I want to rent, or borrow that thing, I'm much more dependent on other people.

Still, when you think about it, people don't fundamentally want *stuff*. What they want is the *stream of services* that stuff provides, over time. So, if people *own* stuff – clothes, tools, cars, houses – rather than *rent*, it is because owning secures services more reliably and at lower cost than renting. But this “preference” for owning is not

¹ The literature on “transaction costs” is large. Key contributions include Coase (1937, 1960), Demsetz (1966, 1969), North (1981, 1990), and Williamson (1975, 1985). A particularly important but under-recognized contribution is Graham, et al. (1972), who recognize the contingent optimality of equilibria in the presence of transaction costs.

real. It could change quickly, if entrepreneurs can figure out ways to *sell reductions in transaction costs*.

And that, in a nutshell, is the thesis of this book: until now, to make money people have had to make, and sell, *stuff*. They often found ways to reduce the transaction costs of those sales, but it was primarily in service of selling the stuff. From now on, much of the new value in the economy is going to come from creating and selling reductions in transaction costs, making better use of stuff that already exists. That change will redefine of our deepest ideas of “commodity,” because almost anything could in principle be rented.

We Are Already the Cooperators We Need to Be

Adam Smith famously said that human beings have a “disposition to truck, barter, and exchange” (Smith, 1981, p. 14).² All of these are forms of cooperation and sharing, and they take advantage of the fact that we are all different. Instead of taking by force, we negotiate and try to figure out ways that both of us can be better off. We have enough stuff, but it’s in the wrong places. If we share, even just by exchanging stuff we already have, many things will move to higher-valued uses.

It might seem like the fact that we are different might make it harder to share, not easier. But in many cases our very dissimilarities are a source of cooperation and benefits from exchange. Say you are

² “By nature a philosopher is not in genius and disposition half so different from a street porter, as a mastiff is from a greyhound, or a greyhound from a spaniel, or this last from a shepherd’s dog. [But] the strength of the mastiff is not in the least supported either by the swiftness of the greyhound, or by the sagacity of the spaniel, or by the docility of the shepherd’s dog. The effects of those different geniuses and talents, for want of the power or disposition to barter and exchange, cannot be brought into a common stock, and do not in the least contribute to the better accommodation and conveniency of the species . . . and derives no sort of advantage from that variety of talents with which nature has distinguished its fellows. Among men, on the contrary, the most dissimilar geniuses are of use to one another; the different produces of their respective talents, by the general disposition to truck, barter, and exchange, being brought, as it were, into a common stock, where every man may purchase whatever part of the produce of other men’s talents he has occasion for.” See Smith (1981, pp. 14).

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good at farming, and I'm good at fishing. We can both be better off if we specialize. These talents need not be innate (though they could be). The important thing is that, through taste, talent, or practice, you are better – at something – than I am. That means that I'm better off trading with you than trying to do everything for myself.

This requires cooperation. But cooperativeness is the *default*, the core tendency, the central psychological fact of human society. Some arrangements called “markets” nurture and expand this natural cooperativeness, at least under some circumstances. In a functioning market, I don't need to know how to do *everything* because I can hire others who have acquired knowledge through practice or ingenuity. This willingness to depend on others creates enormous potential benefits, as all of us work for everybody else. But there is sand in the gears of the system: transaction costs. Transaction costs prevent cooperation, even if that cooperation would be mutually beneficial.

In particular, transaction costs prevent exchanges that would otherwise make two or more people better off. That may not seem so important, but it is. Exchanges correct “mistakes,” because resources are usually not being used in the most valuable way. The reasons may be complicated, involving history, accident, and the residue of dynamic change: what once was optimal is now anachronistic. But that means that people are holding onto resources that other people need more, simply because of transaction costs. If transactions costs can be reduced, people will be able to specialize: each of us can own just a few things, and rent those out to others when we aren't using them. And we can rent the things that someone else has “specialized” in.

For example: I have three old bicycles in my garage. Those bikes have been there for years, unused. That's not just an inefficient use of resources; it's also selfish, maybe even immoral. I could have allowed someone who values those bikes to use them, as long as it didn't cost me anything. Am I a pathetic miser, counting unused bikes and chortling gleefully at my treasure hoard, a low-rent Smaug?

No. The problem is transaction costs. I cannot cheaply or easily find someone who wants to use the bike. So the services of the bike

are wasted, but there is no obvious way of making better use of them. I could probably find someone who wanted to use one of the bikes for an hour, or a day. But they wouldn't pay much for that, and I wouldn't be sure I could trust them to return the bike. And it would all be a lot of trouble. So there they sit.

Once you understand transaction costs, it will change the way you think about almost everything. If I need my yard mowed and the leaves blown, why don't I hire the man in Chowmuhani, or the man in Ambohitompoina, either of whom would gladly do the work for \$5 per day? It wouldn't be exploitative; these workers would love to have the job because they are only making \$3 per day at present. Still, the answer makes the question seem silly: Chowmuhani is in Bangladesh, and Ambohitompoina is in Madagascar. The costs of finding that willing worker, agreeing on a price, transporting him physically to my leaf-choked yard in North Carolina, and then monitoring his work dwarfs the amount I can pay. Those three costs – which I will call triangulation, transfer, and trust – ensure that the world economy is full of mistakes: *resources should move*, but they don't.

THE THIRD GREAT ECONOMIC REVOLUTION:

WHY OWN WHEN YOU COULD RENT?

Suellentrop (2010, p. 33) claimed, in a way that now looks prescient, “We woke up in a Rentership Society, and it's starting to look permanent. And you know what? Thank goodness. Ownership, it turns out, is for suckers.”

If you own something, you have to pay the *average* cost of using it because no one can share it, and you have to pay for what it costs to create and store that thing. If I own a flat, I'm already paying for utilities and making mortgage payments. But what if I'm not always there, or if I have an extra room I only use to store junk? I would be willing – maybe even happy – to offer someone else my place to stay at the cost of having to clean it afterwards, plus whatever extra I can get to pay toward my rent. This cost of use is called *marginal* cost, the expense of sharing the unit for one period of time. If I can collect

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enough to pay my marginal cost, plus part of my mortgage, for a week that I'm going to be away anyway, I'm ahead. If you come to my city, I'd be willing to rent you a room, provided we can solve the transaction cost problem of triangulation, transfer, and trust.³

Likewise, I'm willing to offer rides in my car at the cost of gas, my time, and wear and tear on the vehicle – the *marginal* cost – if I can also make *some* of the car payment for that month, reducing the amount I have to pay out of my pocket. I don't have to make enough to cover the entire car payment, like a taxi driver would. I just need to cover some of it. If I have a car and a few minutes, I have some excess capacity. If you need a ride, there may well be a way for us to share.

The reason we don't see more sharing is that the three components of transaction costs are so hard to negotiate. As I outlined earlier, these include:

Triangulation information about identity and location, and agreeing on terms, including price

Transfer a way of transferring payment and good that is immediate and as invisible as possible

Trust a way of outsourcing assurance of honesty and performance of the terms of the contract.

The problem isn't new of course, but this approach to thinking of everything in terms of transaction costs may take a little getting

³ This difference between "marginal" and "average" costs has important implications. If you go to a resort town, perhaps at the beach in New England, and stop at a restaurant in January, you notice that you are the only customer at 12:30 pm. And you ask yourself, "How can this place stay open? It's totally dead around here." The answer is that the restaurant has many fixed costs, such as rent and utilities (they have to keep the heat on, so the pipes don't freeze!). They have to pay those costs regardless of whether they open for business or not. The marginal costs, the costs of opening for business, are just the costs of food, the wages of the cook and service staff, and some electricity for the sign out front that says "OPEN." If the restaurant can cover the marginal costs, plus even just a small part of their average costs, they are ahead. They aren't making money, but they are losing less than if they stayed closed. Uber operates on the same principle: drivers don't have to make their full car payment in fares to make it useful to drive for money, as long as they cover their marginal costs. Rifkin (2014) questions whether traditional models of capitalist markets can survive the move to marginal cost pricing, or whether some other form of "collaborative sharing" will replace it.

used to. We can use transaction costs to explain things you may have taken for granted. Consider this: if you are going to a city where you don't know anyone, where will you stay? In principle that seems like a hard problem. In fact, it's easy: you stay in a hotel, an organization that has specialized in owning rooms that it can rent out.

But which hotel? To solve that problem, we use a solution called *brand name*. Brand names solve all three transaction costs problems. Still, hotels are expensive because they have to cover their *average* costs: all their value is in the business of selling rooms by the night. Hotels have to charge enough to cover all their mortgage, utilities, the upkeep of their buildings, and wages to employees. That's not true of apartments or homes where people live because those other expenses are being paid already. If I can make even a little money off the apartment where I live, it's all extra cash. So I can charge a price that covers just my additional costs and still be glad to have access to the transaction.

That low price will be better for the buyer also, of course, as long as the three categories of transaction costs can be reliably reduced. A company called Airbnb figured this out. In fact, Airbnb does not rent out space; it sells (1) information on availability and location (triangulation), (2) reliable transactions clearing, and (3) "distributed trust," or dependable access to vetted market participants, so that trustworthy buyers find trustworthy sellers. The rest is up to the people who have stuff (in this case, space) and the people who want to rent that stuff (in this case, an accommodation in a place where they don't know anyone but want to sleep safely).

There is an alternative, and even more extreme, form of "renting" that may be of great importance within a decade or less. That would be "renting" the particular form in which pellets or filament have been "printed" by a 3D printer. If the speed and value of 3D printing continue to increase, and if the cost of reducing the material at the end of its desired use is low enough, then all that would be necessary is to "rent" the material in a particular printed form for a small amount of time. The "buyer" could have the device delivered, and then return it to the 3D print shop, where it would be

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reduced to its constituent metal and plastic parts and used again. Of course, if this scenario comes to fruition it will mean that no one may need to own any tools at all. It would also mean that there would be no manufacturing at all: presumably, 3D printers should be able to print 3D printers. I will not say much about this possibility because a lot of things would have to be worked out before such a system could function.

The point is that, regardless of whether the simple or the extreme form of “renting” comes to dominate, overall each of us will have far fewer actual possessions while we make better use of the stuff we still have. We’ll be less selfish, less crowded, richer, and more cooperative, all because entrepreneurs can sell reductions in transaction costs.

SOFTWARE EATS THE WORLD

The quote I used to start this chapter sounded pessimistic: “People are a problem.” But people *want* to cooperate. The reason people are a problem is that transaction costs can prevent us from helping each other. But increasingly entrepreneurs can use software to reduce transaction costs so other people can share. Software is the “robot” of exchange: where automation replaces humans in manufacturing, software automates *transactions*.

What changed? Two things came together, and a third thing caught up. First, the Internet was constructed, providing very cheap pathways for communication and allowing “permissionless innovation” (more on that later). Second, hardware platforms, particularly smartphones, allowed universal, portable, continuous access to the Internet. The thing that “caught up” was the developing world: suddenly the source of labor for entrepreneurship, and the focus of value-creating exchange, exploded from the 2 billion people in the “first world” to more than 7 billion people, all over the world. Distance, borders, and language are all transaction costs barriers, but with smart phones connected to the Internet they are much less important.

With that platform and those connections, the number and variety of software applications exploded. Marc Andreessen saw it clearly in 2011:

More and more major businesses and industries are being run on software and delivered as online services – from movies to agriculture to national defense. Many of the winners are Silicon Valley-style entrepreneurial technology companies that are invading and overturning established industry structures. Over the next 10 years, I expect many more industries to be disrupted by software, with new world-beating Silicon Valley companies doing the disruption in more cases than not.

Andreessen connected several apparently unrelated events: many things, of many different kinds that had once been done for pay by humans are now done nearly for free by software. Not robots, *software*. But more than that, software can do – and in some cases is already doing – new things humans have *never done*, and have *never thought of doing* because until now the transaction costs have been too high.

In a way, there's nothing new here. Specialization has always meant that people have to solve the problem of cooperating in groups, and larger groups create much larger transaction costs. Over and over again, independently in societies without social contact, people came up with almost exactly the same solution: the original "software" – money.

Money stands in – at one remove – for actual value. Aristotle recognized this as a crucial step in the evolution of a market society.⁴

⁴ Aristotle's view is quite nuanced:

In the [household] there is no function for trade, but it only arises after the association has become more numerous. For the members of the primitive household used to share commodities that were all their own, whereas on the contrary a group divided into several households participated also in a number of commodities belonging to their neighbors, according to their needs for which they were forced to make their interchanges by way of barter, as also many barbarian tribes do still; for such tribes do not go beyond exchanging actual commodities for actual commodities.

... [W]hen they had come to supply themselves more from abroad by importing things in which they were deficient and exporting those of which they had a surplus, the employment of money necessarily came to be devised. For the natural necessities are not in every case readily portable; hence for the purpose of barter men made a mutual compact to give and accept some substance of such a sort as being

He describes a “stamp” as standing in for actual commodities. That stamp is *software*: A set of instructions that direct a computer. Aristotle’s trading stamp was a crude analog computer, but a computer nonetheless. The symbol on paper signified value, but it also created value, in the sense that it sharply reduced the transaction costs of exchange compared to barter.⁵ The “instruction” was the number on the stamp: larger numbers meant more value, even the paper and the number had no intrinsic value at all; it was just an instruction, a mark on a preserving, communicable medium. The “computers” are the minds of human beings, which process transactions in markets using that software.

Currency allows “value” to be reduced to an abstract concept, rather than requiring the cumbersome transfer of the physical commodities that the stamp represented. The fact that people *want* to be able to exchange – the only way I can be better off is if I find a way to make you better off – is not enough. They have to find a way to reduce transactions cost below the value being produced by the exchange, or the exchange won’t happen.

Many, many potentially beneficial acts of cooperation don’t happen. *Each one* of us, on a planet of nearly 7.5 billion people, is wasting time and storage space. Every minute of every day there is *something* we are willing to do that would benefit someone else a great deal. The same is true of many of the things we own, work with, and see around us: someone, somewhere, wants that thing more than we want it. But we don’t know they need it and they don’t know we have it.⁶

itself a useful commodity was easy to handle in use for general life, iron for instance, silver and other metals, at the first stage defined merely by size and weight, but finally also by impressing on it a stamp in order that this might relieve them of having to measure it; *for the stamp was put on as a token of the amount.*

(Aristotle, *Politics, Book I, Section 1257a; emphasis added*)

⁵ The most interesting and wide-ranging history of money and the notions of using abstract value on notes issued by private entities (which might be, but would not have to be, banks) is Selgin and White (1994).

⁶ F. A. Hayek (1945, p. 520) calls attention to the pervasiveness of this general problem of lacking “the knowledge of the particular circumstances of time and place.”