Comment

Life is a Ponzi scheme

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Unless you've spent the last month on a spacecraft returning from Mars, you've probably heard of Bernard Madoff, the American financier who stands accused of perpetrating what may be the greatest investment fraud in history. Estimates of the amount of money lost by investors in the investment fund managed by Madoff, a former chairman of the NASDAQ Stock Market, range up to US$50 billion. One of Madoff's biggest investors, René-Thierry Magon de la Villehuchet, committed suicide on 23 December 2008 following the disclosure of the scheme. Villehuchet is thought to have lost as much as $1.4 billion in Madoff's fund. A number of charitable foundations, several of which provide funding for disease-related biomedical research, lost huge percentages of their endowments. Several universities have been significantly harmed as well, since either some of their own money or the savings of some of their biggest regular donors turned out to have been invested with Madoff.

The particular type of con game that Bernard Madoff practiced is surprisingly simple for someone whose web of deceit appears to have been so tangled. It's called a Ponzi scheme. The fraud takes its name from Charles Ponzi, who was one of the greatest swindlers in history. Born Carlo Ponzi in 1882 in Parma, Italy, he emigrated to the United States in 1903. After working at a series of low-paying jobs for several years, he moved to Montreal in 1907 and became an assistant in a bank that had been set up to serve the needs of Italian immigrants to Canada. The bank eventually failed because of bad real-estate loans - sounds familiar? - but Ponzi stayed on in Canada where eventually he was jailed for three years for check forgery. On his release in 1911 he joined a scheme to smuggle illegal aliens across the border to the United States, was caught, and served a further two years in prison, this time in Atlanta, Georgia. There he met Charles W Morse, a financier who had been convicted of violating federal banking laws. Morse became a sort of guru to Ponzi, who began to see the possibilities in white-collar crime. After his release, Ponzi made his way to Boston, Massachusetts, where he set up the investment scheme that was to make him famous - and notorious.

To call his pitch to prospective pigeons attractive would be to understate the case. He promised clients a 50% profit within 45 days, or 100% profit within 90 days, by buying discounted postal reply coupons in other countries and redeeming them at face value in the United States, a form of what we currently call 'arbitrage' (the practice of taking advantage of a difference in price between two or more markets). A simple, and classic, example of arbitrage would be to collect discarded soda cans in Massachusetts, where they are sold with a deposit of $0.05 each, and truck them to Michigan, where the returned deposit is $0.10 per can. (For those of you thinking of funding your research this way, forget it: the cost of collecting and transporting the cans eliminates the profit. However, about $10 million worth of empty bottles and cans do get smuggled into Michigan from neighboring Ohio and Indiana, which do not require a deposit on beverage containers. Returning those out-of-state bottles and cans in Michigan does make a small profit. Michigan lawmakers have proposed requiring that beverage manufacturers put a code on all bottles and cans that are sold in Michigan, and that automated bottle return machines be programmed to read the code so they accept only containers originally sold in Michigan.)

Ponzi wasn't arbitraging soda cans, though. The commodity he claimed to be buying and selling was international postal reply coupons. A postal reply coupon is a piece of paper included in a message sent by someone in one country to a correspondent in another country, so the recipient can use the coupon to pay the postage for a reply - the modern equivalent, within one country, is the stamped, self-addressed envelope. What made them attractive for arbitrage is that the coupons were priced at the cost of postage in the country of purchase, but were exchanged for stamps to cover the cost of postage in the country where redeemed; if these values were different, there was a

potential profit. Inflation after the First World War had reduced the cost of postage in Italy as expressed in US dollars, so an international postal reply coupon bought in Rome could, in theory, be exchanged in Boston for stamps with a much higher dollar value. As explained by Ponzi, investors would give him money; he would send that money abroad, where his agents would purchase reply coupons; the agents would send the coupons to the US, where Ponzi would redeem them for stamps of a higher value; and he would then sell the stamps. Ponzi claimed that the net profit on these perfectly legal transactions, after expenses and exchange rates, was in excess of 400%.

In the first two months of 1920, some people invested and were paid large returns (100% profit in a few weeks). Word spread, and investment came in at an ever-increasing rate. Ponzi hired agents to drum up new business and paid them generous commissions for every dollar they brought in. At that time all investors were being paid impressive rates, which encouraged others to invest. By May 1920, Ponzi had made $420,000 (over $4.5 million in 2008 dollars). By July 1920, he had made millions. People were mortgaging their homes and investing their life savings in his company. Most did not take their profits out, but reinvested them, believing that the enormous returns would continue forever.

What none of them knew was that Charles Ponzi wasn't buying and selling postal reply coupons. In fact, he wasn't arbitraging anything. What he was actually doing was running what is called a pyramid scheme: as long as money kept flowing in at a greater rate than people were withdrawing it, existing investors (the top of the pyramid) could be paid with a portion of the money brought in from the larger horde of new investors (the pyramid bottom). By 24 July 1920, the pyramid scheme was returning for Ponzi's firm, The Securities Exchange Company, the astounding sum of $250,000 a day.

Well, my father, who was trained as an economist, always said that if something seems too good to be true, it probably isn't either good or true. Clarence Barron, the financial analyst who founded the financial magazine Barron's, started to examine Ponzi's outrageous returns. Barron first noted that Ponzi hadn't invested his own money with his own company - always a red flag. Then he calculated that, to cover the investments made with the Securities Exchange Company, about 160,000,000 postal reply coupons would have to be in circulation. However, only about 27,000 coupons were actually circulating worldwide. He checked with the US Post Office, who confirmed that postal reply coupons were not being bought or redeemed in large quantities, either at home or abroad. Finally, Barron crunched the numbers, and found the same thing for arbitraging postal reply coupons that you would find if you tried to redeem Massachusetts soda cans in Michigan: the gross profit margin in percent on each item was huge, but the actual return per item was very small, and the overhead required to handle the purchase and redemption of the necessarily huge number of items, which were sold individually, would have far exceeded the gross profit.

The *Boston Post* published the results of Barron's investigation, and ran a headline on 2 August 1920, declaring Ponzi hopelessly insolvent. On 10 August federal agents raided the Securities Exchange Company and shut it down. Of course, they found no large stock of postal reply coupons. On 12 August 1920, Ponzi was arrested. Seventeen thousand people had invested millions, maybe tens of millions, with him over a period of less than nine months. Most lost everything.

After serving years in prison on both federal and state charges, Charles Ponzi was deported to Italy in 1934. He died a pauper in a charity hospital in Rio de Janeiro on 18 January 1949.

It now appears that Bernard Madoff was running a similar pyramid scheme, on a colossal scale. He was cleverer about it, of course, since he had Ponzi's mistakes to learn from. Rather than offer suspiciously high returns to all comers, Madoff instead offered modest, but steady returns (about 10-15% per year). Furthermore, Madoff didn't solicit business; instead, he deliberately made it difficult to invest. By catering to an exclusive clientele, one that had to be both super-rich and selected by him, he drove up the demand for his services through their scarcity. The scheme also differed from Ponzi's in that a number of other investment funds invested much or all of their holdings in Madoff's fund, which meant that many individual investors, who believed they were diversified, unknowingly had all their eggs in the Madoff basket.

There were a number of red flags that should have alerted both financial analysts and government regulators to the probably fraudulent nature of Madoff's business (to be fair, a small number, such as Boston financial specialist Harry Markopolos, did sound warnings about Madoff for years, but were ignored). For one, almost identical returns were produced in both up and down markets - an impossibility with honest trading. Another red flag is that the investment method was stated to be a proprietary secret.

The slow pace and 'insider' marketing enabled the scheme to survive for an unusually long time and also to grow far larger than would be expected of a common Ponzi scheme. What caused it to collapse? The general market downturn of 2008 caused new investments to decrease and forced a larger than usual number of existing investors to cash out their positions. That's what usually brings down a pyramid scheme: when the top of the pyramid demands more money back than the bottom is putting in ('illiquidity' in finance-speak).

Now, the reason you're reading about this here, is that I just realized that life itself is basically a gigantic Ponzi scheme, and the pyramid is dangerously close to collapsing. In the developed world, we have evolved a society in which a relatively small number of old people have many of their needs cared for through the financial contributions of a larger number of much younger people. And that made sense, because for over 12,000 years the age distribution of the human population was, in fact, in the shape of a pyramid, with a huge base of young children rising to a smaller number of teenagers and a still smaller number of young adults, and so on up to a tiny tip of the elderly. But sometime in the 1950s, as the birthrate declined and life expectancy continued to increase, the pyramid started to be shaped more like a column. Within the next 40 years it will become one, and then it will slowly invert.

Worldwide, the average life expectancy at birth in 1955 was just 48 years; in 1995 it was 65 years; in 2025 it will reach 73 years. By the year 2025, it is expected that no country on Earth will have a life expectancy of less than 50 years. That has never happened before in human history. Globally, the population of children under 5 will grow by just 0.25% annually between 1995-2025, while the population over 65 years will grow by 2.6%. The average number of babies per woman of child-bearing age was 5.0 in 1955, falling to 2.9 in 1995; it will reach 2.3 in 2025. While only 3 countries were below the population replacement level of 2.1 babies in 1955, there will be 102 such countries by 2025. The World Health Organization has estimated that the proportion of older people requiring support from adults of working age will increase globally from 10.5% in 1955 and 12.3% in 1995 to 17.2% in 2025. In 1955, there were 12 people aged over 65 for every 100 aged under 20. By 1995, the old/young ratio was 16/100; by 2025 it will be 31/100. By the end of the century it will approach unity. Eventually - and eventually isn't that far off - we will live in world where a smaller number of young people will be asked to support a larger number of the very old. No Ponzi scheme can survive that.

Consider healthcare. Total healthcare costs in the United States now exceed $1 trillion, 14% of the gross domestic product. Of this total, a disproportionate share is spent on the care of elderly patients shortly before their deaths. Most elderly people have the bulk of their medical care paid for by Medicare, a state-supported program. Workers pay into it during their years of peak employment, and as retirees they then draw down from it as they age. However, the 5% of Medicare recipients 65 years of age and older who die in any one year account for around 30% of all costs of the Medicare program. Seventy-seven percent of the Medicare decedents' total healthcare expenditures occur in their last year of life, a staggering 52% in the last 2 months, and 40% in the last month. We are basically spending a fortune as a society for healthcare for very old, very sick people that does not increase the lifespan of the individual by more than 30 days, if at all.

We could, of course, handle this cost imbalance by draconian decisions about life and death, but that is probably a political (and maybe ethical) non-starter (although don't be surprised if it doesn't become part of the conversation if we don't find other ways to control costs). And the population pyramid would change dramatically if we had a global thermonuclear war or a planet-wide plague, but we probably won't be so lucky. And science may actually be on its way to making the problem worse.

There are a number of genomics-driven research programs, some based on model organisms but others involving mammals right up to people, that aim to increase the human lifespan. If successful, they would spell the rapid and certain ruin of the Ponzi-like social contract between old and young, by guaranteeing a completely inverted population pyramid. I believe that it is pointless to increase the human lifespan unless the quality of life for the elderly is also increased. Specifically, this means that we must greatly improve the health of our oldest citizens unless we wish to see our economy collapse, soon, from the burden of caring for them.

That's going to be a tall order, because age is a major risk factor for just about everything bad that can happen to a human being. Incidence of neurodegenerative diseases such as Alzheimer's and Parkinson's diseases rises exponentially with age after 65, until people over 80 have almost one chance in two of suffering from one of them. Half of all cancer deaths occur in people over 75 years of age. The greatest risk factor for prostate cancer is age: more than 75% of all prostate cancers are diagnosed in men over 65. Over 80% of deaths from circulatory disease occur in people over 65. Stroke, the third leading cause of death in the United States (after heart disease and all forms of cancer), is 30 times more likely in men over 90 than it is in those aged 55-59. When you add in bone density loss, arthritis, and other age-related disorders, it's hard not to agree with the Rolling Stones' lyric from the song *Mother's Little Helper*: "What a drag it is, getting old."

Controlling healthcare costs and making sure that everyone can afford basic care, though essential, is not going to be enough in the long run - not with that demographic time-bomb ticking away in the background. Our only hope as a species lies with biomedical research. And that research needs to be aimed at prevention, not just treatment, because it's always more expensive to treat an illness than it is to prevent it. Oddly, we tend to be more easily alarmed by the relatively improbable prospect of epidemics such as avian flu than we are by a certain likelihood that most of us will, if we live long enough, fall prey to devastating chronic ailments. As a result, we invest much more money in planning for and

warding off the former than we do in dealing with the latter. This mindset has to change.

The line of succession from Charles Ponzi to Bernard Madoff is more than a chronicle of cupidity. It's a microcosm of the way we've organized our society. For thousands of years it made sense to assume that there would always be more young people to pay for the care of older ones. But Ponzi and Madoff failed because they forgot that no pyramid lasts forever. We had better remember that.