To: jeevacation@gmail.com[jeevacation@gmail.com]; Jeffrey Epstein[jeevacation@gmail.com]
From: [redacted]
Sent: Sat 11/5/2011 9:07:46 PM
Subject: FW: universal exponent for cities and companies (Sante Fe thesis)

From: Tren Griffin
Sent: Saturday, November 05, 2011 7:13 PM
To: [redacted]; Steven Sinofsky
Subject: universal exponent for cities and companies (Sante Fe thesis)

Supportive of [redacted] thesis that urban poverty work is super important.

From: Tren Griffin
Sent: Saturday, November 05, 2011 9:54 AM
To: Bill Gates; Nathan Myhrvold; Michael Larson; Jerry St. Dennis; Alan Heuberger
Cc: Lowell Wood; Edward Jung; Larry Cohen; Boris Nikolic (bgC3)
Subject: universal exponent for cities and companies (Sante Fe thesis)

My edited version of a talk by Geoffrey West of Santé Fe: http://edge.org/conversation/geoffrey-west

> ...[Cities scale] in what we called a super linear fashion. Instead of being [redacted] exponent less than one, indicating economies of scale, the exponent was bigger than one, indicating what economists call increasing returns to scale.
>
> What does that say? That says that systematically, the bigger the city, the more wages you can expect, the more educational institutions in principle, more cultural events, more patents are produced, it's more innovative and so on. Remarkably, all to the same degree. There was a universal exponent which turned out to be approximately 1.15 which translated to English says something like the following: If you double the size of a city from 50,000 to a hundred thousand, a million to two million, five million to ten million, it doesn't matter what, systematically, you get a roughly 15 percent increase in productivity, patents, the number of research institutions, wages and so on, and you get systematically a 15 percent saving in length of roads and general infrastructure.
>
> There are systematic benefits that come from increasing city size, both in terms of the individual getting something — which attracts people to the city, and in terms of the macroscopic economy. So the big cities are good in this sense.

... It's good that we have super linear scaling, because what that says is you have open-ended growth. And that's very good. Indeed, if you can check it against data, it agrees very well. But there's something very bad about open-ended growth.

One of the bad things about open-ended growth, growing faster than exponentially, is that open-ended growth eventually leads to collapse. It leads to collapse mathematically because of something called finite times singularity. You hit something that's called a singularity, which is a technical term, and it turns out as you approach this singularity, the system, if it reaches it, will collapse. You have to avoid that singularity in order to stop collapsing. It's great on the one hand that you have this open ended growth. But if you kept going, of course, it doesn't make any sense. Eventually, you run out of resources anyway, but you would collapse. And that's what the theory says.

How do you avoid that? Well, how have we avoided it? We've avoided it by innovation. By making a major innovation that so to speak, resets the clock and you can kind of start over again with new boundary conditions. We've done that by making major discoveries or inventions, like we discover iron, we discover coal. Or we invent computers, or we invent IT. But it has to be something that really changes the cultural and economic paradigm. It kind of resets the clock and we start over again.

There's a theorem you can prove that says that if you demand continuous open growth, you have to have continuous cycles of innovation. Well, that's what people believe, and it's the way people have suggested that's how you get out of the Malthusian paradox. This all agrees within itself but there is a huge catch.

I said earlier that in biology you have economies of scale, scaling that is sub linear, three quarters less than one, and that the pace of life gets slower the bigger you are. In cities and social systems, you have the opposite. You have the super linear scaling. You have increasing returns to scale. The bigger you are, the more you have rather than less.

... **Companies** are more like **organisms.** They grow and asymptote. **Cities** are open ended.

More importantly, what we discovered is that on the one hand, sales increased linearly with company size. On the other hand, profits increased sub linearly of [redacted] exponent of about one eighth. This data is all U.S. data on publicly traded companies.

Sales to profits are systematically decreasing so that eventually, the profit to sales margin is going to zero. If you just extrapolate this, indeed, if you look at the data, you see that the fluctuations in all these quantities are proportional to the size of the company. The fluctuation is getting bigger and bigger. The profits are decreasing relative to sales. Even though the profits are increasing the bigger you are, where you think, "we made several billion dollars" what you realize is that you're in [redacted] environment where the fluctuation is eventually bigger than that. This is possibly the mechanism by which companies die.

... Let me tell you the interpretation. Again, this is still speculative.

The great thing about cities, the thing that is amazing about cities is that as they grow, so to speak, their dimensionality increases. That is, the space of opportunity, the space of functions, the space of jobs just continually increases. And the data shows that. If you look at job categories, it continually increases. I'll use the word "dimensionality." It opens up. And in fact, one of the great things about cities is that it supports crazy people. You walk down Fifth Avenue, you see crazy people, and there are always crazy people. Well, that's good. It is tolerant of extraordinary diversity.

This is in complete contrast to companies, with the exception of companies maybe at the beginning (think of the image of the Google boys in the back garage, with ideas of the search engine no doubt promoting all kinds of crazy ideas and having maybe even crazy people around them).

Well, Google is a bit of [redacted] exception because it still tolerates some of that. But most companies start out probably with some of that buzz. But the data indicates that at about 50 employees to a hundred, that buzz starts to stop. And a company that was more multi dimensional, more evolved becomes one-dimensional. It closes down.

Indeed, if you go to General Motors or you go to American Airlines or you go to Goldman Sachs, you don't see crazy people. Crazy people are fired. Well, to speak of crazy people is taking the extreme. But maverick people are often fired.

It's not surprising to learn that when manufacturing companies are on a down turn, they decrease research and development, and in fact in some cases, do actually get rid of it, thinking "oh, we can get that back, in two years we'll be back on track."

> Well, this kind of thinking kills them. This is part of the killing, and this is part of the change from super linear to sublinear, namely companies allow themselves to be dominated by bureaucracy and administration over creativity and innovation, and unfortunately, it's necessary. You cannot run a company without administrative. Someone has got to take care of the taxes and the bills and the cleaning the floors and the maintenance of the building and all the rest of that stuff. You need it. And the question is, "can you do it without it dominating the company?" The data suggests that you can't.

[West's final statement here is that somehow science is going to create a theory that is **predictive** about complex adaptive systems. The reality is that there is no real progress on this to date. The best one might hope for a is predictive model (not a theory) that gets you odds that are better than "even" over time.]

> The question is, as a scientist, can we take these ideas and do what we did in biology, at least based on networks and other ideas, and put this into a quantitative, mathematizable, predictive theory, so that we can understand the birth and death of companies, how that stimulates the economy? How it's related to cities? How does it affect global sustainability and have a predictive framework for [redacted] idealized system, so that we can understand how to deal with it and avoid it? If you're running a bigger company, you can recognize what the metrics are that are driving you to mortality, and possibly put it off, and hopefully even avoid it.
>
> Otherwise we have a theory that tells you when Google and Microsoft will eventually die, and die might mean a merger with someone else.

In the comment section of the Edge talk Emanuel Derman says a few kinds words about this talk, but wth a cautionary note:

> When physical scientists tackles the social sciences they often seek laws like the laws of physics, and their models end up simplifying the object.

Derman has a new book out about the perils of modeling in which he creates this taxonomy:

> *Theories* are attempts to discover the principles that drive the world; they need confirmation, but no justification for their existence. Theories describe and deal with the world on its own terms and must stand on their own two feet.
>
> *Models* stand on someone else's feet. They are metaphors that compare the object of their attention to something else that it resembles. Resemblance is always partial, and so models necessarily simplify things and reduce the dimensions of the

world. In a nutshell, theories tell you what something is; models tell you merely what something is like.

Intuition is more comprehensive. It unifies the subject with the object, the understander with the understood, the archer with the bow. Intuition isn't easy to come by, but is the result of arduous struggle. http://blogs.reuters.com/great-debate/2011/11/03/the-physics-of-[redacted]-economic-crisis/

Michael Maubouissin wrote me this week:

> ... it's important to recognize that there's luck in a strategy working out. This is the point that Michael Raynor makes in "The Strategy Paradox" and I buy it: you can have a well conceived and executed strategy that flops and a poorly conceived strategy that succeeds. Better strategies have a better chance of success, but no guarantees.
>
> Picking successes and then attributing the success to something is always bad research, which is why there is zero predictive value in anything [Jim] Collins has ever done [Good to be Great etc] . It is probably benign myth telling, and does motivate managers. But it ain't rigorous thinking about real problems.