Will Technology Make Health Economists Obsolete?

or

Why Old Dogs Might Want to Learn Some New Tricks

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A Glaring Contradiction

- In one way or another, most of us work—either directly or indirectly—for what is arguably the most technologically advanced industrial enterprise humankind has ever known—the biopharmaceutical industry
- We easily can forget dizzying pace of technological change in biopharma:
  - When I began my career, notable advances in drug development included sustained-release formulations of oral meds (holes drilled by lasers in pills[!]) and transdermal delivery systems
  - And today I am working for companies designing treatments to change our DNA and cure genetic diseases
- Yet technology we use to produce models to assess value of medical interventions has been stagnant for long time

How We Produced Health Economics Models 20 Years Ago

How We Produce Health Economics Models Today

Our Production Technology Has Remained Unchanged for Many Years

- Most health-economics models today are developed in Excel on bespoke basis, same way they were 20 years ago:
  - Unless we all agree to begin working 12-hour days, big gains in production efficiency—bringing lower costs and reduced turnaround times—are unlikely to occur
- Ironic that technologically advanced industry like biopharma is so dependent for its survival and success on artisans and guild methods of production:
  - Do we believe there are no C-suite discussions about this problem?
  - We may be inclined to ignore this problem, as biopharma's costs are mother's milk of our profession

Our Production Technology Has Remained Unchanged for 20 Years (Cont.)

- We should see this situation as unsustainable:
  - "If something cannot go on forever, it will stop" ("Stein's Law")
    - Herbert Stein, former Chairman of US Council of Economic Advisers
- Moreover, from perspective of those who depend on information we produce, problems with our production technology are not limited to high cost and long production times for our work products

Our Production Technology Also Creates Huge Need for Quality Control

- Bespoke model development also means that every new model must be carefully checked for errors, from ground up
- We are fooling ourselves if we think that we can ensure that calculations in our spreadsheet models are correct:
  - These models easily can contain tens or hundreds of thousands of worksheet cells (or more), making process of error-checking tedious and time-consuming at best—and in many instances, impossible
  - And even if we wanted to thoroughly check our work for errors, our brains are pre-wired to ignore them

Our Ability to Spot Errors

Our Ability to Spot Errors (Cont.)

Our Brains Are Pre-Wired to Ignore Errors

- *Acocrdnig to a resaerchre at Cmabrigde Uniervtisy, it deosn't mattre in waht ordre lettres in a wrod are, the olny imrpotnt tihng is taht the frist and lsat ltteers be in the rghit plcae. The resst can be a toatl mess and you can sitll read it withuot probelm. Tihs is bcuseae the huamn mnid deos not read ervey lteter by istlef, but wrods as a whoel.*

Problem of Errors in Our Models

- We probably do a poor job of catching errors in models we build in Excel
- While these models can be validated by building second one from scratch, this is rarely done due to budget and time constraints:
  - *"Do it right first time instead of charging me twice!"*
  - And if second model yields different answer than first, then what?
- In reality, we do not know how extensive problem of undetected errors is in our work:
  - To better understand this, we can learn from other fields
  - Let's consider field of *cetology*, or study of whales

Errors in Models: Whale's Tales

- My interest is not with these kinds of whales . . .

Errors in Models: Whale's Tales (Cont.)

- . . . but rather in these kind

What Cetaceans Can Teach Us: Tale of a London Whale

- This particular cetacean's name is Bruno Iksil:
  - A talented modeler who worked for JP Morgan in London
  - He developed new "value-at-risk" (VaR) model in Excel to help bank manage its credit derivatives portfolio
- Every night, JP Morgan (along with other banks) placed "bets" in credit derivatives market:
  - Bets would be placed with borrowed money
  - Borrowing allows banks to place much larger bets than they could if they were limited to using their own funds
  - Leverage means that banks can make—and lose—a lot of money on these bets

What Cetaceans Can Teach Us: Tale of a London Whale (Cont.)

- Banks use VaR models to make sure they don't wager more than they could afford to lose:
- Bruno's new model, like those of his peers, was developed in Excel:
  - His model was reviewed by JP Morgan's in-house Model Review Group, comprised of many talented and experienced modelers
  - Model Review Group gave "thumbs-up" to Bruno's new model
- And then one day in 2012, JP Morgan announced that it had lost ~$6B overnight, based on bets Bruno had placed in credit derivatives market:
  - Everyone thought that he had committed a crime
  - He was dubbed the "London Whale"

What Cetaceans Can Teach Us: Tale of a London Whale (Cont.)

- Intensive investigation was conducted, by law enforcement authorities and various bank officials, including JP Morgan's Model Review Group
- These investigations revealed that bank's massive loss occurred because it had placed much larger bets in credit derivatives market than it should have:
  - And reason this happened? A *single error* in Bruno's model!
  - Report of JP Morgan's Model Review Group:
    - *"After subtracting old rate from new rate, spreadsheet divided by their sum instead of their average, as (Bruno) had intended; this error muted estimated volatility and lowered VaR"*
    - Bruno's model had series of linked worksheets, in which he often would manually copy/paste data from one worksheet to another

What Cetaceans Can Teach Us: Tale of a London Whale (Cont.)

- Thought should be sobering that JP Morgan was betting billions of dollars on predictions of an Excel model that was checked much more carefully than most of *our* models:
  - Everyone missed fact that *single (simple) equation* was wrong
  - Mistake was easy to see if you knew what you were looking for—but easy to overlook if you did not know that a mistake existed, and where it could be found
- Perhaps I am cherry-picking, and this example is isolated:
  - Can find other examples where simple—but important—errors in Excel models go unnoticed?
  - We don't need to look very far to find more cetaceans

What Cetaceans Can Teach Us: Tale of Two Harvard Whales

- In 2010, two Harvard economists, Carmen Reinhart & Kenneth Rogoff, circulated their now–famous paper entitled, "Growth in a Time of Debt":
  - Its authors argued that they had identified critical "threshold" for government debt (0.9 x GDP), which would cause economic growth to fall sharply if exceeded
  - They argued for fiscal austerity to limit government spending and borrowing, and stop level of debt from rising
  - Reinhard & Rogoff achieved near-sainthood among self-proclaimed political guardians of fiscal responsibility
  - Their "tipping point" was treated not as a hypothesis, but as an undisputed fact

What Cetaceans Can Teach Us: Tale of Two Harvard Whales (Cont.)

- There was one problem, however:
  - No one had been able to replicate their findings
  - Finally, in April 2013, mystery of their irreproducible results was solved
- BBC reported that an undergraduate student doing a homework assignment had discovered errors in Reinhart and Rogoff's calculations:
  - The professors, it seems, accidentally left 5 countries out of a key calculation when copying and pasting a formula in Excel
  - Inclusion of data for these 5 countries, which professors had meant to do, changed their findings
  - In fact, there was no magic "tipping point" when debt rose to 90% of GDP

What Cetaceans Can Teach Us: Tale of a French Whale Too

- In 2013, a French economist, Thomas Picketty, published a best-selling book, *Capital in the Twenty-First Century*:
  - Piketty argued that when rate of return on capital is greater than rate of economic growth, result is concentration of wealth, which leads to widespread social and economic instability
  - He proposed global system of progressive taxes on wealth to help reduce inequality and avoid this dire outcome
- There was one problem, however

What Cetaceans Can Teach Us: And a French Whale Too (Cont.)

- In 2014, *Financial Times* reported that it had launched major critique of analyses underpinning Thomas Piketty's bestseller
- There were errors, newspaper reported, in Piketty's spreadsheets:
  - Unfortunately, *Financial Times* reported, Piketty had bad habit of hard-coding adjustments into his worksheet formulas, resulting in errors in analyses that underpinned his conclusions

Excel Can Cause Us To Conflate Looking and Seeing

- While Excel has reputation of being highly transparent, we often mistaking looking for seeing:
  - In above examples, errors in worksheets were in plain sight, but nonetheless went undetected
- Error in Bruno's model was discovered only because one of world's largest banks almost blew up
- Errors in Reinhard & Rogoff's and Piketty's models were discovered only because thousands of people reviewed their published work:
  - Their models were reviewed much more closely than most—if not all—of our models

Will Technology Make Us Obsolete? A Little Crystal-Ball Gazing

- Technology that many of us use to build models (ie, Excel) is old, inefficient, costly, and time-consuming:
  - It also is prone to errors, which can be difficult to find
- As marketplace accords greater importance to value of new medical interventions, information we produce is becoming increasingly important to decision makers:
  - Aside from increasing length of our workday, it is largely impossible to increase our productivity with existing technology
- New technologies are emerging that can automate many tasks on which we routinely spend hours (eg, hēRo3):
  - It would be naïve to assume that those who are dependent on information we produce will not embrace new technologies

Will Technology Make Us Obsolete? A Little Crystal-Ball Gazing (Cont.)

- New technologies cannot replace all bespoke modeling—but they can replace a lot of it
- New technologies will drive down turnaround times and costs needed for model development, which in turn will increase demand for health-economics models across product lifecycles
- Technological change will not make health economists obsolete—but it will be disruptive, providing opportunities for some, while posing threat to others