

GRANT'S[®]
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**THE WORLD
IS NOT
A MODEL**

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Outline

- Preamble: The Trouble With Finance
- Ways of Understanding the World
 - Metaphors
 - Models
 - Theories
 - Intuition
- The Theory of Deliciousness
- What's Wrong With It
- What Can Be Done

The Trouble With Finance

Fundamental Theorem of Finance. *Security prices exclude arbitrage if and only if there exists a strictly positive value functional, under the technical restrictions that the space of portfolios and the space of contingent claims are locally convex topological vector spaces and the positive cone of the space of contingent claims is compactly generated, that is, there exists a compact set K of X (not containing the null element of X) such that*

$$C = \{x \in X : x \geq 0\} = \bigcup_{\lambda \geq 0} \lambda K.$$

- The fundamental theorem of arithmetic: Every natural number greater than 1 can be written as a unique product of prime numbers.
- The fundamental theorem of algebra: Every polynomial equation of degree n with complex number coefficients has n complex roots.
- Economists don't understand the difference between theorems and laws.
- They have fallen in love with mathematics, rigor and formalism for their own sake, irrespective of their efficacy. It's not their fault that they can't find better models; economics is a social science and people are difficult to theorize about. It is their fault that they don't understand the difference.

Understanding the World

- Metaphors
- Models
- Theories
- Intuition

Metaphors

- *Sleep is the interest we have to pay on the capital which is called in at death; and the higher the rate of interest and the more regularly it is paid, the further the date of redemption is postponed.*
- Arthur Schopenhauer
- *Periodicity of sleep and coupons* is the common element of the metaphor.
- Metaphors are an insight that state that something *is something else*.
- Much of our knowledge is a layer of metaphors.
- Metaphors and language build on our physical nature:
 - Elation/depression
 - Light/dark

Models

- Models are elaboration of metaphorical insights.
- Model airplanes: what makes it a model?
Limited but significant resemblance to properties that are important to user.
- Fashion model: Only the surface is important.
- Weather model: measurable abstractions like pressure, temperature, and known/tested equations; limitations are the omissions.
- Economic model: invisible abstractions like supply, demand, untested equations; limitations are the concepts and equations and the omissions.
- Liquid Drop Model of the Nucleus.

Why Is A Model A Model?

- A model is not the thing in itself: there is a gap between the model and the system.
 - It is a metaphor with limited applicability.
 - It is a caricature.
 - It focuses on parts.
 - It is a fetish, and therefore attractively dangerous.
- Models are labor-saving devices, allow you to avoid thinking/working for yourself.
- Models reduce dimensionality
- Models extrapolate or interpolate

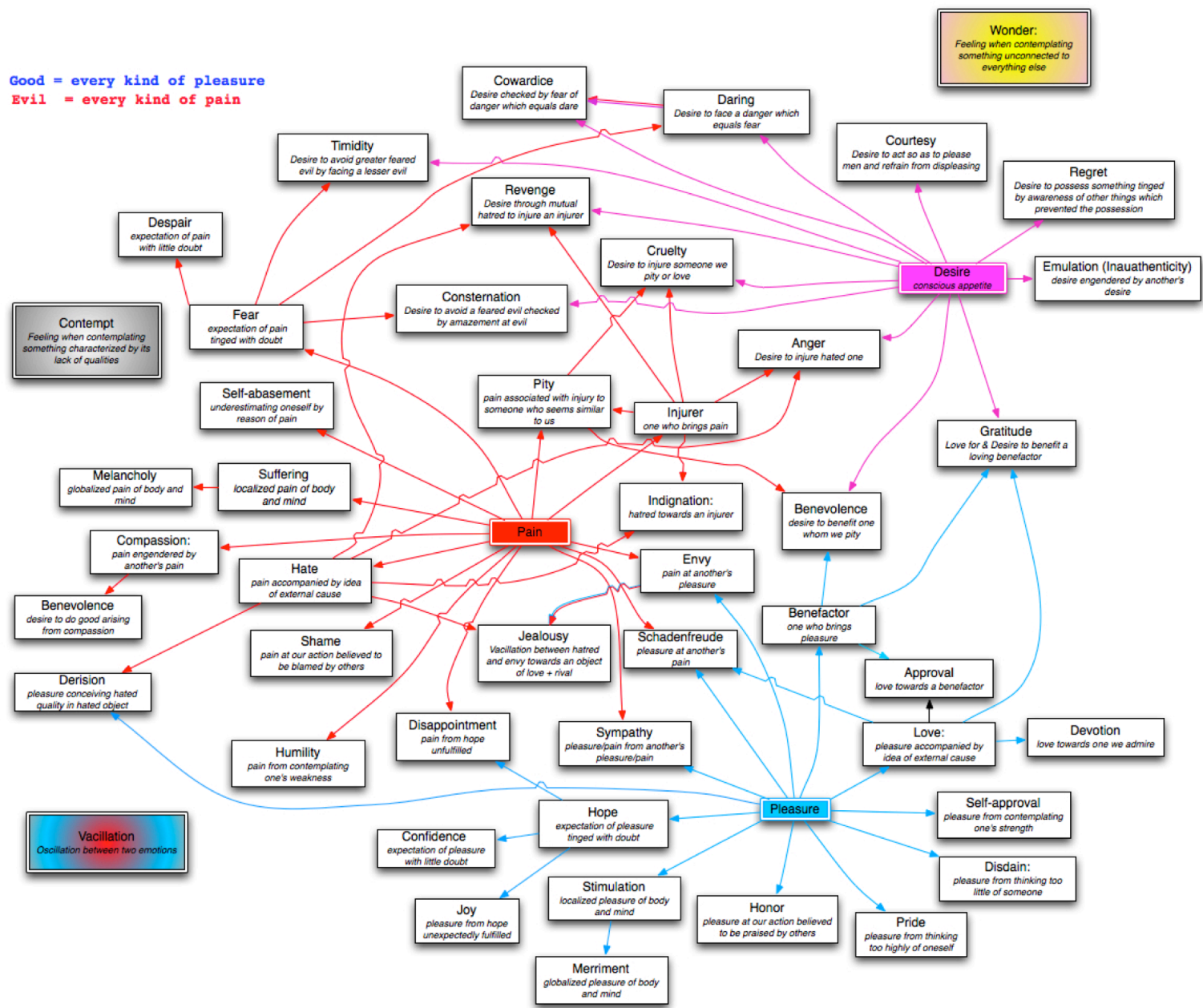
Why Is A Theory A Theory?

- Models are *analogies* and *relative*. Theories are **the real thing**.
- A theory is the ultimate non-metaphor: אֶהְיֶה אֲשֶׁר אֶהְיֶה *I am that which I am.*
- Theories tell you what something **is**. Models tell you what something is **more or less** like.
- The Dirac equation for the electron: $(-i\partial + m)\psi = 0$
- Maxwell's equations for light:
$$\begin{array}{ll} \nabla \cdot \mathbf{B} = 0 & \nabla \cdot \mathbf{D} = \rho \\ \nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} & \nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t} \end{array}$$
- A theory provides **non-metaphorical** insight, deals in **absolutes**; hence often uses math.
- A correct theory is indistinguishable from the world.
- Theories are deep, models are shallow. Nothing wrong with that.
- The ultimate goal would be: to grasp that everything in the realm of fact is already theory
Goethe, Maxims and Reflections

A Non-Math Example: Spinoza's Theory of Emotions ...

- Spinoza's treats emotions like Euclid treats geometry: emotions are derivatives.
 - Primitives are **Desire**, **Pleasure**, **Pain**.
- *Good* is everything that brings pleasure, and *Evil* is everything that brings pain.
- Love: **Pleasure** associated with an external object.
- Hate: **Pain** associated with an external object.
- Envy: **Pain** at another's **Pleasure**.
- Hope: Expectation of future **Pleasure** tinged with doubt.
- Fear: Expectation of future **Pain**.
- Cruelty: **Desire** to inflict **Pain** on a someone **Loved**.
- Three more primitives:
 - Vacillation, Wonder, Contempt.

A Non-Physics Theory ...Spinoza's Theory of Emotions as Derivatives



Intuition

- It takes intuition to discover the nature of the world.
 - Kepler, Newton, Ampere, Maxwell.
- Intuition may sound casual but it takes intimate knowledge of the world acquired by careful observation and painstaking effort.
- Keynes on Newton:

“I believe that the clue to his mind is to be found in his unusual powers of continuous concentrated introspection ... His peculiar gift was the power of holding continuously in his mind a purely mental problem until he had seen straight through it.”
- Maxwell on Ampère

“We can scarcely believe that Ampere really discovered the law of action by means of the experiments which he describes. We are led to suspect, what, indeed, he tells us himself, that he discovered the law by some process which he has not shown us, and that when he had afterwards built up a perfect demonstration, he removed all traces of the scaffolding by which he had built it.”

A Theory of Deliciousness

- Delicacies sell on the basis of **deliciousness**, an independent primitive quantity, unrelated to caloric and nutritional value.
- Realized deliciousness: ω
Expected/Implied deliciousness: Ω
- Chefs in restaurants can charge more for greater expected deliciousness Ω .
- If realized deliciousness ω turns out to be less than expected Ω , restaurant will have to lower prices; if it turns out that $\omega > \Omega$, it can raise them.
- The key question: **what is the fair price of deliciousness?**

A Theory of Deliciousness

- Let the price of a delicious food per 100 gm. be denoted by P .
- The theoretical principle:
 - Equal deliciousnesses should sell for equal prices; and
 - There is an **absolutely deliciousless** food whose cost is U per 100 gm.
- You can replicate less deliciousness from more by diluting a food with deliciousless nutrition costing U .
- Then you can show that the excess cost per unit of deliciousness, $\frac{P - U}{\Omega_P}$ must be the same for all foods.

The Pleasure Premium

- **The Pleasure Premium:**

$$\frac{P-U}{\Omega_P} = \Lambda$$

The excess amount of dollars diners are willing to pay per unit of expected pleasure

- The pleasure premium Λ (henceforth, the so-called **Derman Ratio**) is the same for all foods.

- Some questions:

How do we measure/quantify deliciousness ω ?

Asking people? Their facial expressions? PET scans?

Is Λ really constant across foods?

Can we theorize about the right value for Λ ?

MultiDeliciousness Theory

- There is more than one kind of **deliciousness**:
sweetness, tartness, smoothness, lumpiness, spiciness, blandness ...
- If there is one easy-to-obtain cheap generic deliciousness shared partly with all deliciousnesses, with market cost is M deliciousness Ω_M
- Then people will pay more only for the deliciousness they get over and above this generic cheap deliciousness. **All idiosyncratic deliciousness** must have the same **Derman Ratio**.
- You can then show that the price of deliciousness P for any food is given by

$$(P - U) = \beta_{PM} (M - U) \quad \text{where} \quad \beta_{PM} = \rho_{PM} \frac{\Omega_P}{\Omega_M}$$

- I leave it as an exercise to extend this to more general kinds of (non-oral) pleasure.

Questions

- This theory of deliciousness is a theory. It stands on its own two feet.
- Would you use it? What's wrong with it?
- Do you find **this** theory reliable:

$$(\mu - r) = \beta(\mu_M - r)$$

and would you use **it**?

Conclusion

- You can capture inanimate nature in an equation a few inches long. It's a miracle. There may be a TOE.
- There is no TOE in finance; you're lucky if there's a TOA.
- Don't abandon models; be aware of their limitations.
- Blake: *If a fool would persist in his folly he would become wise.*
- A little hubris is good.
- The greatest danger in financial modeling is idolatry
- A model may be entrancing but no matter how hard you try, you will not be able to breath true life into it.
- To confuse the model with the world is to embrace a future disaster driven by the belief that humans obey mathematical rules.

The Financial Modelers' Manifesto

- I will remember that I didn't make the world, and it doesn't satisfy my equations.
- Though I will use the models I or others create to boldly estimate value, I will always look over my shoulder and never forget that the model is not the world.
- I will not be overly impressed by mathematics. I will never sacrifice reality for elegance without explaining to its end users why I have done so.
- I will not give the people who use my models false comfort about their accuracy. I will make the assumptions and oversights explicit to all who use them.
- I understand that my work may have enormous effects on society and the economy, many beyond my apprehension.
- **MODELERS OF ALL MARKETS, UNITE!**
You have nothing to lose but your illusions.