



CONSTRUCTAL LAW LEADS TO DISCOVERY OF THE FUNDAMENTAL LAW IN ECONOMICS

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Fundamental Law of Economics (FLoE).

A finitely (not infinitely) converging algorithm addressing simultaneously the dual market variables price and quantity represents the mathematical formulation for the economic globalization of the planet.

The document discusses the application of the Constructal Law and the Fundamental Law of Economics in addressing resistance to flow in economic systems, leading to the globalization of the planet

Keywords: Economic equilibria; Duality in physics; Duality in economics; Duality in geometric programming.

1. INTRODUCTION

Constructal Law: For a finite economic system to persist in time must evolve with freedom such as to increase access to what flows.

Problem with economic systems is that they do not evolve with freedom. There is a resistance to flow. Therefore, we need a corollary to the Constructal Law.

Corollary: For an economic system to evolve with freedom the resistance to flow must be contained.

The document discusses the application of the Constructal Law and the Fundamental Law of Economics (FLoE) to address resistance to flow in economic systems, which is crucial for the economic globalization of the planet. Key points include:

Constructal Law in Economics: Economic systems must evolve with freedom to increase access to what flows. Resistance to flow, often caused by human actions like market arbitrage, must be contained. *Market Arbitrage:* Market arbitrage, which exploits global price differentials without producing value, is a significant issue, estimated to cause \$150 trillion in global market distortions annually. *Entanglement in Economics:* The concept of entanglement from quantum physics is applied to economics, suggesting that dual variables like price and quantity are instantaneously complementary. This is demonstrated through market models showing how changes in quantity or price affect the other variable. *Finitely Converging Algorithm:* A finitely converging algorithm, derived from the equilibrium of electrical circuits, is proposed to address dual variables simultaneously, integrating physical sciences with economics. *Economic Equilibrium:* The algorithm can solve economic equilibrium problems efficiently, returning significant value to producers and consumers, and negating the need for parallel trade. *Globalization and Wealth Redistribution:* The FLoE aims to secure the globalization of the planet by economic cycles without the negative effects of recessions and depressions, redistributing wealth equitably upfront. *Integration of Physics and Economics:* The document emphasizes the ultimate integration of physics and economics, aligning with Adrian Bejan's "Physics of Life," and proposes that economic systems can evolve without the negative impacts of current business practices. The document concludes that the FLoE can contribute to the natural economic globalization of the planet by addressing resistance to flow and ensuring equitable wealth distribution.

2. EXPLAINING THE FUNDAMENTAL LAW OF ECONOMICS FLOE

The Fundamental Law of Economics (FLoE) is a concept that integrates principles from physics, specifically the Constructal Law, into economic systems. It posits that for an economic system to persist and evolve over time, it must increase access to what flows within the system, such as goods, services, science / technology and capital.

The FLoE addresses the dual market variables of price and quantity simultaneously to achieve economic equilibrium and reduce resistance to flow, which is often caused by human actions like market arbitrage.

Key aspects of the FLoE include:

Simultaneous Addressing of Dual Variables: The FLoE involves a finitely converging algorithm that simultaneously addresses the dual variables of price and quantity, ensuring that changes in one variable are instantaneously reflected in the other.

Containment of Resistance to Flow: Resistance to flow, such as market arbitrage, must be contained to allow the economic system to evolve freely. This resistance is seen as a hindrance to the natural flow of economic activities.

Entanglement Principle: The FLoE applies the concept of entanglement from quantum physics to economics, suggesting that price and quantity are entangled variables that assume complementary statuses instantaneously in measurable time and space.

Economic Equilibrium: By using the finitely converging algorithm, the FLoE aims to achieve economic equilibrium efficiently, maximizing revenue and ensuring equitable distribution of wealth.

Globalization and Wealth Redistribution: The FLoE supports the natural economic globalization of the planet by promoting economic cycles that do not crash but transfer energy to new cycles, thus avoiding recessions and depressions and making wealth redistribution more effective.

Overall, the FLoE seeks to integrate physical laws with economic principles to create a more efficient, equitable, and sustainable global economic system.

2. MATERIALS AND METHODS

The dual market variables in economics are price and quantity. These variables are interdependent and play a crucial role in determining market equilibrium. When entangled these dual variables act in tandem.

Price: This is the amount of money required to purchase a good or service. It is influenced by factors such as supply, demand, production costs, and market competition.

Quantity: This refers to the amount of a good or service that is available for purchase or that consumers are willing to buy at a given price. It is influenced by factors such as consumer preferences, income levels, and the availability of substitutes.

In economic models, changes in one of these variables typically result in adjustments in the other to reach a new equilibrium. For example, an increase in the price of a good generally leads to a decrease in the quantity demanded, while a decrease in price usually results in an increase in the quantity demanded.

Example (Table 1): from our study of five medicines in seven European markets we have the medicines in the first column, sponsors in the second, recorded market arbitrage aka parallel trade next. Actual measured market arbitrage in the 4th column. Notice that the recorded market arbitrage is always underreported sometimes as much as 50%. This can be due to a couple of reasons: defective market statistics, but more likely intentional underreporting by parallel traders in an effort to justify the legality of parallel trade. Next two columns are the percentage returns of the resistance to flow after we resolve the economic equilibrium problem. Next column we have the annual sales of these five medicines as per market statistics.

Last two columns are the dollar returns of the resistance to the producers and consumers. \$2 billion are returned to the five producers, \$800 million to the consumers. This is a significant finding. It is challenging the reason for parallel trade to become legal. Parallel traders claim that they benefit consumers. From our study above it turns out the parallel trade is hurting consumers by \$800 million. Return of resistance to producers and consumers will increase access to what flows. This is the way the FLoE is affecting the economic globalization of the planet.

From our study of five medicines in seven European markets, we have the medication in the first column, the sponsor in the second, and recorded market arbitrage, parallel trade next. Actual measured market arbitrage is in the 4th column. Notice that the recorded market arbitrage is consistently underreported to legitimize the legality of market arbitrage. Applying optimal solutions that are optimal prices and optimal quantities (optimal trade flows) will return the flow resistance, aka market arbitrage, to the sponsors of the medicines and the global patient in the amount of about three billion dollars. \$2 billion to the producers, \$800 million to the consumers. This will increase access to what flows. This return of capital to the sponsor and consumer is productive capital, which will stimulate the economic globalization of the planet. This is about knowing the laws of physics and developing the instruments to affect globalization positively.

Table 1

Parallel trade earnings in seven European countries are to be returned to the pharma and global patients

Medicine	Pharma sponsor	Recorded Parallel Trade	Actual Parallel trade losses	return to pharma	welfare improvement global patient	Global Annual sales 2018	Pharma gains with optimal solution	Global patient gains with optimal solution
Adalimumab (Humira)	ABBVIE	8.48%	11.64	6.82%	1.65%	\$20,358,000,000	\$1,388,415,600	\$335,907,000
Levothyroxine Sodium	Abbot	0.59%	18.38%	12.69%	6.13%	\$2,600,000,000	\$329,940,000	\$159,380,000
Enbrel (Etanercept)	Amgen Pfizer	8.27%	15.42%	13.9%	1.76%	Not available; seven European countries sales 2017 \$2,677,631,644	\$372,190,798.52	\$47,126,316.93
Infliximab (Remicade)(DRY INF VIAL 100MG 1)	Johnson & Johnson	13.83%	17.86%	8.93%	8.61%	\$3,700,000,000	\$330,410,000	\$318,570,000
HYDROXYCHLOROQUINE (Plaquenil)	Mylan, Teva	4.54%	47.6%	13.11%	9.26%	Not available; seven European countries sales 2017 - \$50,549,039	\$6,626,979.01	\$4,680,841.01
Average			22.18%					
Total revenue returned to pharma sponsor via optimal solution							\$2,427,583,377.53	
Welfare gain to global patient								\$865,664,157.94

OGP (Optimal Global Pricing) technology can measure size of global parallel trade markets from market statistics.

Calculations performed on IMS statistics 2017.

* Factoring in client statistics will likely drive up these numbers.

3. Results

Generalizing the FLoE. Economic systems are Man-Man systems.

For all Man-Man systems:

A finitely (not infinitely) converging algorithm addressing simultaneously the dual variables of the system represents the mathematical formulation for the globalization of the system.

Our finitely converging algorithm in economics has been the subject of my PhD. research under Elmor L. Peterson. The computer code activating this algorithm I developed in collaboration with a brilliant software engineer, Mihnea Galca from Politehnica Bucharest. Peterson has some other similar algorithms and invites collaboration in writing the computer code for them. For these algorithms the appropriate scientific laws, have been “digitized” by “meshing” and “discretization”: Rush Hour Traffic (travel), Simulation of Heavy-hydrogen Fusion (science), Cosmic Simulation (science), Climate Simulations and Weather Predictions (science).

4. DISCUSSION AND CONCLUSIONS

Fundamental Law of Economics (FLoE):

Integrates principles from physics, specifically the Constructal Law, into economic systems.

Aims to increase access to what flows within the system (goods, services, science, technology, capital) to ensure the system's persistence and evolution. Addresses dual market variables (price and quantity) simultaneously to achieve economic equilibrium and reduce resistance to flow.

Key Aspects of FLoE:

Simultaneous Addressing of Dual Variables: Uses a finitely converging algorithm to ensure changes in price and quantity are instantaneously reflected in each other. **Containment of Resistance to Flow:** Reduces resistance caused by market arbitrage to allow the economic system to evolve freely. **Entanglement Principle:** Applies the concept of entanglement from quantum physics, suggesting that price and quantity are interdependent and complementary. **Economic Equilibrium:** Achieves equilibrium efficiently, maximizing revenue and ensuring equitable wealth distribution. **Globalization and Wealth Redistribution:** Promotes natural economic globalization, avoiding recessions and depressions, and making wealth redistribution more effective.

Entanglement Principle:

Derived from quantum physics and applied to economics. Suggests that price and quantity are entangled, meaning changes in one variable are immediately reflected in the other. Helps achieve economic equilibrium more efficiently by quickly adapting to changes and maintaining balance between supply and demand.

Impact on Globalization:

Supports economic cycles that avoid the negative effects of recessions and depressions. Ensures equitable wealth distribution upfront, making traditional wealth redistribution methods obsolete. These insights could be valuable in the strategic planning and understanding of economic systems.

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ADDENDUM: EXPLAINING THE ENTANGLEMENT PRINCIPLE IN THE CONTEXT OF THE FLOE

In the context of the Fundamental Law of Economics (FLoE), the entanglement principle is derived from quantum physics and applied to economics. It suggests that the dual market variables of price and quantity are entangled, meaning they are instantaneously complementary and interdependent. Changes in one variable (*e.g.*, price) are immediately reflected in the other variable (*e.g.*, quantity), and vice versa.

This principle implies that price and quantity are not independent but are closely linked in such a way that adjustments in one will directly and instantaneously affect the other. This entanglement helps in achieving economic equilibrium more efficiently, as the system can quickly adapt to changes and maintain balance between supply and demand. By addressing these dual variables simultaneously, the FLoE aims to reduce resistance to flow within the economic system, leading to more stable and equitable economic outcomes.