

## Entropy and Growing Global Interdependence

In recent years, growing global interdependence “has had an almost utopian appeal,” wrote the *Wall Street Journal* in 1983. The newspaper remarked that this was the dream of the 1960s and early 1970s. Global thinkers maintained that increasing economic interdependence among nations would also bind them together politically. “‘Peace through trade’ was the catch phrase. A Brazilian-grown chicken in a French-made pot: What a feast the two could make!”<sup>47</sup>

The paper pointed out that global interdependence is now here and growing. It has brought heightened world trade and increased incomes—and living standards—and has propelled some developing countries into industrialization. International investment has bloomed, opening new and seemingly unlimited avenues for the determined entrepreneur.

The increased interdependence also has brought about some problems—disorders—that proponents did not foresee when touting its potential benefits. Nations are far more vulnerable to outside economic disruptions than they were before. Inflation can spread quickly across national borders. Previously safe domestic industries have been hit by world markets, necessitating painful adjustments. Distortions in currency exchange rates can shut out nations’ traditional export markets. Economic autonomies of nations have been limited, as drastic actions by one nation quickly translate into hardships to others. “As a result, there are serious questions whether the long-sought-after interdependence hasn’t finally reached the point where its costs may be outweighing its benefits,” remarked the *Wall Street Journal*.<sup>48</sup>

The desirability of increased interdependence has not always been shared by economists and policymakers. An article in the *Yale Review* called for “a greater measure of national self-sufficiency and economic isolation” among nations. “Ideas, knowledge, science, hospitality, travel—these are the things which should of their nature be international,” the author argued. “But let goods be home-

spun whenever it is reasonably and conveniently possible, and, above all, let finance be primarily national.”<sup>49</sup> The author was John Maynard Keynes, in 1933.

“It’s still too early to tell how the debate over ‘increased interdependence’ will turn out,” concluded the *Wall Street Journal*. “But the concept plainly has far more minuses [disorders] than it seemed to have in the 1960s—and that may require more thought.”<sup>50</sup> As it turns out, the Second Law of Thermodynamics gives us an insight into the situation.

Imagine a cube made of a transparent material whose volume is 250 cubic feet, with 250 compartments filled with liquids of different colors. What happens if we make a pinhole on each side of the compartments? The individual molecules, finding additional degrees of freedom, will start to move around within a larger volume. The entropy of the system will increase. When the entropy of a system increases, so does our ignorance about the system. Before, we knew that a green molecule was in the green compartment. Now it can be in any compartment. With the passage of time, our ignorance about the system increases as the mixing process goes on. And if the size of the pinhole opening within the compartments should widen, the molecules will find more degrees of freedom to roam around, further increasing our ignorance—uncertainty—about the system.

The same principle applies to world affairs. Suppose those compartments were national boundaries. As barriers between nations begin to fall, each constituent (molecule) finds more degrees of freedom to move around in a larger volume. In our case, the molecules can be anything: people, ideologies, knowledge, religions, raw materials, goods, diseases, chemicals, information (or misinformation), cults, factories, jobs, terrorism, technology, money, food, drugs, or weapons. It is crucial to realize that once physical barriers fall, it becomes a practical impossibility to “control” the types of things that cross national boundaries.

For example, as international travel increases, diseases spread more easily and rapidly. Not surprisingly, the deadly disease AIDS has, within a short time, become a worldwide problem, because the world has become highly interactive. In this interconnected world, pests, weeds, and dangerous pathogens have also found new ways to move around with ease. Brown tree snakes are hitchhiking from Guam to Hawaii hidden in the wheel wells of a jet. Zebra mussels are being swept up in the ballast water of a supertanker and are

finding a new home, and new victims, in the Great Lakes. And the extremely aggressive Asian tiger mosquito, a major carrier of dengue fever, encephalitis, and yellow fever is moving from country to country in containers of used tires.<sup>51</sup>

In 1933, Keynes advocated that knowledge should be international. At the time, humans did not possess the knowledge to build nuclear bombs. Today no one suggests making public the technological know-how to build compact nuclear weapons. And how about the knowledge to manufacture viruses through recombinant DNA: Should that be made international?

We must also recognize that there are vast cultural differences between nations. What some people consider art, others call pornography, and find it offensive. There are also wide differences in social habits. Some nations are high-entropic, oriented toward consumption, while others like to save their money and live a simpler life. Advanced countries with high levels of productivity can produce huge quantities of consumer goods per unit time, and quickly distribute them throughout the world. They can generate intense disturbances all over the world, thus creating additional tensions among nations.

Of course, not all nations are in the same entropic state. When physical barriers fall and the mixing process begins, less-developed nations come in contact with technologically advanced nations, and people with less individual freedom become exposed to those with more freedom. Agricultural nations with simple means of production and communication become cognizant of more intense means of production and faster methods of communication. Pressure mounts on the less-developed nations to “modernize” quickly and become part of the high-entropic community. As more people become indoctrinated into a life-style governed by profligate methods of production and consumption and high levels of obsolescence, the pressure on natural resources heightens, the disorder of the environment magnifies, and the competition—ideological, socio-economic, and technological—between people and nations intensifies. Life becomes more hectic, more disorderly, more problematic, more uncertain.

The entropies produced by “free trade” and globalization of commerce gradually picked up momentum in the 1980s, especially after the demise of the Soviet Union, and became increasingly disturbing

and apparent. Books and articles began to talk about the effects and “minuses” of growing global interdependence.

The discipline of economics accepts the concept of free trade as an axiom not to be challenged. As MIT economist Paul Krugman, author of *Rethinking International Trade*, has pointed out, “If there were an Economist’s Creed,” it would surely contain the affirmation, “I believe in free trade.”<sup>52</sup> Consequently, it is difficult for professors of economics to publish articles and books criticizing the fundamentals behind free trade. Professor John M. Culbertson had to publish his book on this subject himself in 1984.<sup>53</sup> But his ideas have not been ignored, notably by Herman E. Daly and John B. Cobb, Jr. In their book *For the Common Good*, they have elaborated on Culbertson’s ideas with cogent challenges of their own to the free trade dogma.

Daly and Cobb remark, “The claim in favor of completely free trade is that it is advantageous not only to both participants but also to the communities as a whole.”<sup>54</sup> They show through many examples that this is not the case, as the *Wall Street Journal* pointed out almost two decades earlier. In a later book, *Beyond Growth*, Daly further denounces the economists’ free trade dogma: “Economists overwhelmingly agree that (1) economic growth, as measured by GNP, is a very good thing, and (2) that global economic integration via free trade is unarguable because it contributes to competition, cheaper products, world peace, and especially to growth in GNP. Policies based on these two conceptually immaculate—and interrelated—tenets of economic orthodoxy are reducing the capacity of the earth to support life, thereby literally killing the world.”<sup>55</sup>

Free trade with free movement of just about everything among nations has many offensive side effects—from financial to social to ecological. Each book on globalization of commerce emphasizes some aspect of the entropies that free trade produces. In *One World, Ready or Not*, William Greider describes the new world as “dauntingly complex and abstract and impossibly diffuse. . . . Everything seems new and strange. Nothing seems certain.”<sup>56</sup> When we increase entropy massively and rapidly, as we are doing through free trade, we also increase the complexity and the uncertainty of the state of the thermodynamic system, as the Second Law implies.

We also cannot ignore the environmental disorders that free trade produces, which most books on the subject point out to some extent. In *The Ecology of Commerce*, businessman and environmen-

talist Paul Hawken succinctly summarizes the ecological situation this way:

Quite simply, our business practices are destroying life on earth. Given current corporate practices, not one wildlife reserve, wilderness, or indigenous culture will survive the global market economy. We know that every natural system on the planet is disintegrating. The land, water, air, and sea have been functionally transformed from life-supporting systems into repositories for waste. There is no polite way to say that business is destroying the world.<sup>57</sup>

When factories migrate from industrial to developing nations, a process under way, they bring with them not only capital and jobs but also “environmental dangers.” Hilary French of Worldwatch Institute points out, “Hazardous industries, such as battery manufacturers, chemical companies, and toxin-laden computer chip assembly facilities, are becoming increasingly concentrated in countries ill equipped to handle the pollution.”<sup>58</sup>

More and more economists are speaking out on the environmental side effects—the externalities—of free trade. In *The Myth of Free Trade*, economist Ravi Batra reminds us that airborne trade pumps millions of tons of jet fuel wastes into the atmosphere; when merchant ships crisscross the globe, they use energy and dump contaminants into the water; when trucks zip through Europe, Asia, and Africa transporting products from one nation to another, they burn gasoline, pollute the air, and contribute to global warming. He concludes: “Thus international trade is a major source of environmental degradation.”<sup>59</sup>

Environmental degradation also has a socioeconomic side effect: it is a cause of poverty worldwide. “Poverty is now exemplified by people who search desperately for firewood, find themselves trapped by encroaching deserts, are driven from their soils and forests, or are forced to endure dreadfully unsanitary conditions,” writes Wolfgang Sachs in *The Case Against the Global Economy*.<sup>60</sup>

The planet is becoming bitterly divided between rich and poor. Thanks to technological advances, some people and institutions have a tremendous capability to move and manipulate money, information, goods, factories, and jobs around the world at dizzying speeds, thus creating entropy at unprecedented levels. In *Divided*

*Planet*, environmental activist Tom Athanasiou points out, "From the perspective of the new world disorder, with economic, political, and ecological chaos all competing for our scant time and attention, . . . care for the weak and vulnerable, environmental protection, or even democracy, the schemes of the post-World War II geopoliticians do not seem to have worn well at all."<sup>61</sup> What many are asking is, Who is going to care for the weak and vulnerable, and the environment that we all depend on for our survival?

While some enthusiasts of the free trade doctrine find globalization a near Utopia for humanity, others point out the entropies generated by its processes.<sup>62</sup> As John Gray, professor of European thought at the London School of Economics, tells us in *False Dawn: The Delusions of Global Capitalism*, already the "Utopia of the global free market" has resulted in more than "a hundred million peasants becoming migrant labourers in China, the exclusion from work and participation in society of tens of millions in the advanced societies, a condition of near-anarchy and rule by organized crime in parts of the post-communist world, and further devastation of the environment."<sup>63</sup>

The socioeconomic disorders generated by increased global free trade have become so pronounced that even George Soros, a long-time capitalist and practitioner of international finance, is writing about them. Recent events, such as the financial collapse of Asia, the Russian meltdown, and the financial crisis in Latin America, made Soros even more aware that "the global capitalist system was unsound and unsustainable."<sup>64</sup> In *The Crisis of Global Capitalism*, he remarks that classical economists were inspired by Newtonian physics and its laws. Their goal was to use the laws of mechanics to explain and predict economic behavior.<sup>65</sup> As Soros points out, this has not happened:

The rethinking must start with the recognition that financial markets are inherently unstable. The global capitalist system is based on the belief that financial markets, left to their own devices, tend towards equilibrium. They are supposed to move like a pendulum: they may be dislocated by external forces, so-called exogenous shocks, but they will seek to return to the equilibrium position. This belief is false. Financial markets are given to excesses and if a boom/bust sequence progresses beyond a certain point it will

never revert to where it came from. Instead of acting like a pendulum financial markets have recently acted more like a wrecking ball, knocking over one economy after another.<sup>66</sup>

Soros is expressing what thermodynamics has been telling us through its Second Law for nearly a century and a half—that we live in an irreversible world, not a pendulum-like world. In the early 1970s, economist Nicholas Georgescu-Roegen began urging his colleagues to pay attention to the Law of Entropy. Herman Daly has reminded economists of his teacher's work.<sup>67</sup> In *Living Within Limits: Ecology, Economics, and Population Taboos*, Garrett Hardin reiterates in strong words that economists can no longer evade the Laws of Thermodynamics.<sup>68</sup> Had economists embodied the principles of thermodynamics in their theories, they would not have made such a gross error in thinking that financial markets, or economic activities in general, behave like a reversible mechanical pendulum.