

# Chapter 2

## The Tertiary Economy: A Threat to the Global Economy

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### 2.1 Introduction

Given the continuing crises in the global financial system and the inequalities between individuals, corporations, and nations that seem to compound daily, it seems logical to reflect on the structure of the economy that has precipitated these issues and has proposed changes to the monetary system that might alleviate some of them. The current monetary system fosters the creation of money far in excess of the resources (energy and materials) that support it, producing an illusion of increased wealth. For the most part, this illusory wealth is concentrated in the hands of a few, while the remaining population has seen their incomes shrink and “cost-of-living” increase due to inflation.

Following Schumacher’s (1973) concept of the primary economy (nature providing ecosystem services, energy, and minerals) feeding the secondary economy (agricultural and industrial production), we suggest that there now exists a tertiary economy (the financial system of trade, banking, insurance, and stocks). This economy (also called sector in most economic terminology) is the tail that wags the dog (i.e., economy) of modern nation states. Driven by expectations for continued growth, investments in most nations have been increasingly directed toward the tertiary economy rather than toward the primary and secondary economies. As most of the economic theories are based on growth, the planning and policy recommendations for economic health of nations are also based on growth. Yet, growth cannot continue forever, and in fact, the insistence on continued growth is at the root of the current economic crises.

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In this chapter, we demonstrate using the economies of the USA and India that recent increase in wealth suggested by a growing gross domestic product (GDP) are actually only an illusion of more wealth as the biophysical basis for the economy has not increased in a like manner. The biophysical basis is measured by the emergy concept (the amount of solar emergy needed for resource generation by nature and processing by humans, Odum 1996), a measure of the demand for environmental support by a process or an economy. Emergy (Brown and Ulgiati 2004, 2011) is measured in a common unit (solar equivalent joule, seJ), and is the investment of energy and material resources by linking an economic process to the biophysical basis of a country, a farm, or a city. The increasing concentration of money in the tertiary economy represents paper wealth as there are few, if any, flows of emergy connecting the tertiary with the rest of the economy. We hypothesize that the increasing distance (spread) between the actual increase in wealth (measured by emergy throughput) and the illusion of wealth (measured by GDP) is a sign of serious future shocks or stochastic surprises similar to the boom and bust cycles that have occurred till 2008. With each boom and bust cycle over the past 100 years, the consequences are even more severe.

In reality, it is a good thing that the newly created illusionary wealth remains concentrated in the tertiary economy in the form of stock profits and bank deposits. Should it be released into the “main economy,” it would result in hyperinflation as limited resources would not be matched to the large influx of money. In addition to the potential of precipitating future stochastic surprises, paper wealth concentrated in the tertiary economy represents a significant threat to the larger economies by causing hyperinflation if it were to be spent in the economy.

## 2.2 Resources Are Wealth

The wealth of a nation, as was well recognized in the past by Adam Smith (1776), is the nation’s resource base. Smith, in *The Wealth of Nations*, described wealth as “the annual produce of the land and labour of the society.” An obvious consequence of this viewpoint should be that the wealth of a nation is its natural, human and physical *assets*, or *capital*. Natural assets include things such as land, forests, fossil fuels, and mineral resources. Human assets include the education and/or skill levels of the population, while physical assets include the manufactured capital (roads, buildings, machines, etc.) (Odum 1996).

In the last 50–100 years, the popular usage of the term “wealth” has defaulted to “the state of controlling or possessing items of economic value, usually in the form of money, real estate, and personal property.” The shift has resulted from the general concepts of monetary economics, which provides the framework for money as medium of exchange, store of value, and the unit of accounting.

Unfortunately, the preoccupation with money has translated into measuring the wealth of nations as the monetary value of that which is produced. Viewed in this way, the wealth of nations is the market value of the final goods and services

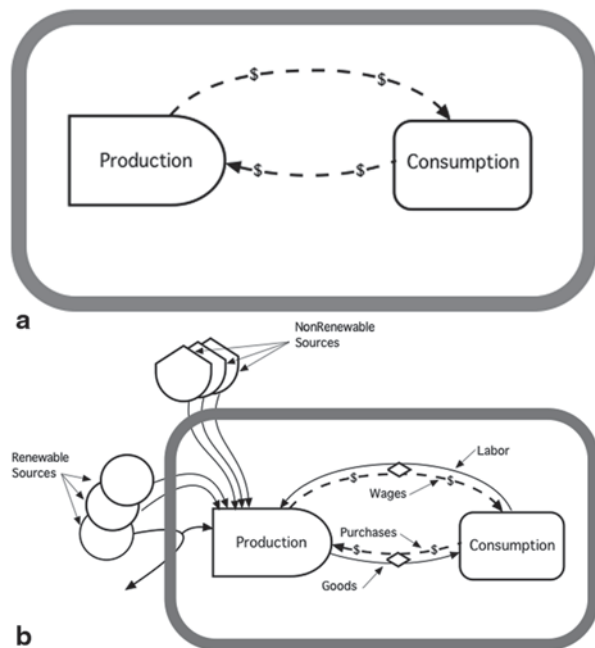
produced within a country in a given period of time, known as the GDP. Contrary to how most of us view the economy, however, the monetary value of that which is produced is not a real measure of wealth, rather it is a measure of what people are willing to pay for wealth. In other words, the natural, human, and physical capital, and the products generated from that capital are the true wealth, and market price (monetary value) is a way of valuing it from the human perspective.

### 2.3 Biophysical vs. Monetary Economy

We define the measure of biophysical productivity of an economy by the *gross emergy product* (GEmP), which is the emergy value of all goods and services produced within a country in a given period of time, and by definition is equal to total emergy use in the economy. GEmP is similar to the GDP, which is the economic term, for market value of all final goods and services produced within a country in a given period of time (generally 1 year).

Figure 2.1a is the basic diagram that every student taking a beginners course in economics sees as his/her first glimpse of the economy. In this, the economy is composed of producers and consumers connected by the flow of money, which is explained as the payment for goods and services by consumers to producers and the payment of wages and rent by producers to consumers. It is explained that this

**Fig. 2.1** Elementary view of the economy (*top*) showing the cycle of money between the producing and consuming sectors of the economy. A more realistic view of the economy (*bottom*) shows that the economy is driven by the inputs of renewable and nonrenewable resources



represents the economy and if one was to quantify the two flows, it would be a measure of the total productivity of the economy (in the ideal situation the two flows are equal).

The biophysical economic system is composed of flows of matter, energy, and information with counter-current flows of money as shown in Fig. 2.1b. The most striking difference between this depiction of the economy (Fig. 2.1b) and standard text book diagrams of the economic system (Fig. 2.1a) is the driving energies and the environment that are completely ignored when one only looks at the economy as a circulation of money between producers and consumers. From a *biophysical* point of view, energy and other resources drive the circulation of money, and no circulation of money is possible independent of resources. Thus, in Fig. 2.1b, the circular economy is shown being driven by *renewable* sources and *nonrenewable* storages of matter and fossil fuels.

The economy, when viewed from a biophysical perspective, is a hierarchical, interconnected system of resource, and monetary flows driven by available energy and resources. The flow of resources, products, human labor, and information within the economy, each having a counter flow of currency based on the prices paid. From an economic perspective, total productivity of the economy and individual sectors is determined by the monetary value of the goods, services, or information produced. From the emergy perspective, total productivity is computed as the sum of the inputs necessary to produce the goods, services, and information.

## 2.4 The Emergy Basis of the Economy

The graphs in Fig. 2.2 show the emergy basis for the US and Indian economies as an emergy signature (breakdown of emergy input flows) for the year 2008. The inputs to each economy are expressed in emergy per year, so they represent the total emergy throughput of each economy. Emergy inputs are grouped as renewable, indigenous (which represent nonrenewable resources from within the countries), and imports of nonrenewable resources. The sum of inputs represent the total emergy driving each economy (emergy throughput), which is the basis for the generation of goods and services that are produced. Reflecting back on the diagrams in Fig. 2.1, the emergy inputs to the economy represent the biophysical basis for the circulation of money because each flow of money is accompanied by a transaction (the diamond symbol), which results in the purchase of resources or services.

While the total emergy throughput of the two economies was quite different (the US economy had over four times as much emergy throughput than the Indian economy), the structure of both economies was similar. Both economies are dominated by the use of indigenous resources with imports totaling to about 50% of the total emergy throughput. The Indian economy seems to be dominated by the use of indigenous minerals and metals, while the US economy is dominated by a combination of indigenous minerals and metals and fossil fuels.

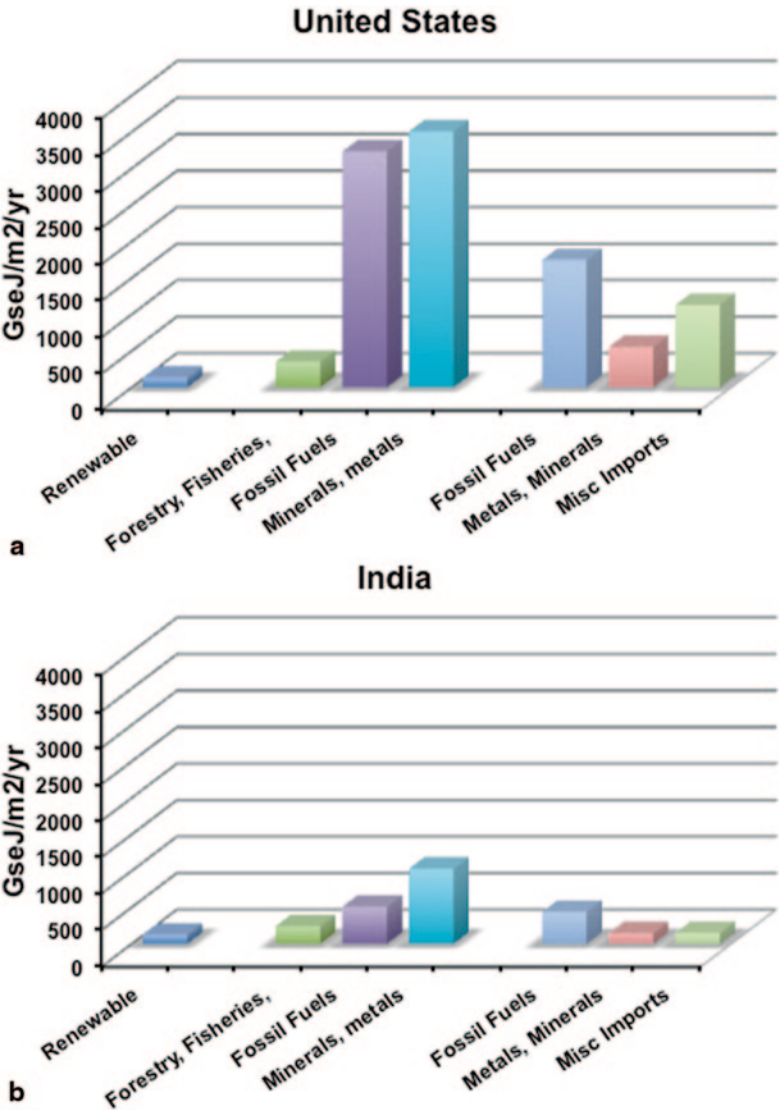
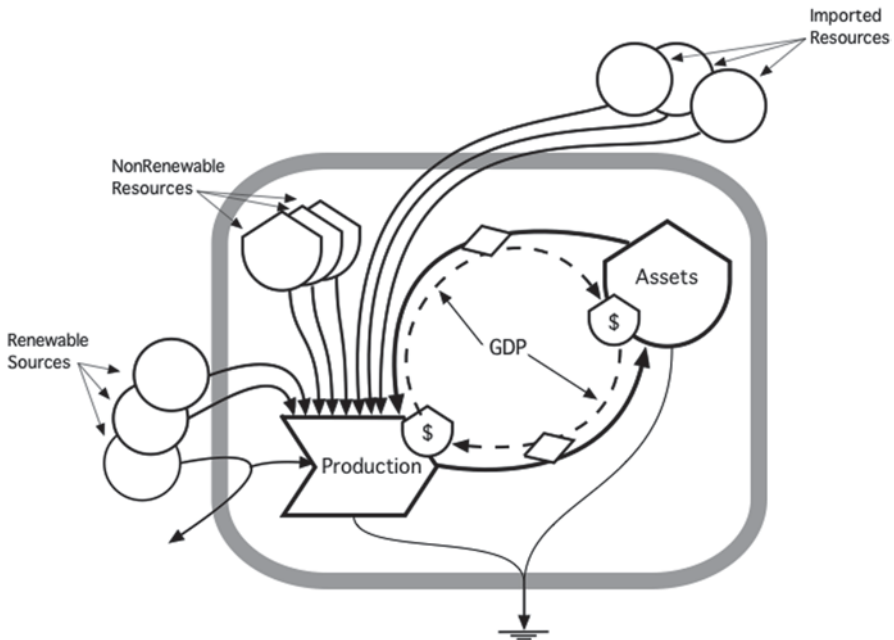


Fig. 2.2 Energy signatures of the US and Indian economies showing the resource throughput of each economy expressed in Giga-solar emjoules per m<sup>2</sup> per year

2.5 Emergy and Inflation

In economics, inflation is an increase in the prices of goods and services over a period of time. To put it another way, it is an increase in the money required to purchase the same quantity of goods and services. From a biophysical perspective, inflation results when an increase in the circulation of money is not accompanied by an increase in the emergy throughput of the economy. The diagram in Fig. 2.3



**Fig. 2.3** An aggregated diagram of a national economy driven by renewable resources, nonrenewable resources, and imports. Total production flows into a storage of assets, which are used in turn to foster more production, the counter current flow of money is the GDP

illustrates the biophysical perspective. There are three main energy resource inputs, renewable, nonrenewable, and imported. These resources drive the economy, which is shown as the circular flow of money GDP within the circular flow of resources.

If the circulation of money increases faster than the resource throughput, the result is inflation. Nations use the supply of money to either stimulate or slow down the economy by either increasing or decreasing the supply respectively. With small changes in the money supply, there are corresponding small rates of inflation. In general, when money supplies are increased there is an increase in demand for resources and the economy is stimulated with the additional resource flows. However, if too much stimulus is applied, or if the resource flows are not available, then the increase in money results in inflation (more money circulating for a smaller quantity of resources).

The graph in Fig. 2.4 relates to the total energy driving the world economy to the Gross World Product (GWP) since 1900, showing that the growth rate of GWP far exceeds the growth rate of the energy throughput. The difference in growth rates is the inflation rate as shown in the bottom graph in Fig. 2.4. The increase in money represented by the GDP without a corresponding increase in the driving energy throughput results in more money for purchasing smaller and smaller quantities of resources and services at each transaction.

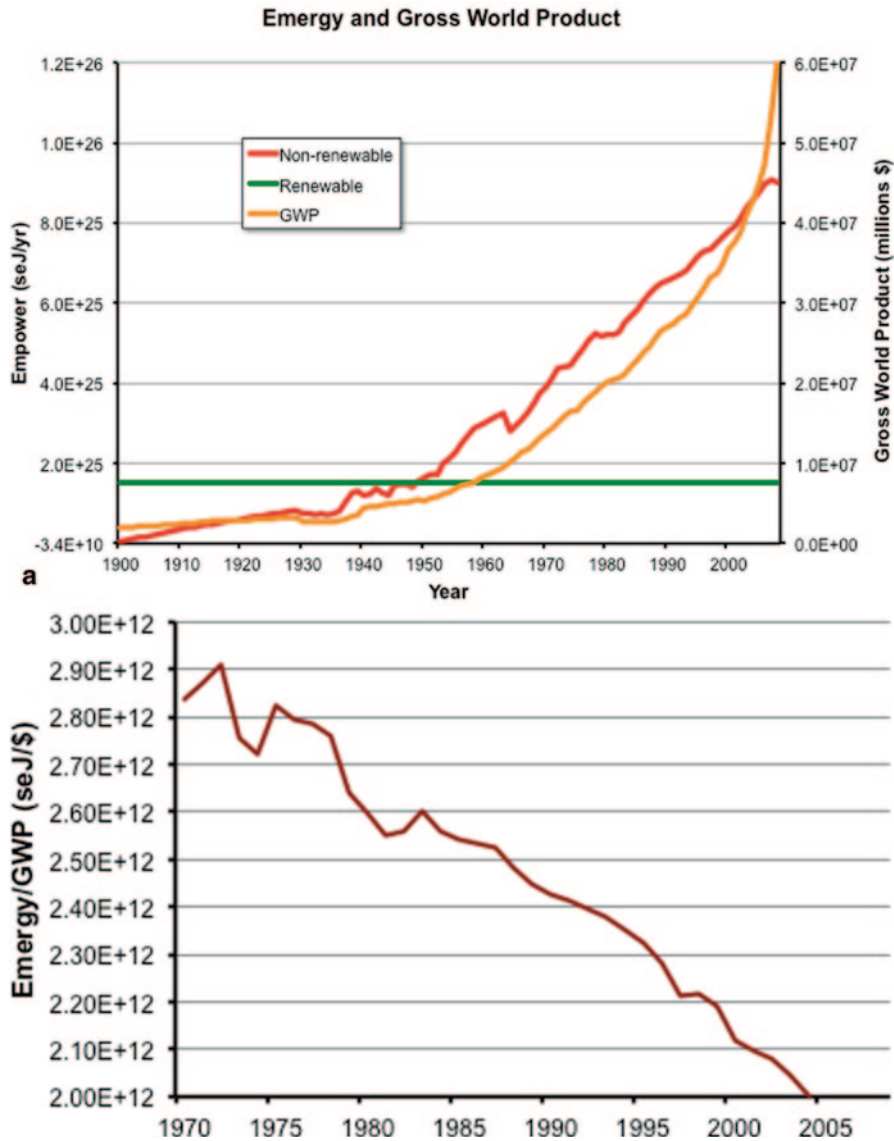
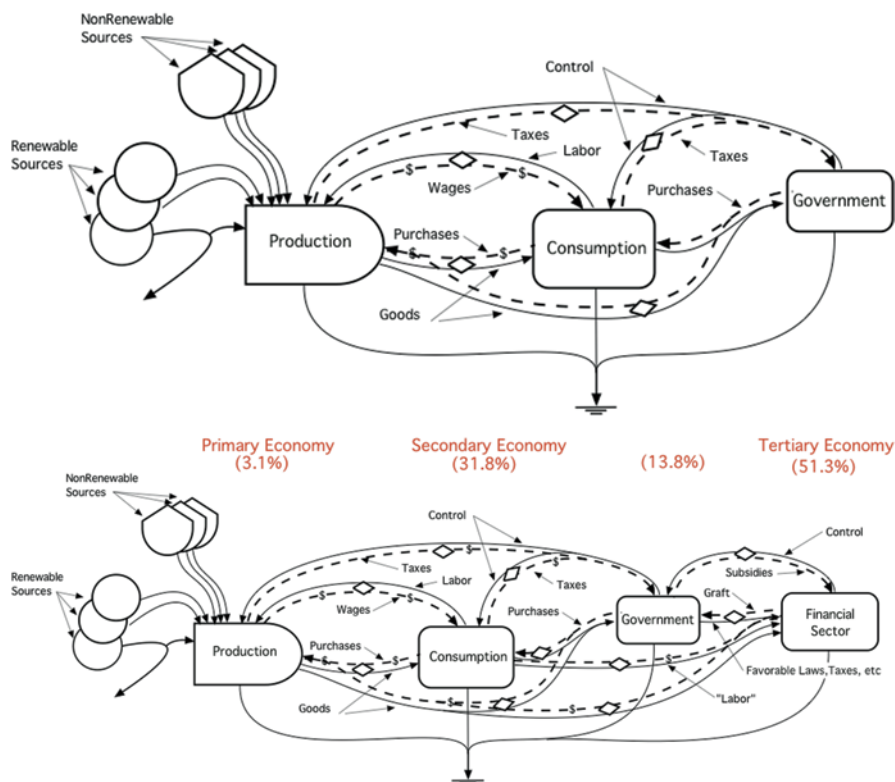


Fig. 2.4 The growth of global nonrenewable energy use (red line) and GWP (gold line) since 1900 (top). Energy per dollar of GWP is declining, which indicates the rate of inflation (bottom)

### 2.6 The Tertiary Economy

If we decompose a national economy into sectors, the result is depicted in Fig. 2.5a, which shows the production sector (primary economy), the consumption sector (secondary economy), and the government. To call the secondary economy as “consumption” is a bit of a misnomer because obviously through consumption it



**Fig. 2.5** Diagram of a typical economy showing three main sectors production, consumers, and government (*top*). In recent years there has been explosive growth of the financial sector termed the “tertiary economy” (*bottom*). The numbers in parentheses indicate the percentage of the monetary economy

produces (services and labor) just as the primary economy consumes resources to produce products. Government is actually a part of secondary economy, but is shown separately to make the point that it provides needed services and controls to the primary and secondary economies. In the last several decades, many national economies have experienced unprecedented growth of a third sector (Fig. 2.5b) that in the past was too small to be considered as a part of the secondary economy. However, with its increase in size the tertiary economy now controls major monetary flows in the economy. The tertiary economy is composed of the financial sector, which includes banks, investment firms, insurance companies, and real estate. The numbers in parentheses at the top of the diagram show the percentage of the US GDP that is attributable to each sector.

The graphs in Fig. 2.6 show the changes in the percentage of GDP that is derived from each of the three sectors of the US and Indian economies. The tertiary economy is now over 50% of the US economy and over 35% of the economy of India. While it would seem that deriving such a large portion of the GDP in one sector is not a bad thing; consider that this sector is capable of increasing a nation’s money

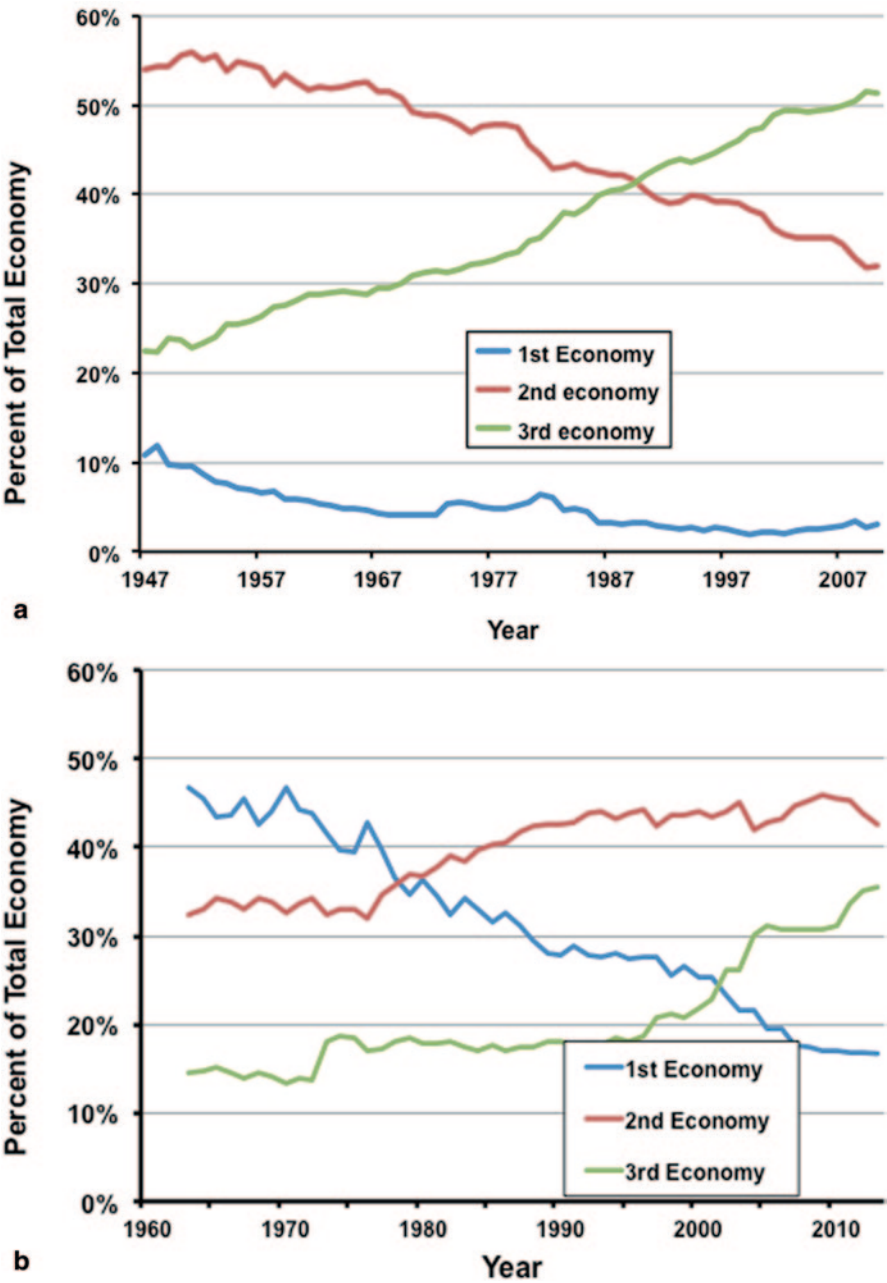


Fig. 2.6 Changes in the three main sectors of the USA (*top*) and Indian (*bottom*) economies. The first economy is comprised of agriculture, forestry, fishing, hunting, mining, utilities, construction, and manufacturing, the second economy is comprised of wholesale and retail trade and transportation. The third economy is composed of information, finance, professional services

**Table 2.1** Emergy money ratios for selected countries (2008)

Country	GDP (\$/year)	Total energy use (seJ/year)	Emergy money ratio (seJ/\$)
Japan	4.85E+12	9.20E+24	1.90E+12
UK	2.67E+12	5.50E+24	2.06E+12
Italy	2.30E+12	5.10E+24	2.22E+12
<i>USA</i>	<i>1.43E+13</i>	<i>3.60E+25</i>	<i>2.52E+12</i>
Germany	3.60E+12	9.10E+24	2.53E+12
Sweden	4.90E+11	1.40E+24	2.86E+12
Brazil	1.65E+12	5.50E+24	3.33E+12
New Zealand	1.32E+11	5.00E+23	3.79E+12
Australia	1.05E+12	4.40E+24	4.19E+12
Mexico	1.09E+12	5.30E+24	4.86E+12
Russia	1.66E+12	8.70E+24	5.24E+12
Costa Rica	2.98E+10	1.60E+23	5.37E+12
South Korea	9.30E+11	5.60E+24	6.02E+12
<i>India</i>	<i>1.26E+12</i>	<i>8.10E+24</i>	<i>6.43E+12</i>
Panama	2.30E+10	1.62E+23	7.04E+12
South Africa	2.74E+11	2.20E+24	8.03E+12
Botswana	1.36E+10	1.50E+23	1.10E+13
China	4.52E+12	5.10E+25	1.13E+13
Ireland	2.63E+11	6.40E+24	2.43E+13
Mali	2.78E+09	6.90E+22	2.48E+13

supply through the creation and sale of debt. In doing so, the tertiary economy has the power to affect the money supply, and as it increases in size, its potential impact on the economy grows as well. The result of this top heavy national economy is the potential for serious shocks, when the economy readjusts the monetary system to the biophysical system. As it was stated numerous times since the beginning of the world recession in 2008...“too big to fail.” The tertiary economy in most developed and developing economies is so large and centralized that it dominates the economy, and indeed could be catastrophic in failure. Governments now would do well to constrain the growth of the tertiary economy and reinvest in growing the secondary economy (within the constraints of available natural capital), which by virtue of its basic diversity is less likely to cause catastrophic failure should the economy experience a downturn.

## 2.7 The Emergy Money Ratio

Given in Table 2.1 are data for a selected number of national economies showing the total driving emergy and the resulting GDP measured in dollars or other reference currency. Since, as we have already pointed out, emergy drives the economy, we

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