#### CHAPTER

# 1

# Economic growth: a different view

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# 1.1 The emergence of growth

# 1.1.1 The emergence of growth

Economic growth is the continuing increase in constant dollar GDP per capita. This growth started in England in the 18th century. New production techniques created a series of cheaper and new products, creating a succession of mass markets, starting with cotton goods and progressing through products made using steam power, iron, and steel. The United States took over economic leadership around the turn of the 20th century (see Maddison, 2006) and it too has seen a succession of new products and new industries, resulting in continuing growth.

US real GDP has increased at an average of 3.3% a year since 1890, while GDP per capita has increased at a 2.0% rate. Growth rates have varied considerably—there has not been steady growth. Table 1.1 shows the trends.

### 1.2 Our approach

## 1.2.1 Our approach

We first investigated the growth process in Hudson (2015). This chapter extends this earlier investigation, focusing on the United States.

We work at the industry level; this allows us to identify the mechanisms of growth, how the economy has changed, and what has driven these changes. Our industry analysis uses data from the National Economic Accounts, U.S. Bureau of Economic Analysis (BEA). These industry data start in 1947. For much of our analysis we compare growth before and after 1973. 1973 was a transition year as the first oil price shock hastened the end of the rapid growth of the metals and machinery industries, and an acceleration of the shift to electronics and services.

#### 1.3 Industry growth

#### **1.3.1** Changing structure

Different industries have performed in different ways. Table 1.2 shows the growth rates since 1947 for the BEA broad industry categories.

The economy grew at an average of 3.2% a year, but there was a wide range of growth rates for different industries, ranging from 0.8 to 4.7%. These differing growth rates lead to large changes in the sizes of the various industries. Mining in 2016 was less than twice its size in 1947, while Information was 23 times its 1947 size. The changes in detailed industries, not

Average annual growth rates						
	1890 to 1913	1913 to 1929	1929 to 1947	1947 to 1973	1973 to 2016	1890 to 2016
Real GDP	3.9%	3.1%	3.4%	4.0%	2.7%	3.3%
Real GDP per capita	2.0%	1.7%	2.5%	2.5%	1.7%	2.0%

# **TABLE 1.1**US Economic growth.

Source: Data from Maddison (2006) and U.S. Bureau of Economic Analysis.

# **TABLE 1.2**Industry growth relative to GDP.

Relative growth rates of value-added quantity indexes				
	Growth rate relative to real GDP	Share of current dollar GDP 1973		
	1947-2016			
Agriculture, forestry, fishing, and hunting	0.9	4%		
Mining	0.3	1%		
Utilities	0.7	2%		
Construction	0.6	5%		
Durable goods	1.1	14%		
Nondurable goods	0.8	8%		
Wholesale trade	1.5	6%		
Retail trade	1.0	8%		
Transportation and warehousing	0.7	4%		
Information	1.5	4%		
Finance and insurance	1.3	4%		
Real estate and rental and leasing	1.1	10%		
Professional and business services	1.4	5%		
Educational services	1.1	1%		
Health care and social assistance	1.1	3%		
Arts, entertainment, and recreation	1.0	1%		
Accommodation and food services	0.7	2%		
Government	0.6	16%		
Other services	0.6	2%		
Sum		100%		

Source: Based on data from U.S. Bureau of Economic Analysis.

There have been large differences in industry performances—economic growth involves continuing change in the structure of spending and production.

#### 1.3.2 Growth before 1947

Kendrick (1961, 1973) tracked growth by industry for the period 1899–1966. GDP increased at an average of 3.4% a year (see Maddison, 2006), but several industries grew at around double this rate. These were Electric machinery, Rubber products, Communications and public utilities, Chemical products, Transportation equipment, and Petroleum and coal products. These were the growth industries of the industrialization of the United States over the first half of the 20th century.

#### 1.3.3 Leading industries 1947–1973

Table 1.3 shows the development of industries leading the economy in the years 1947–1973.

Rapid growth in this period was concentrated in just five industries, accounting for less than 10% of total value added (GDP). These industries continued their rapid growth from earlier in the century. However, four of these five industries slowed after 1973, falling below the GDP growth rate. The one remaining rapid growth industry, Petroleum and coal products, accounted for less than 1% of GDP. With the old growth drivers slowing after 1973, new leading industries were required if GDP growth was to continue.

#### 1.3.4 Growth industries after 1973

Table 1.4 shows the development of industries which led the economy after 1973.

Only one of these seven later growth industries had been a leader in the earlier period. This was joined by six new leaders. Computer and electronic products, some of Information, some of Finance, Air transportation, and some of Professional and business services were relatively new products, now beginning to grow rapidly. Wholesale trade also grew rapidly (reflecting new ways of organizing business rather than being a new product).

Not all industries within Information, Finance and insurance, and Professional and business services were fast-growing, but, due to several data series not starting until after 1973, we could not identify these more detailed industries for Table 1.4. Our estimate is that these fast-

	Growth ra to rea	Share of current dollar GDP	
	1947–1973	1973-2016	1973
Chemical products	2.0	0.5	1.9%
Machinery	1.6	-0.1	2.2%
Plastics and rubber products	1.5	0.6	0.8%
Petroleum and coal products	1.5	2.7	0.4%
Other transportation equipment	1.4	0.1	1.1%

**TABLE 1.3** Rapid growth industries 1947–1973.

Note: These are industries with growth exceeding 1.4 times real GDP growth, 1947–73. Source: Based on data from U.S. Bureau of Economic Analysis.

	Growth ra to rea	Share of current dollar GDP		
	1947-1973	1973-2016	1973	
Computer and electronic products	1.2	5.4	1.5%	
Petroleum and coal products	1.5	2.7	0.4%	
Information	1.1	1.8	3.8%	
Finance and insurance	1.0	1.7	4.0%	
Wholesale trade	1.3	1.6	6.4%	
Air transportation	na	1.5	0.4%	
Professional and business services	1.4	1.4	5.0%	

#### **TABLE 1.4**Industries leading growth after 1973.

Note: These are industries with growth exceeding 1.4 times real GDP growth, 1973–2016. Source: Based on data from U.S. Bureau of Economic Analysis.

growing new products represented less than 10% of GDP; this is similar to the share of leading industries in the 1947–1973 period.

#### **1.3.5** Industry changes

Economic growth depends on a few industries growing rapidly; these growth leaders have accounted for only a small part, around 10%, of GDP. Most industries grow at close to the overall rate of GDP growth. A growth leader will ultimately saturate its market and slow. New leading industries have then emerged. The emergence of new growth leaders is critical to overall growth continuing.

History since 1947 shows these mechanisms in action. A new set of growth industries emerged in the 1970s. These electronics and service industries superseded the mechanical and materials industries of the earlier period.

#### 1.4 Growth of demand

#### 1.4.1 Keynes and FDR

Keynes (1936) saw that economies produce in response to spending. Keynes rejected the classical mantra, often expressed as Say's law, that all markets would equilibrate so that the economy would always operate at full capacity. This classical view was that production capacity would create equal demand. Keynes demonstrated the opposite chain of causation—demand ruled, demand would drive production. Actual production would be whichever was less—demand or full capacity.

The Great Depression of the 1930s demonstrated that Keynes was right. Keynes provided the theoretical answer to recovery, but Franklin Delano Roosevelt (FDR) had already demonstrated in practice the primacy of spending. FDR's answer was simply to increase spending, whether by government spending directly or government income support to boost private spending. (In fact, it was not until World War II that defense spending drove GDP to full capacity.)

Keynes' policy recommendation for economic recovery was half right, but only half. Keynes focused on investment and argued for more private and government investment. However, Keynes' own logic implies that any boost to spending would have helped recovery. This could be personal consumption, private investment, government purchases, or exports. (These are all part of the equilibrium condition of Keynesian theory: Y = C + I + G + X - M.)

Keynes' insights and FDR's policies demonstrated at the macroeconomic level that demand (spending) leads and supply (production) follows; they apply equally at the industry level at which we are working.

#### 1.4.2 Final demand

Final demand is the sum of personal consumption expenditures, private investment, government purchases, and net exports. Total expenditure is much larger than final demand, as primary and intermediate goods and services are needed in the production of finished goods and services.

Personal consumption is the largest category of final demand, typically accounting for around 65% of GDP. Private investment accounts generally for around 15% with government purchases typically adding a further 20%. Net exports of goods and services have generally been small although exports and imports each have averaged around 10% of GDP.

#### 1.4.3 Growth in final demand

Most categories of final demand have grown roughly in line with GDP. However, a few types of final demand purchases have grown more rapidly. These rapid growth categories are shown in Table 1.5.

From 1947 to 1973 consumption spending on Motor vehicles, Recreational goods and vehicles, and Health care grew rapidly. This changed after 1973 when Durable equipment, Recreational goods and vehicles, Other durable goods, and Recreation services became leaders.

Private investment grew more rapidly than GDP. The two rapid growth types of investment, both before and after 1973, were Information

	Growth rate relative to real GDP		Share of current dollar GDP	
	1947–1973	1973–2016	1973	
Rapid growth within personal consumption				
Motor vehicles and parts	1.6	1.0	3.8%	
Furnishings and durable household equipment	1.0	1.5	2.7%	
Recreational goods and vehicles	2.0	3.5	1.8%	
Other durable goods	1.2	1.7	0.9%	
Health care	1.5	1.1	4.7%	
Recreation services	0.8	1.6	1.3%	
Rapid growth within gross private domestic investm	ent			
Information processing equipment	2.5	4.3	1.4%	
Intellectual property products	1.8	2.4	1.6%	
Rapid growth in international trade				
Exports	1.0	2.0	6.7%	
Imports	1.7	2.0	6.4%	

TABLE 1.5	Rapid	growth	types	of	final	demand
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Note: Spending with growth exceeding 1.4 times the real GDP growth rate in either time period. *Source: Based on data from U.S. Bureau of Economic Analysis.* 

processing equipment and Intellectual property products. Exports grew rapidly but detailed data are not available for the two time periods here. In recent years, exports of financial and information services have grown rapidly.

Rapid growth in final demand has been concentrated in a relatively small number of spending categories, some in personal consumption and some in private investment (and, recently, some in services exports). Some types of final demand grew rapidly both before and after 1973, while some early leaders slowed but were replaced by new types of spending.

#### 1.4.4 Interindustry demand

Final demand drives demand for all the different industries through an input–output process of the type first described by Leontief (1941). Industries supplying rapidly growing producers of finished goods and services will themselves grow relatively rapidly; conversely, industries supplying producers of slowing categories of final demand will tend to have slow growth.

# 1.5 Development of consumer demand

#### **1.5.1** Importance of consumers

Economic growth, on the expenditure side, is growth in final demand. Personal consumption expenditure accounts for most of GDP while much investment spending is directed to creating capacity for the production of consumer goods and services. In short, consumers are the key to understanding economic growth.

# 1.5.2 Product innovation

Innovation is central to the growth of consumer spending. New or vastly improved consumer products come from innovation. This could be process innovation which reduces costs, permitting such a large reduction in prices that a mass market is created; or, it could be product innovation which greatly improves an existing popular product; or, it could be product innovation which creates an entirely new product for which a mass market develops.

Some examples illustrate different ways in which product innovation has occurred. The automobile created a mass market by reducing the time cost of personal travel. Distributed electricity was an entirely new product, allowing the adoption of all sorts of useful electrical machines. Household electrical appliances created huge markets as they drastically reduced the time required for housework. Another set of products, radio and television, provided new types of entertainment services, creating huge new markets. The telegraph created the initial market for rapid personal communication, but subsequent developments such as the telephone and cellular mobile telephones vastly improved and cheapened the service such that the market kept expanding for more than a century.

#### 1.5.3 Creating a mass market

The growth of a popular new product follows a logistic path. This is an S-shaped path of slow growth on introduction, accelerating growth as adoption spreads by a contagion-like process, and then slow growth as the market becomes saturated. Logistic growth is a demand-led process.

The critical outcome, from the point of view of economic growth, is the creation of a mass market. There are several key features in the creation of mass markets.

The emergence of the "consumer society" (the term given by Lebow (1955) although the concept originated as far back as Veblen (1899)) allowed consumer demand to keep increasing even when people's basic needs had already been met. In the consumer society, people seek status or recognition from their peers, or even

just self-esteem, from being seen to have the latest products.

Marketing is central in maintaining the consumer society. Marketing informs customers of the product and its benefits, helps persuade potential customers that they need the product, and makes it accessible and easy to purchase. The development of product design, of more effective and diverse advertising on new mass media, and of multiple retail channels have worked together to reinforce the consumer society.

Then, potential customers must have or be able to get the money to buy new products. Consumer spending cannot grow if people simply spend out of their current incomes. Spending growth requires that some customers spend more than their current income. Consumer credit permits this. The development of multiple forms of consumer or household credit has enabled the continuing growth in consumer spending.

### 1.6 Development of investment demand

## **1.6.1** Expand capacity

GDP growth typically is led by consumer demand for new and popular goods and services. Capacity to produce these popular new goods and services requires rapid expansion of the capital stock in the growth industries. Demand for these investment goods, whether structures or equipment or intellectual capital products, increases accordingly.

# 1.6.2 Adoption of new processes

Productive new technologies often are embodied in physical or intellectual capital. As industries throughout the economy strive to adopt these new technologies, the demand for these capital goods can expand rapidly. This leads to increasing demand for these investment goods.

# 1.6.3 Investment in mainstream industries

The established or mainstream industries, which make up the great bulk of the economy, grow in line with GDP. Even this moderate growth requires continuing expansion of the capital stock.

#### 1.7 Different growth paths

#### **1.7.1** Different behaviors

Some final demand industries grow particularly rapidly. These industries also generate increasing demand for industries supplying them with intermediate goods and services. We look in the following sections at some specific examples of rapidly growing industries-Motor vehicles, Steel, Computers and electronic components, and Computer systems design. Most industries grow roughly in line with GDP, so we look at the features of a typical mainstream industry, Arts, entertainment, and recreation. Finally, a few industries are in relative or absolute decline. These might be former leading industries which have saturated their markets or industries which have been left behind by changing tastes or industries which have been overtaken by foreign competition. We look at an example of a declining industry, Steel.

The industries considered earlier were taken from the National Economic Accounts and are relatively broad. Some of these broad industries show the introduction and adoption of new products but to see the life cycles of important metals and mechanical industries, early growth leaders, we use more detailed data from the U.S. Census Bureau and other sources.

#### 1.7.2 Leading industries

A good example of a growth industry is Motor vehicles. Fig. 1.1 shows Motor vehicles per household along with a logistic curve fit to these



Note: Motor vehicles includes all automobiles, vans, trucks and busses.

FIGURE 1.1 Motor vehicles per household. *Source: Data from U.S. Census Bureau.* 

data. (These include all motor vehicles, not just those owned by households.)

The motor vehicle industries took about 100 years to complete their growth cycle. Sales began to accelerate with the introduction of the Ford Model T in 1908, grew rapidly until the 1970s, and then slowed as markets for vehicles became saturated.

This growth of a leading industry pulls its supplying industries along similar growth paths. Steel is a major input to motor vehicles. The growth curve for steel, shown in Fig. 1.2, peaks at the same time as motor vehicles. (In addition, several other steel-using industries, such as appliances, approached market saturation at around this same time.)



FIGURE 1.3 Computers and electronic components. *Source: Data from U.S. Bureau of Economic Analysis.* 

A more recent growth industry is Computers and electronic components; Fig. 1.3 shows its growth cycle. Computers experienced rapid growth beginning in the 1970s and are still growing but now at slower rates as their market matures (approaches saturation).

In turn, new growth industries are emerging. A particularly important one is Computer systems design and related services. Its growth curve is given in Fig. 1.4. This industry is still on the rapid growth part of the logistic curve. There is no telling when its rapid growth will stop or what will be the ceiling level of output. Ceilings of anything from 300 to 900 (relative to 2009 = 100) are consistent with the logistic curve to date.



FIGURE 1.2 Consumption of steel. Source: Data from U.S. Census Bureau and World Steel Association.



FIGURE 1.4 Computer systems design and related services. *Source: Data from U.S. Bureau of Economic Analysis.* 

## 1.7.3 Length of the growth cycle

The logistic process means that a leading industry will grow rapidly until its market becomes saturated. From that point, demand for the product will grow only with average incomes (or even less rapidly). The previously leading industry will become a mainstream or even declining industry.

The examples above indicate that a long time is required for a major new product to work through its full adoption process. Motor vehicles reached 90% of full market penetration in the 1970s, around 75 years into their life cycle. The logistic curve for Computers and electronic components suggests that penetration reached 93% in 2016, 70 years into its life cycle.

Bowden and Offer (1994) report on the market penetration of many appliances. They distinguish between "time-saving" and "time-using" appliances. (Time-using appliances are those used for entertainment or leisure.) Adoption periods for time-saving appliances are long; for example, the refrigerator took 43 years to reach 75% penetration, the washing machine took 60 years and the vacuum cleaner 76 years. These features are consistent with our analysis of Motor vehicles and Computers. Adoption of timeusing appliances typically is much more rapid; for example, black and white television took 14 years to reach 75% adoption, radio took 16 years, and color television took 22 years.

# 1.7.4 The growth path of mainstream industries

Mainstream industries make up the bulk of the economy. These cater to established markets and, as such, grow with incomes and/or population. Reflecting their demand drivers, their growth is exponential, not logistic. Fig. 1.5 shows the growth of the Arts, entertainment, and recreation industry, together with its exponential trend.



FIGURE 1.5 Arts, entertainment, and recreation. Source: Data from U.S. Bureau of Economic Analysis.

#### 1.7.5 The path of declining industries

A few industries are in decline. These typically were once growth or mainstream industries whose products are no longer in demand. A prime example is steel. This industry grew rapidly for decades but many of the markets for the products in which steel is used (products such as motor vehicles, machinery, and appliances) became saturated in the 1970s. Steel consumption then leveled off. Fig. 1.6 shows the trends. Production followed the same trends as consumption, but employment in steel-making has fallen steadily, due to efficiency improvements within the industry.



FIGURE 1.6 Steel use, production, and employment. Source: Data from U.S. Census Bureau, U.S. Bureau of Labor Statistics and World Steel Association.

#### 1.8 Sustaining economic growth

#### 1.8.1 Maintaining demand growth

Growth can be disrupted if spending increases at either an inadequate or an excessive rate relative to productive capacity. Restrictive financial and credit conditions and/or restrictive government spending can lead to falling demand and so to recessions. Conversely, too rapid growth in spending, reflecting overly permissive credit conditions and/or excessive government spending, can lead to accelerating inflation. High or rising inflation leads to inefficient spending and investment decisions and finally to economic disruptions resulting from corrective government policies.

Suitable government policy can keep aggregate demand growing in line with productive capacity. The principal tools open to governments to stabilize growth are fiscal policy (changing government revenues and spending) and monetary policy (changing credit conditions). Fiscal policy led the way out of the Great Depression. Monetary policy was used to bring under control the high inflation of the 1970s. Both policies work by influencing demand—consumer, investment and/or government spending.

#### **1.8.2** Supply growth in leading industries

Leading industries must expand production rapidly to meet the growing demand. This is illustrated by motor vehicles. Kendrick's (1961, 1973) growth accounting of the Transportation equipment industry covers the years of its most rapid growth, 1899–1966. Output increased at an average of 6.4% a year. Factor inputs accounted for around half the increase in output, total factor productivity (TFP) the remainder. Although productivity gains were vital, massive growth in labor and, in particular, capital inputs also was needed.

#### 1.8.3 Growth of production in general

Economic growth requires overall production to keep increasing to sustain the continuing growth in demand. Labor, capital, and productivity have all been essential contributors to this production growth although factor inputs, rather than productivity, have been dominant. Jorgenson (2005) has analyzed the sources of growth for 1948 to 2002 finding that labor quantity accounted for 20% of GDP growth, labor quality 10%, capital quantity and quality 50% with TFP providing the remaining 19%.

#### 1.9 Innovation and growth

# 1.9.1 The roles of innovation

Innovation is vital to economic growth. Product innovation (innovation on the demand side) leads economic growth while process innovation (innovation on the supply side) helps production increase to meet the growing demand.

#### **1.9.2** The nature of product innovation

Product innovation seeks to design and market new products, or to greatly improve existing products, for which there are large potential markets. This innovation might be directed to creating entirely new products, or to improving the appeal of existing products, or to reducing the price of existing products to such an extent that new mass markets are created.

It typically is individuals or small companies who lead the search for radical new products. These people have little existing business to lose and every incentive to throw the dice for a big win. In contrast, existing businesses tend to focus on incremental improvements or extensions to existing products. (Reluctance to undermine existing success is characterized by Christensen (1997) as "the innovator's dilemma.")

#### **1.9.3** Innovation in production

Jorgenson (2005) calculates that gains in capital quality contributed 10% of GDP growth from 1948 to 2002. These gains presumably were incorporated into new capital and so were introduced through new investment, principally in the mainstream industries. These productivity gains tend to be spread over time as the new technology is gradually adopted and as existing capital is replaced.

In addition, some improvements come from incremental improvements in operating efficiency. Most businesses try to increase margins by reducing unit costs. Reductions in costs are akin to the dual of productivity gains. These improvements typically come from managers and engineers working steadily to reduce costs/ improve efficiency.

#### 1.9.4 Research and development

Discussions of economic growth often associate productivity improvement with research and development (R&D) carried out by established businesses or institutions. What matters for economic growth is either highly attractive new or improved consumer products, or production advances which clearly reduce operating costs; these changes may or may not follow from R&D activity. Many product advances come from new or small businesses, many cost reductions come from operating personnel rather than R&D, and many reductions in unit costs come simply from economies of scale. R&D undoubtedly is important, but it is only one among several features underlying growth in production and productivity.

# 1.10 The outcome

#### 1.10.1 Increasing incomes

Economic growth has generated huge increases in average income. Real GDP per capita increased at an average of 2.0% a year from 1890 to 2016; this corresponds to average real incomes increasing by a factor of 12. These gains in material standards of living have been accompanied by huge gains in health, life expectancy, education, leisure time, and leisure opportunities.

#### 1.10.2 Who gains?

Income never is equally distributed; in fact, market income generally is distributed in a log normal fashion. In the short run, economic growth moves most people to higher incomes. However, some incomes will fall such as a result of people losing jobs or people entering retirement. Low income earners get some protection by the safety net provided by modern-day tax and transfer programs. In the long run, though, the entire distribution moves to the right so that virtually everybody gains from higher incomes as well as from improved health, education, and consumption choices.

### 1.10.3 Constant change

Labor and capital in growth industries have experienced rapidly rising incomes. However, as leading industries mature this income growth slows. New leading industries emerge, but these new industries typically involve different skills, different capital, and different locations.

Recent experience highlights these processes. Motor vehicles and steel, growth industries until the 1970s, are now static or even in decline. This decline has been concentrated in the Midwestern industrial states. Not only has demand leveled off but some production has moved to lower cost locations. Parallel to this, growth industries in entertainment, finance, electronics, and software have emerged, leading to boom times in different locations.

As mainstream industries make up the bulk of the economy, workers and capital in these industries generally enjoy incomes rising along a moderate trend. Even here, though, there is change as capital substitutes for labor and as productivity advance releases inputs.

Change is continual. Workers and capital in declining industries or workers whose jobs are replaced by capital have either to change occupation and/or industry and/or location or put up with lower incomes. While virtually everyone gains in the long run, the continuing changes in spending and production patterns generate a complex pattern of changes in income and income distribution.

#### 1.11 Our view of economic growth

#### 1.11.1 Our view

Our view of economic growth operates at the industry level. We introduce a demand side, based on people's spending behavior. Growth is driven by demand for innovative products, whether consumer products or investment products, and the industries which cater to these demands. In addition, these growth industries create growing demand for their supplying industries through the input–output mechanism. However, the rapid growth industries account for only around 10% of the economy. The bulk of the economy, the established industries, grows at a moderate rate; demand for their products is driven by population and average incomes. In time, the growth industries will saturate their markets and their growth will slow. Continuing economic growth then depends on the emergence of new mass market products which create new growth industries.

Production capacity increases by using more and better labor, more and better capital, and by improvements in TFP. Production in each industry is the lesser of demand and capacity. In this way, production responds to growing demand; economic growth is demand-driven and supply-enabled.

Innovation is vital for economic growth. We separate innovation into two types—product

innovation and process innovation. Product innovation underlies the creation of new products which lead to the new mass markets which are the drivers of growth. Process innovation operates on the supply side by increasing productivity; process innovation contributes to the expansion of supply to accommodate increasing demand.

#### 1.11.2 Hudson–Jorgenson

Our approach could be expressed formally in a model of the type pioneered by Hudson and Jorgenson (1974). The Hudson–Jorgenson framework had multiple industries, a Leontief type of input–output structure but with endogenous price formation and endogenous input– output coefficients including for factor inputs, and an endogenous consumption component of final demand. The characteristics of consumption expenditure and capital formation developed above could be incorporated into this earlier framework.

## 1.11.3 Schumpeter

Schumpeter (1942) described a long economic growth cycle. Innovation by entrepreneurs, in the pursuit of profit, leads to the introduction of new products. Some of these will be commercially successful. Their markets will grow rapidly until finally they fade and disappear. This final stage is Schumpeter's "creative destruction." New products then appear and go through their own boom and bust cycle. In this way, with a succession of new product cycles, the economy moves forward.

Our concept of leading or growth industries is similar to Schumpeter's. However, we do not view growth as moving in cycles; instead we have identified growth industries at only around 10% of the economy with most of the economy growing at modest rates, in line with GDP. Nor do we stress creative destruction. Our view is that when the markets of growth industries become saturated, their growth simply slows. But, like Schumpeter we view economic growth as depending on a succession of innovative products creating new mass markets.

#### **1.12** Relationship to existing theory

#### 1.12.1 Existing growth theory

The central result of growth theory in the Solow (1956) tradition is that GDP growth converges to a steady rate; in the simple models this rate is g + n, the rate of growth of labor effectiveness plus the population growth rate. This theory is mathematically elegant and has some intriguing implications, such as Samuelson's (1965)catenary turnpike establishing that there is a unique optimal growth path and that balanced growth converges to this path. However, this theory does not explain growth-both the growth coefficients are given from outside of the model. More recent developments have tried to ease some of the limitations of the Solow framework. These developments include AK models and endogenous growth theory (see, for example, Romer (1986, 1990) and Lucas (1988)). Capital has been extended to include human capital and no longer exhibits diminishing returns. And, productivity advance, the driver of growth, has been endogenized by appealing to R&D, knowledge, and learning by doing.

#### 1.12.2 Growth accounting

Growth accounting, in particular the KLEMS approach led by Dale Jorgenson, provides a different perspective. Growth accounting separates growth, either of GDP or at the industry level, into contributions by factor quantities and qualities, and TFP. Growth accounting is not a theory of growth; rather, its objective is to better understand the process of growth on the production side.

#### 1.12.3 Scientific theory

Theory in some sciences, such as physics, seeks to predict accurately the outcome of a process. An example is Newton's law of gravity:  $F = G \times M1 \times M2 / D^2$  where the gravitation force, F, between two bodies depends on their masses and their distance apart. G is a constant, originally inferred from observations. This model is universally applicable. This theory does not get involved with how gravity works but simply predicts its outcome with universal accuracy (short of radiation moving at light speed).

Conventional growth theory is similar in seeking a standard, universally applicable, mathematical, predictive model. However, conventional growth theory does not generate universally accurate predictions. Economic growth is about people, and people are not universally regular and consistent. Events such as wars, the Great Depression, the Global Financial Crisis, and bad government seem to recur. The United States has survived these events and GDP growth has continued, although at varying rates. It is possible to put a trend through actual growth, but this does not represent accurate prediction. Gordon (2016) makes a similar point with his observation that US growth has decelerated since 1973. As this slowdown began a full 45 years ago, it is hardly a transitory blip.

Neither our approach nor growth accounting aspires to be a universally applicable, predictive theory.

Theory in many natural sciences, such as biology, is different—it seeks to explain a process so we can understand its operation and outcome. An example is Darwin's theory of evolution. This is that species evolve as genetic changes which enhance survival and reproductive success become more common in successive generations of a population. There is no mathematics involved and there are no predictions. However, Darwin's theory provides an explanation of evolution which allows us to understand what is going on.

#### 1. Economic growth: a different view

Endogenous growth theory attributes growth to increased capital, including human capital, and to reported R&D. Although both are important, they are not the whole story. The human sources of growth, such as new product creation, marketing, consumer behavior, and improvements in operating efficiencies, also are important. Conventional theory does not explain economic growth.

Our approach is a theory in the sense of the natural sciences—it clarifies the processes involved with economic growth and allows us to better understand growth. Similarly, growth accounting is concerned with measuring what has happened, not with predicting what will happen. Our approach is complementary to growth accounting—we aim to advance understanding on the demand side, the driver of growth, while growth accounting advances understanding on the production side, the sustainer of growth.

#### 1.12.4 Understanding

The two fundamental questions involved in understanding economic growth are: how does growth happen and why does it happen?

Our analysis shows how economic growth operates. Growth is driven by a succession of new and popular products which lead to a succession of rapid growth industries; these, in addition to the continuing moderate growth of established industries, keep increasing demand. At the same time, production capacity increases, through investment, productivity improvement, and more employment, to meet this rising demand. Growth is demand-led and supplyenabled.

Our approach also shows why growth happened—because of consumer behavior. Consumers always want new and popular products or just cheaper products. Adoption of these new products leads spending growth until their markets become saturated at which time consumers' imaginations are caught by new products which lead to new rounds of spending growth.

#### 1.13 Other countries

#### 1.13.1 Other countries

We have described the growth of the United States. This growth has been led by rapid growth in spending on a succession of new consumer and investment products. Many, although certainly not all, other countries have also achieved continuing GDP growth. All have used the same processes although the demand drivers and leading industries have differed.

The western European countries have followed the US model of consumption- and investment-led growth; some countries have followed a commodity-led path, exporting essential materials and foodstuffs to industrialized countries; and some countries have followed a lowcost path, exporting low-priced goods to higher income countries.

The US model will continue to be effective as long as consumers rush into new products. The commodity export strategy faces more risks as commodity use in high-income countries slows with the shift from goods to services. The lowpriced export strategy also has risks as rising incomes, and so costs, diminish the export price advantage.

# 1.14 Conclusion

# 1.14.1 Conclusion

We have set out a different approach to viewing economic growth. We seek to clarify and understand how economic growth works. Unlike conventional growth theory, we do not seek to develop a universally valid predictive model. We are not seeking to replace conventional theory but rather to complement it with a framework which allows better understanding. The essence of our methodology is to introduce a demand side and to look at growth at the industry level. With this innovation:

- economic growth becomes less of a black box; the processes are revealed;
- demand (or spending) leads the economy; economic growth depends on a succession of innovative products for which mass markets emerge; production responds to demand;
- the nature and role of innovation are clarified; innovation is essential both on the product side (for demand) and the process side (for supply);
- the vital roles of credit and of government stabilization policy become clear;
- it becomes apparent that there is nothing automatic or necessarily steady about economic growth;
- we can better understand the industrial, occupational, income distribution, and geographic changes which are inevitable features of economic growth.

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