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Business Cycles

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This paper describes the empirical regularities of growth and business cycles that characterize market economies. Relatively little is know at this point about economic fluctuations in planned economies, partly because the system of national income accounting used by these countries produces information that is not easily comparable with data for market economies. Still, the lessons from market economies are likely to become increasingly relevant as planning economies rely more on market forces.

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1. INTRODUCTION

During the last century many countries have experienced an unprecedented increase in their standard of living. But this growth in per capita income did not occur smoothly, with the economy expanding at a constant rate. Periods of economic expansion alternated with recessions featuring a slowdown in economic activity. The source and characteristics of these business cycles have been of long standing interest to economists. In the 1940's two researchers at the National Bureau of Economic Research, Arthur Burns and Wesley Clair Mitchell, pioneered the study of business cycle regularities. Their findings, summarized in their 1946 treatise "Measuring Business Cycles," continue to be a remarkably good description of business cycles not only in the United States but in many other countries.[1] The fact that business cycles look similar over time and across countries suggest that there may be caused by the same underlying forces. The search for these forces is one of the most important lines of research in macroeconomics.

[1] See Backus and Kehoe (1992) for a discussion of the statistical properties of business cycles in various countries.

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This paper is organized into three sections. Section 1 summarizes facts about economic growth. Section 2 discusses business cycle facts. Finally, section 3 provides a brief discussion of the influence of these facts on macroeconomic theory.

2. WHAT HAPPENS WHEN AN ECONOMY GROWS?

The most important economic fact about the United States and many other market economies is not that they undergo expansions and contractions but that their income levels have risen at a sustained rate over long periods of time. Before we move on to discuss the characteristics of business cycles it is useful to pause and gather some facts about this long-run growth process.

The Kaldor Facts.

One remarkable feature of the U.S. economy is that there are a number of key variables that tend to remain roughly constant over long periods of time. These variables are:

- The growth rate of per capita output;
- The real rate of return to capital;
- The shares of labor and capital in national income;
- The capital-output ratio;
- The investment-output ratio;
- The consumption-output ratio.

Kaldor (1957) first suggested that these variables might be constant in the long run so this constancy is often referred to as the ‘Kaldor facts’. We will use a series of figures, extracted from Kongsamut, Rebelo and Xie (2001) and King and Rebelo (1999), to depict the behavior of these different variables. Figure 1, which displays the U.S. real per capita GDP (in logarithms) for the period 1902 to 1999 shows that the U.S. growth rate computed over long periods of time (say, decades) has been surprisingly stable. The average annual growth rate of the U.S. economy during this period is roughly 2 percent per year.

FIG. 1. U.S. Real GDP per capita, 1902-1999 (in logarithms)

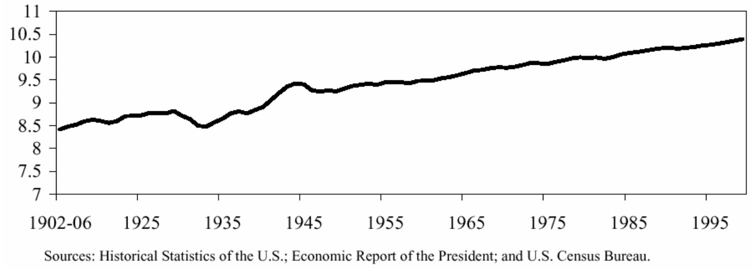


Figure 2, constructed using data from Siegel (1992), shows the behavior of the real rate of return to the U.S. stock market as measured by a version of the Standard and Poors 500 index (an index comprised of the 500 largest firms in the stock market) for three distinct time periods: 1802-1870, 1871-1925 and 1926-1992. The real rate of return is remarkably stable, at a level that is roughly 6.5 percent per annum, across these three periods.

FIG. 2. Annual, Real, Geometrically Compounded Returns to U.S. Stock

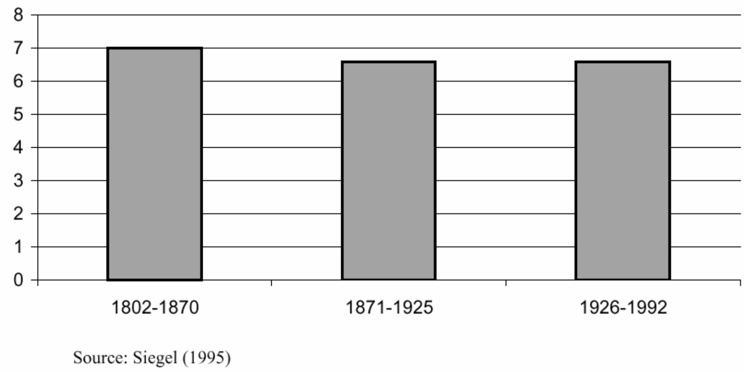
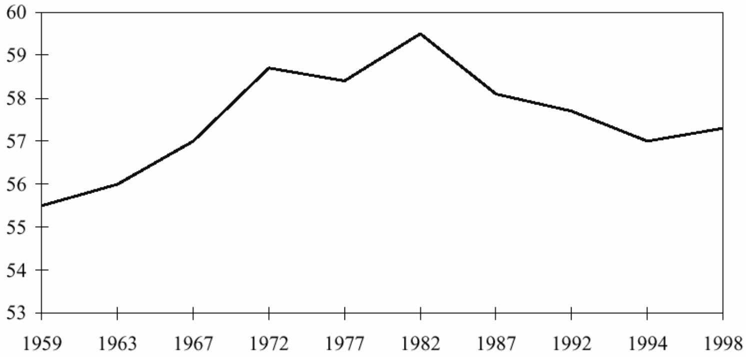


Figure 3 depicts the fraction of total income that is paid to workers in the U.S. The average share of labor income from 1959 to 1998 is roughly 57 percent.[2] It is difficult to discern a clear trend in the path for this variable.

Figure 4 shows the capital-labor ratio for the period 1929 to 1989. Except for an obvious rise associated with the large decline in output associated with the Great Depression this ratio is reasonably stable over time.

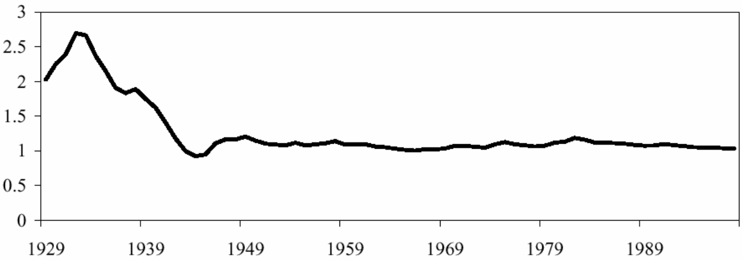
[2]The share of labor income is difficult to compute and compare across countries. This is because it is difficult to identify the fraction of proprietors income, an important component of national income in many countries, that can be attributed to labor.

FIG. 3. U.S. Share of Labor Income in Total Income, 1959-1998



Source: Survey of Current Business, August 1996, and June 2000.

FIG. 4. U.S. Capital-Output Ratio, 1929-1998



Sources: Fixed assets and consumer durable goods. Survey of current business, May 1997, April 2000. NIPA (B.E.A. website).

Figures 5 and 6 depict the investment-output ratio and the consumption-output ratio from 1947 to 1997. Once again we see that these variable are reasonably constant over time.

The stability of the long-run U.S. growth rate suggests that one should be skeptical of the idea that the emergence of new industries and technologies can transform the growth process, raising permanently the rate of economic expansion. Even though investors were infatuated with electronics in the 1960's, biotechnology in the 1980's and the internet in the 1990's it is difficult to look at Figure 1 and detect changes in the aggregate growth rate associated with the rise of these technologies. The U.S. growth rate also seems impervious to the large increase in the importance of international trade in the world economy since World War II, suggesting that the growth impact of globalization on U.S. growth is not dramatic.

FIG. 5.

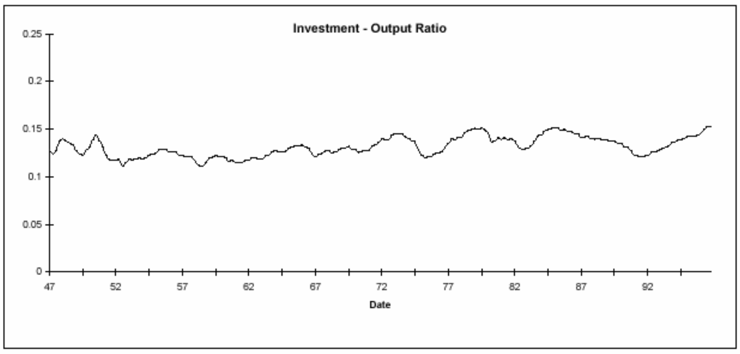
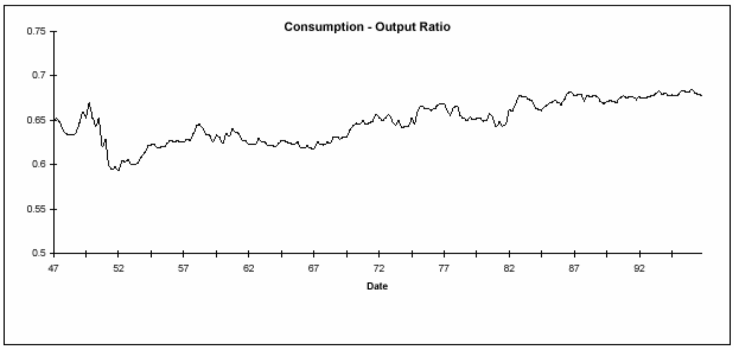


FIG. 6.



It is important to caution that evidence in favor of the Kaldor facts is strongest in the U.S. economy during the period depicted in Figure 1. Data for other countries and longer run data for the U.S. is consistent with the idea that there has been a slow but steady acceleration of the rate of growth. This acceleration becomes obvious once we look beyond the last century. As Lucas (1997) emphasized, the sustained growth suggested by Figure 1 is a recent phenomenon, that characterizes at best the last two hundred years. In pre-industrial times the level of income remained stable over long periods of time. This stability is reflected in the writings of the classical economists–Smith, Ricardo and Malthus–who imagined a world where sustained income growth was impossible.

Many theories of economic growth (e.g. Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992)) predict that the rate of growth of the world economy should accelerate over time. These theories stress the important fact that the cost of inventing a new good is independent of the number of units of the good that will later be produced. Inventing a new vaccine costs the same, regardless of how many doses of the vaccine are sold. This means that when markets are small we should not expect to see much costly innovation, because the smallness of the market makes it difficult to recoup the innovation cost with sales of the new product. In contrast, large markets make it easy to recoup the fixed cost of innovation. The speed at which new goods and technologies are discovered in the present age seems consistent with the idea that globalization and growth in the world economy have increased the size of the market so that there is a greater incentive to innovate.

Productivity Growth.

In most growth theories sustained expansions in output such as that depicted in Figure 1 for the U.S. are the result of technical progress. In the original Solow (1956) this technical progress was modeled as an exogenous force that increased labor productivity. In more recent theories the rate of technical progress is endogenous to the model, resulting from the profit maximizing decisions of Research and Development firms.

The fact that long-run growth stems from productivity growth has created a lot of interest in computing the rate of growth of productivity. To discuss the concept of productivity it is useful to write down a production function. This function describes the number of units of output that can be produced with a certain amount of capital and labor. To simplify our exposition we will make use of a Cobb-Douglas production function:

$$Y = AL^{\alpha}K^{1-\alpha}. \tag{1}$$

This production function has a convenient form and is often a good local approximation to other production functions. It also exhibits constant returns to scale: doubling the amount of both capital and labor in the production process results in a doubling of the output: $A(2L)^{\alpha}(2K)^{1-\alpha} = 2Y$. There is a fair amount of evidence consistent with this constant returns to scale property.[3]

The two notions of productivity most commonly used by economists are the average productivity of labor and the total factor productivity. The average productivity of labor is given by Y/L. This notion of productivity is easy to compute since all it requires is a measure of output in the economy and a measure of total labor hours. Total factor productivity corresponds

[3] See Burnside, Eichenbaum and Rebelo (1995) and Basu and Fernald (1997) for estimates of returns to scale in U.S. manufacturing.

to the variable A in equation (1). Computing A is harder since it requires an estimate of the stock of capital and of the elasticity α. The stock of capital is usually estimated with the "perpetual inventory method". This relies on the following equation:[4]

$$K_{t+1} = I_t + (1 - \delta)K_t \tag{2}$$

where I_t represents investment in physical capital, K_t is the capital stock at date t and δ is the rate of depreciation. Given an estimate of the initial capital stock at some point in the past, we can use a time series for investment, together with equation (1) to generate a time series for the stock of capital. The value of α is usually computed by using the fact that when factor markets are competitive α coincides with the share of labor income in the economy.

Once we obtain a time series for the stock of capital and a value for α we can compute total factor productivity. Macroeconomists are usually not interested in the level of total factor productivity but on its growth rate. It is this growth rate that drives the long run rate of expansion in many models. The growth rate of A can be computed as:

$$g_A = g_Y - \alpha g_L - (1 - \alpha)g_K$$

where we used the notation g_x to denote the continuously compounded rate of growth $(ln(x_{t+1}/x_t))$ of variable x. We will later discuss the behavior of these two notions of productivity over the business cycle.

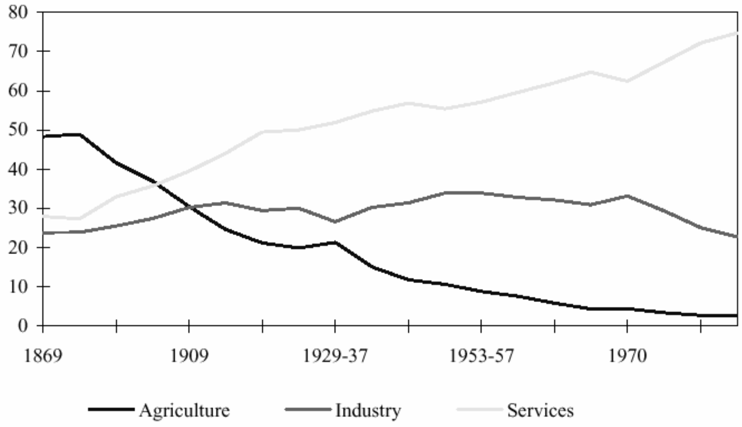
The Kuznets Facts.

In countries such as the U.S., long-run growth in income has been relatively smooth at the aggregate level for at least one century. However, during this period of time, the sectoral composition of the economy has changed dramatically. Agriculture, which accounted for almost 50 percent of employment in 1869 was reduced to less than 2 percent of employment by 1998. Figure 7 shows the enormous sectoral reallocation of labor that has taken place in the U.S. since 1869, with a dramatic decline in employment in agriculture and a rise in service employment.

This decline in the importance of agriculture is likely to have been the result of two factors. First, the income elasticity of the demand for agricultural goods is less than one, so the percentage of income spent on food as

[4]In practice the perpetual inventory method does not assume that the rate of depreciation, δ, is constant.

FIG. 7. U.S. Employment Shares by Sector, 1869-1998



Sources: Historical Statistics of the United States, 1975 edition.
Statistical Abstract of the United States, 1999.

a fraction of income falls when income rises.[5] Adam Smith predicted this decline in the importance of agriculture when he wrote that "The desire of food is limited in every man by the narrow capacity of the human stomach". Figure 8, which depicts the share of various types of consumption spending as a share of total spending, shows the decline in the relative importance of spending on agricultural goods.

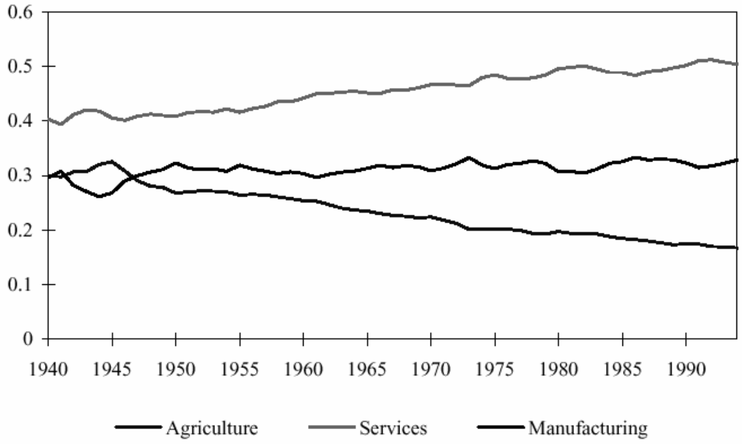
The second factor that has contributed to the decline in agricultural employment is the rapid rate of technical progress in the agricultural sector. Johnson (2002) compiles statistics for the long run behavior of agricultural yields. He shows that the corn yield increased from 25 bushels per acre in 1866 to almost 140 bushels per acre in 1999. During the same time period the wheat yield increased from 12 to 42 bushels per acre. While the accumulation of both physical and human capita in agriculture were surely important contributors to these dramatic yield increases, technical progress is likely to have played a major role.

3. WHAT HAPPENS DURING BUSINESS CYCLES?

We have seen that variables such as real GDP, consumption and investment grow over time. Hence, the statistical measurement of business cycles

[5]See Bils and Klenow (1998) for estimates of the income elasticity of demand for agricultural goods.

FIG. 8. U.S. Consumption Shares by Sector, 1940-1999



Source: Economic Report of the President (1990,2000).

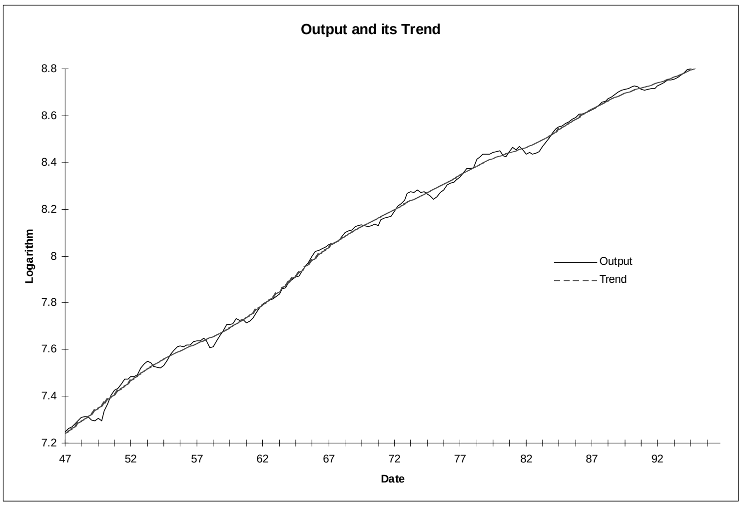
requires that these time series be rendered stationary. This is commonly done by the extracting a secular trend from the data. A common detrending procedure in macroeconomics is the Hodrick and Prescott (1980) filter, which extracts a smooth trend from the data.[6] We will now use a series of figures taken from King and Rebelo (1999) to document the characteristics of business cycles. Figure 9 shows the level of real per capita GDP and its Hodrick-Prescott trend. Figure 10 shows the detrended real GDP series. The recessions apparent in this Figure include both periods in which the level of real output actually declined and times during which there was only a slowdown in the growth rate of output.

Figures 11 to 22 depict the detrended path for the key macroeconomic aggregates together with detrended output. Table 1 summarizes a set of statistics that describe the cyclical properties of the key macroeconomic aggregates obtained using these series. The salient features of the business cycle suggested by this table are as follows.

Comovement.

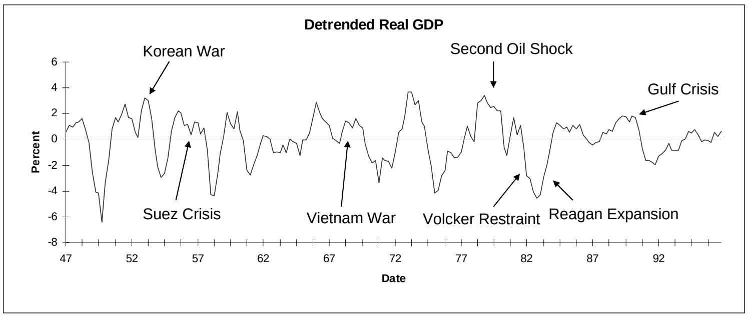
[6]In essence, this method involves defining cyclical output y_t^c as current output y_t less a measure of trend output y_t^g, with trend output being a weighted average of current and future observations: $y_t^c = y_t - y_t^g = y_t - \sum_{j=-J}^{J} a_j y_{t-j}$. King and Rebelo (1993) discuss the statistical properties of this detrending method.

FIG. 9.



Source: Robert G. King and Sergio Rebelo, "Resuscitating Real Business Cycles," in J. Taylor and M. Woodford Handbook of Macroeconomcs, North-Holland, 1999.

FIG. 10.



Most macroeconomic aggregates are procyclical, that is, they are positively correlated with output.[7] This means that an expansion is like an economic crescendo: output, consumption, investment, total hours worked in the economy, average labor productivity and total factor productivity all tend to rise simultaneously. Table 1 shows that high degree of correlation between these variables and aggregate output (ranging from .88 for consumption and labor to .55 for labor productivity). This high degree of coherence can also be gleaned from Figures 11 to 21.

[7]The trade balance, which is countercyclical, is an important exception.

FIG. 11.

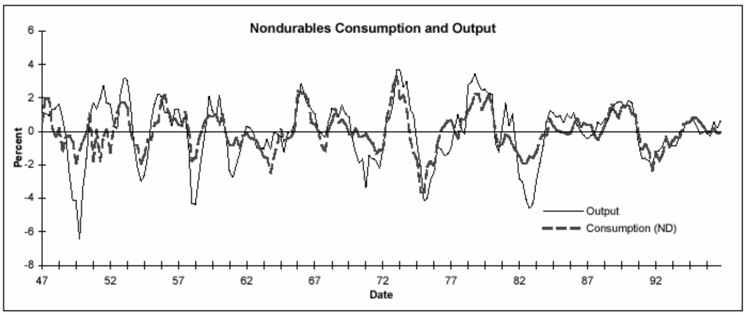
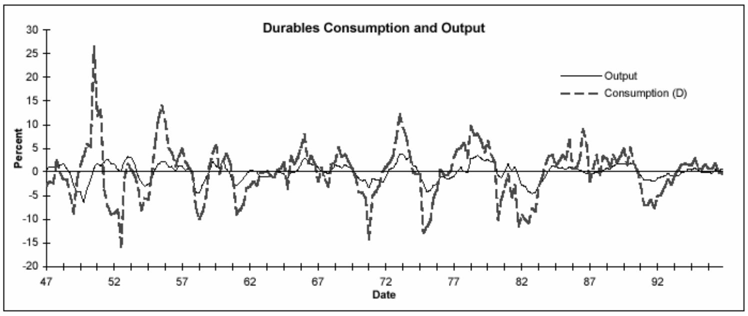


FIG. 12.



Source: Robert G. King and Sergio Rebelo, "Resuscitating Real Business Cycles," in J. Taylor and M. Woodford Handbook of Macroeconomics, North-Holland, 1999.

FIG. 13.

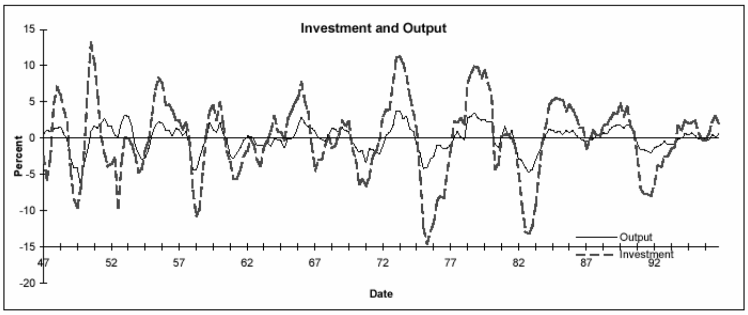


Table 1 shows that wages, government expenditures, and the capital stock are essentially acyclical. The correlation between these variables and output is close to zero. The real interest rate is mildly countercyclical.

There are a number of comovement facts about the labor market that have been investigated by Davis, Haltiwanger and Schuh (1996) and Blan-

FIG. 14.

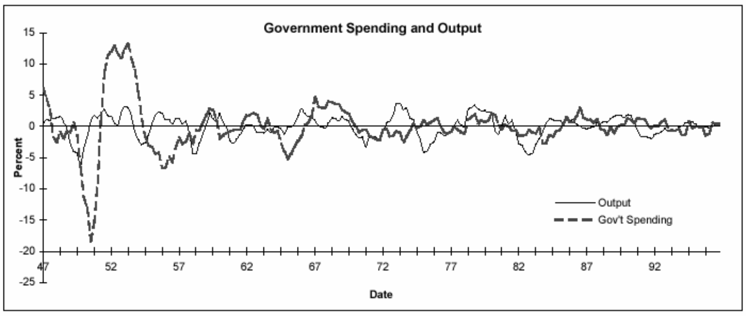


FIG. 15.

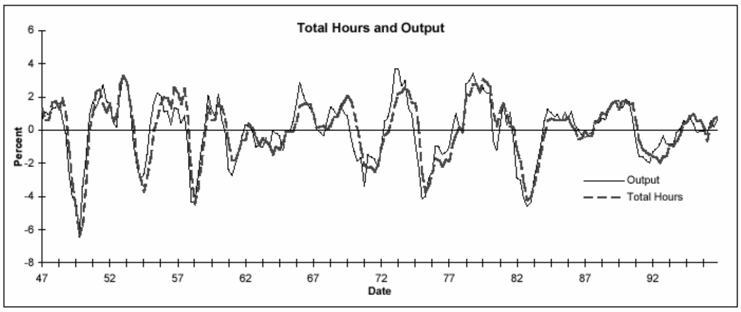
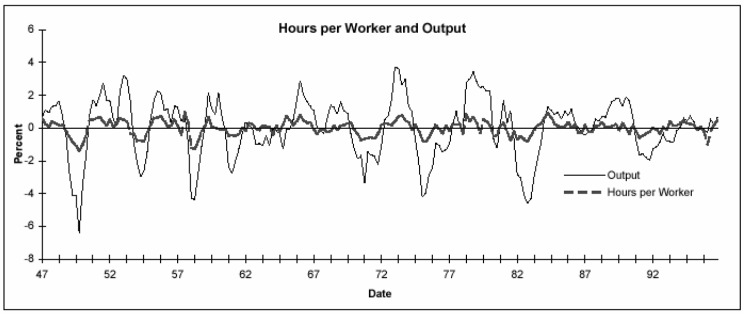


FIG. 16.



chard and Diamond (1990). The most obvious of these facts is that unemployment is countercyclical: the number of workers without a job is high in recessions and low in expansions. The average duration of unemployment (the average number of weeks it takes for the typical unemployed worker to find a job) is also countercyclical: it takes longer to find a job in recessions than in expansions. Quits (the number of workers who voluntarily

FIG. 17.

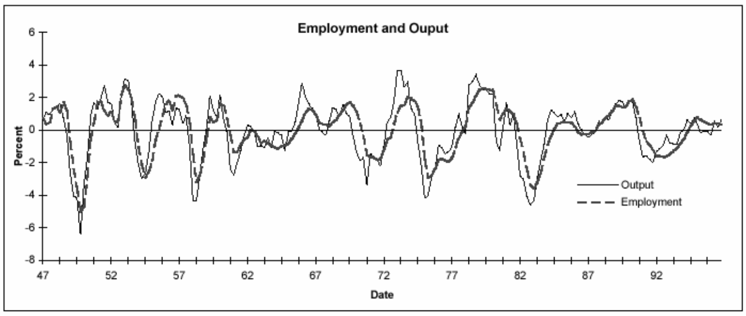


FIG. 18.

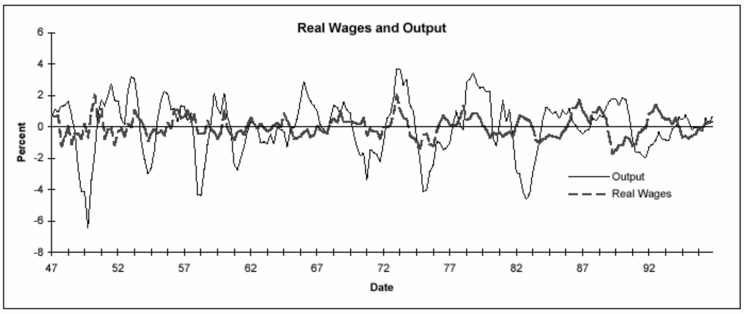
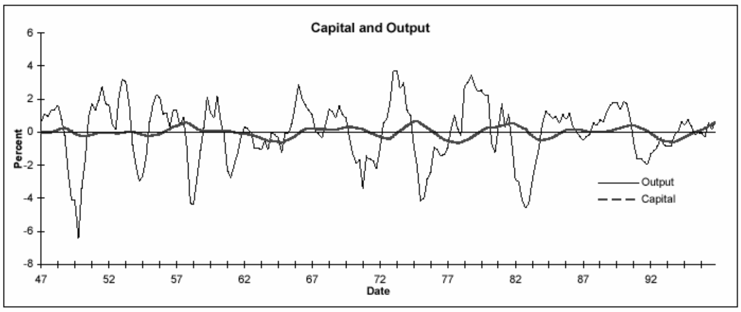


FIG. 19.



leave their jobs) and new hires are procyclical while layoffs (workers whose job is at least temporarily terminated by the employer) and recalls are countercyclical.

Comovement is a feature not only of the major macroeconomic aggregates, but also of employment in different industries and income in different regions of the same country. Table 2, extracted from Christiano and

FIG. 20.

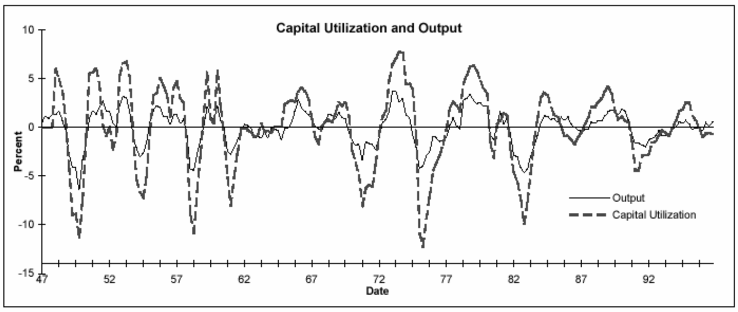
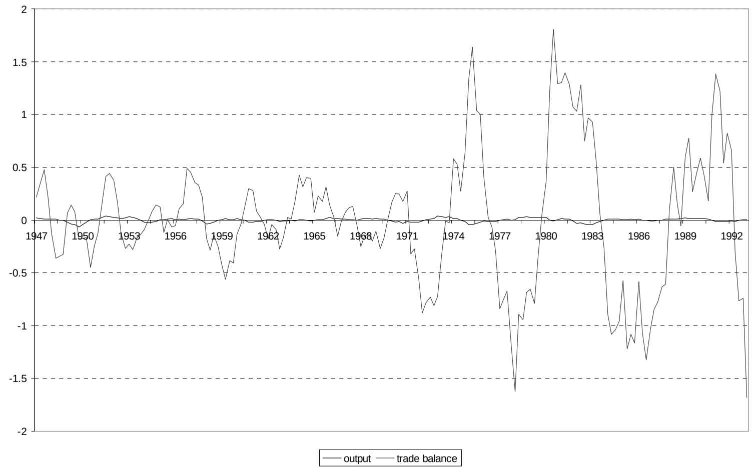


FIG. 21.



Fitzgerald (1998), shows that the number of hours employed by most industries is highly correlated with the total hours employed by the private sector.[8]

Table 3, extracted from Carlino and Sill (1998), shows that there is a high degree of correlation between the growth rate of real per capital income in different U.S. regions.[9]

The strong comovement between the level of activity in different industries and different regions suggests to many economists that business cycles are caused by aggregate shocks. However, there is disagreement as

[8]See Burnside, Eichenbaum and Rebelo (1996) for a discussion of the properties of total factor productivity at the sectoral level.

[9]See Kouparitsas (2001) for an analysis of the degree of comovement between regional output in both the U.S. and the European Community.

FIG. 22.

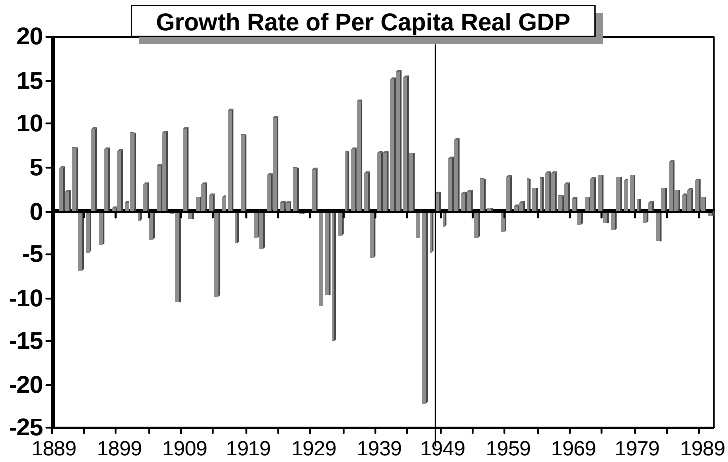


TABLE 1.

Business Cycle Statistics for the U.S. Economy

	Standard Deviation	Relative Standard Deviation	First Order Auto -correlation	Contemporaneous Correlation with Output
Real GDP	1.81	1.00	0.84	1.00
Consumption	1.35	0.74	0.80	0.88
Investment	5.30	2.93	0.87	0.80
Hours Worked	1.79	0.99	0.88	0.88
Labor Productivity	10.2	0.56	0.74	0.55
Real wage rate	0.68	0.38	0.66	0.12
Real interest rate	0.30	0.16	0.60	−0.35
Total factor productivity	0.98	0.54	0.74	0.78

Note: All variables have been logged (with the exception of the interest rate) and detrended with the HP filter.

to the nature of these shocks, with some theories emphasizing exogenous movements in productivity (e.g. Kydland and Prescott (1982), Prescott (1986), and Long and Plosser (1983)), others monetary shocks (e.g. Christiano, Eichenbaum and Evans (2001)) and yet others changes in beliefs (e.g. Benhabib and Farmer (1998)).

Persistence.

TABLE 2.

Properties of the business cycle components of hours worked

Variable number	Hours worked variable	Relative magnitude	Relative volatility	Business cycle comovement
1	Total private	1.00	1.00	.00
2	Goods producing industries	.33	2.91	.99
3	Mining	.03	5.48	.38
4	Construction	.17	6.75	.88
5	Manufacturing	.80	3.92	.97
6	Durable goods	.58	6.90	.97
7	Lurnber and wood products	.06	10.18	.89
8	Furnture and fixtures	.04	8.14	.94
9	Store, clay, and glass products	.05	4.99	.95
10	Primary metal industries	.09	9.89	.88
11	Fabricated metal products	.13	7.21	.98
12	Machinery, except electrical	.19	11.10	.93
13	Electrical and electronic equipment	.15	8.75	.88
14	Transportation equipment	.17	7.83	.89
15	Instruments and related products	.09	5.03	.78
16	Miscellaneous manufacturing	.04	3.23	.90
17	Nondurable goods	.42	1.39	.91
18	Food and kindred products	.21	.18	.50
19	Tobacco manufactures	.01	1.83	.08
20	Textile mill products	.11	3.92	.78
21	Apparel and other textile products	.15	2.64	.85
22	Paper and allied products	.09	1.97	.85
23	Printing and publishing	.16	.91	.90
24	Chemicals and allied products	.13	1.01	.80
25	Petroleum and coal products	.02	2.02	.16
26	Rubber and misc. plastics products	.09	7.82	.89
27	Leather and leather products	.03	2.71	.64
28	Rubber and misc. plastics products	.02	2.02	.18
29	Transportation and public utilities	.10	.87	.95
30	Wholesale trade	.10	.85	.87
31	Retail trade	.31	.38	.87
32	Finance, insurance, and real estate	.10	.35	.48
33	Services	.38	.19	.49

Another notable feature of the business cycle is that recessions and expansions tend to be protracted. The economy does not alternate quickly between periods of growth and period of contraction. If an economy is in

TABLE 3.
Simple Correlation of Real Regional Per Capita Personal Income Growth, 1953:3 - 95:2

	U.S.	NE	ME	GL	PL	SE	SW	Std. Deviation
New England (NE)	0.75							0.0116
Mideast (ME)	0.77	0.70						0.0104
Great Lakes (GL)	0.84	0.55	0.66					0.0124
Plains (PL)	0.64	0.23	0.33	0.55				0.0185
Southeast (SE)	0.84	0.59	0.57	0.69	0.47			0.0113
Southwest (SW)	0.76	0.49	0.50	0.53	0.45	0.70		0.0114
Farwest	0.75	0.55	0.52	0.52	0.26	0.59	0.44	0.0122

an expansion this quarter, most likely it will also be in an expansion in the next quarter. A standard measure of persistence is the first order autocorrelation, that is, the correlation of a generic variable, x_t, with its value in the previous quarter, x_{t-1}. Table 1 shows that aggregate output has a first-order autocorrelation of 0.84. The other variables in this table also exhibit a considerable degree of persistence. This high serial correlation is the reason why there is some predictability to the business cycle.

The strong persistence exhibited by most macroeconomic series has led researchers to search for models that have strong propagation mechanisms. Such models can produce persistent movements in output in response to shocks that have low persistence. Unfortunately, the model that forms the basis of many macro theories–the neoclassical growth model–has a relative weak propagation mechanism. For this reason this model can generate realistic business cycles only when the shocks that buffet the economy are themselves persistent.

Volatility.

Table 1 shows that different macroeconomic aggregates can differ dramatically in their volatility. Investment, the trade balance and the purchases of consumption durables are all more volatile than output. Investment, is about three times more volatile than output.

Employment and the number of hours worked in the economy display the same level of volatility as output. One important fact about the variability of total hours is that it stems mostly from changes in employment. This means that in an expansion total hours increase not so much because employed workers work longer hours but because more people are employed.

Similarly, in recessions total hours worked decline mostly because the level of employment declines.

Among the variables that are less volatile than output the most important are the consumption of non-durable goods, the average hours worked and the real wage.

The capital stock has much lower volatility than output, displaying very little cyclical variation (see Figure 19).

3.1. Business Cycles are Becoming Less Severe

Table 4 shows the duration of recessions and expansions for three time periods between 1886 and 2000. Note that economic expansions have become much longer during the post war period: 56 months as opposed to 34 months in the prewar period. Table 5 shows the duration and depth of recent US recessions. The average post-war recession lasted 11 months and was relatively mild, with output declining only by 2 percent from peak to through. Figure 22, which displays the U.S. growth rate of output between 1889 and 1989 provides further evidence that business cycles are becoming milder: the volatility of the growth rate of output is noticeably lower in the postwar period.

TABLE 4.

The Duration of Business Cycles (months)

	Recessions	Expansions
1886-1916	9.7	34.0
1920-1940	14.0	31.6
1948-2000	10.7	55.9

This trend toward business cycles that are less volatile is not unique to the US. Table 6 shows the standard deviation of output growth for 13 countries. In all cases this volatility is lower–sometimes dramatically so–in the postwar period.

While we do not have a present a fully satisfactory theory of the business cycle, the decline in growth volatility is likely to partly reflect our improved understanding of certain aspects of the economy.

3.2. The Cost of Business Cycles

Lucas (1987) confronted an agent with preferences that are standard in macroeconomic models with the question of how much consumption he or she would be willing to give up to eliminate all fluctuations in consumption associated with business cycles. The answer was–very little, suggesting

TABLE 5.

Duration and Depth of Recent Recessions

	Duration	Fall in Output
	(months)	(peak to trough)
1948-49	11	3.6
1953-54	10	2.6
1957-58	8	3.2
1960-61	10	0.5
1969-70	11	0.1
1973-75	16	3.4
1980	6	2.2
1981-82	16	2.8
1990-91	8	1.3

TABLE 6.

Standard Deviation of Output Growth

Country	1885–1939	1950–1999
Argentina	6.49	5.12
Australia	6.10	2.05
Belgium	5.31	1.97
Brazil	8.65	5.38
Canada	6.32	2.23
Finland	5.06	2.67
Italy	4.32	3.84
Netherlands	6.25	2.82
Portugal	8.68	3.07
Sweden	4.71	2.17
Switzerland	3.07	2.84
UK	4.86	4.31
USA	4.95	2.83

that the welfare cost of business fluctuations is very small. In contrast this hypothetical agent would be willing to forego a significant fraction of his consumption to live in an economy which expands at a faster rate.

Lucas's welfare calculation suggest that there is much more to be gained from understanding the determinants of the growth process than from fine tuning our understanding of what drives economic fluctuations.

4. BUSINESS CYCLE FACTS AND MACROECONOMIC THEORIES

The facts that we discussed in this paper have greatly influenced the development of macroeconomic theories. The smoothness of non-durable consumption has led macroeconomics to model consumers as having preferences that assign higher utility to smooth consumption paths. The high volatility of investment underlies Keynes's notion that investmentor sentiment may be an important influence on investment behavior. The low cyclical volatility of capital is often taken to imply that one can safely abstract from movements in capital in constructing a theory of economic fluctuations. But while the stock of capital is relatively immutable at cyclical frequencies, the intensity with which the capital is utilized displays large variation over the business cycle. This has motivated the development of models that emphasize capital utilization.[10] The high correlation between hours worked and aggregate output has led some economists to believe that understanding the labor market is key to understanding business fluctuations. Finally, the relatively small variability of real wages and the lack of a close correspondence of wages with aggregate output, has led some economists to conclude that the wage rate is not an important allocative signal in the business cycle.

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[10] See, for example, Greenwood, Hercowitz, and Huffman (1988), Bils and Cho (1994), Burnside and Eichenbaum (1996), and Burnside, Eichenbaum, and Rebelo (1995).

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