DEPARTMENT OF ECONOMICS

Working Paper

Long Waves of Capitalist Development: An Empirical Investigation

by

Deepankar Basu

Working Paper 2016-15

UNIVERSITY OF MASSACHUSETTS AMHERST

Long Waves of Capitalist Development: An Empirical Investigation

Deepankar Basu[±]

December 18, 2016

Abstract

In this paper, I investigate the phenomenon of long waves of capitalist development from two perspectives. First, I look for evidence of long waves of economic growth taking the dates for turning points of long waves from the historical literature (Mandel, 1995). Using historical data for 20 capitalist countries from the Maddison-Project, I find that the growth rate of real per capita GDP (and real GDP) is significantly higher in the upswing than in the downswing phase of long waves. I interpret this as evidence of long waves of economic activity. Second, I revisit the method used by Gordon, Weisskopf and Bowles (1983) to identify long waves, using historical data on the U.S. economy from Duménil and Lévy (2013). I use this definition of long waves to test their hypothesis that business cycle downturns are "reproductive" during the upswing phase and "non-reproductive" during the downswing phase of long waves. I find evidence in support of the hypothesis.
JEL Codes: B14; B24; B51.
Keywords: capitalism; long waves; expected profitability.

1. Introduction.

In the heterodox tradition of political economy, it is common to analyze the dynamics of capitalist economies at two very different time scales. The first is the "long run" that spans several decades, or even centuries, during which capitalism's underlying long run tendencies related to the growth of the forces of production, inter-capitalist competition and the capital-labour conflict come to the fore. The second is the "short run" that spans a few years – typically

± Department of Economics, University of Massachusetts, Amherst. Email: dbasu@econs.umass.edu. I would like to thank Sam Bowles, Debarshi Das, Duncan Foley, Tom Weisskopf and participants at the Political Economy Workshop in the Department of Economics, University of Massachusetts, Amherst, for comments on an earlier version of the paper. The usual disclaimers apply.

the length of a business cycle – during which the operation of economic, social and political forces give rise to marked and irregular fluctuations in the pace of economic activity. An interesting hypothesis is that capitalist economies also display long waves of economic activity that span several business cycles.

These long waves, spanning several business cycles, are composed of alternating periods of growth (long upswings) and relative stagnation or decline (long downswings). During the long upswing phase, the average pace of economic activity increases even as the economy fluctuates at business cycle frequencies. In an analogous but opposite movement, the average pace of economic activity declines over the long downswing phase, even as the economy moves through shorter fluctuations of the typical business cycles.

The hypothesis that capitalist development moves through long waves, i.e., in alternating periods of growth and stagnation, attracted attention of the economics profession in the 1930s. In a series of papers and books that were published in Russian in the decade of the 1920s, economist and statistician, Nikolai D. Kondratieff proposed the theory of and provided some evidence for long waves. Some of Kondratieff's work was translated into English in the early 1930s (Kondratieff and Stolper, 1935). But it really became part of the mainstream discourse in economics when Kondratieff's work on long waves was endorsed strongly by Joseph A. Shumpeter in his magisterial work on business cycles (Schumpeter, 1939; Lange, 1941).

It is an interesting fact of the history of economic thought that important work on long waves predates Kondratieff's research on this topic. The phenomenon of long waves of capitalist economic development was first proposed and studied by Marxist scholars at the end of the 19th century. The German Marxist Alexander L. Parvus and the Dutch Marxist Jacob van Gelderen did pioneering work on long waves. Russian Marxists like Trotsky, Ospirin and others participated in developing this literature further (for details, see chapter 4 in Mandel, 1978).

While the mainstream and Marxist literature on long waves had some commonalities, they differed in two key respects. First, for the Marxist tradition, fluctuation in the rate of profit is the central mechanism for the generation of long waves. For mainstream theorists like Kondratieff and Schumpeter, on the other hand, factors like the availability of credit, the accumulation of money capital, investment in long-lived capital assets and major technological innovations interact to create long waves. There is no role for profitability in their theories. Second, for mainstream theorists, there is a certain automaticity to the long waves; a long wave downturn almost automatically generates the next long wave upturn through the operation of purely economic factors. The Marxist tradition differs sharply from this understanding. For Marxist theorists, there is no automatic mechanism to ensure that a long wave downturn will become the next long wave upturn. The role of extra-economic factors is important in generating a long wave upturn.

Within the Marxist tradition itself, one can discern at least two different, though related, approaches. The first approach, which I will call the traditional Marxist approach, identifies turning points of long waves by relying on qualitative evidence from the historical literature, and uses changes in the average pace of economic activity, measured by changes in the growth rate of output (or exports), as evidence of long waves of capitalist development.

Long waves, in this approach, are generated by fluctuations in the pace of capital accumulation, the latter determined, in turn, by fluctuations in the rate of profit. For this approach, the transition from a long wave downturn to a new long upturn is caused by extra-economic factors like wars, revolutions, spatial expansion of capitalism, and imperialism.

The second Marxist approach is associated with the social structure of accumulation (SSA) approach in Marxist political economy that was developed in the United States in the late 1970s (see, e.g., Gordon, 1980; Gordon, Edwards and Reich, 1982; Gordon, Weisskopf and Bowles, 1983). In this approach, a matrix of institutions that impinge on the capital accumulation process – institutions that govern the capital-labour relation, the process of inter-capitalist competition, the provision of money and credit, and other such institutions – is identified as a SSA, and long waves of capitalist development are associated with the succession of SSAs. Once in place, an SSA provides stability to profitability expectations, which, in turn, spurs capital accumulation and economic growth. This upswing phase gradually erodes the conditions that anchor profitability expectations, and gives place to a long downswing phase. A construction of a new SSA, that is the result of political, economic and social factors, is required to initiate the next long wave.

Within this general SSA framework of analysis, Gordon, Weisskopf and Bowles (1983) offer an interesting and theoretically grounded way of identifying upswing and downswing phases of long waves. To differentiate the upswing and downswing phases of long waves, they differentiate between reproductive and non-reproductive business cycle downturns. They argue that business cycle downturns that are associated with increases in the expected profit rate should be understood as “reproductive” cycles because these cyclical downturns endogenously restore profitability expectations; in an analogous manner, cyclical downturns that do not display this property could be classified as “non-reproductive” cycles. This leads them to suggest that the upswing phase of a long wave is composed of (possibly a sequence of) reproductive business cycles, and the downswing phase is composed of (again, possibly a sequence of) non-reproductive business cycles.

Gordon, Weisskopf and Bowles (1983) also advance a hypothesis about the mechanism that drive the reproductive and non-reproductive cycles: changes in the reserve army of labour is restorative of profitability expectations in one case (reproductive cycle), but stops working in the other (non-reproductive cycle). Thus, increases in the unemployment rate, understood as a proxy for changes in the size of the reserve army of labour, should be positively associated with changes in expected profitability during reproductive cycles; no such association should be seen for non-reproductive cycles.

This paper contributes the literature on long waves in two ways. First, I use data on per capita real GDP for 20 capitalist countries to investigate if there is any evidence for the existence of long waves of economic growth. I find strong evidence for the existence of long waves of economic activity in these 20 capitalist countries since 1848. I also find that the long wave associated with the so-called Golden Age of capitalism, the two and a half decade period after the end of the Second World War, is an anomaly in the history of capitalism: for the Golden Age, there is no significant difference in the pace of economic activity between the upswing and downswing phases. But the difference in the pace of economic activity re-emerges in the neoliberal period since the early 1980s.

Second, I use historical data on the US economy from Duménil and Lévy (2013) to revisit the analysis advanced in Gordon, Weisskopf and Bowles (1983). In particular, I use their method to identify long waves and find that the US economy has witnessed 7 long waves since 1869. I also use this data, along with data on the unemployment rate from Carter (2006) and the Bureau of Labour Statistics (BLS), to test the Gordon, Weisskopf and Bowles (1983) hypothesis regarding the difference between reproductive and non-reproductive cycles. My analysis of US data between 1869 and 2010 shows two things: (a) increases in the reserve army of labour are associated with increases in expected profitability during reproductive cycles, and (b) increases in the reserve army of labour are associated with reduction in expected profitability during non-reproductive cycles. This evidence is consistent with the hypothesis in Gordon, Weisskopf and Bowles (1983).

The rest of the paper is organized as follows. In section 2, I investigate the presence of long waves for a sample of 20 advanced capitalist countries since 1848. In section 3, I discuss the SSA approach to long waves, outline the Gordon, Weisskopf and Bowles (1983) hypothesis and present results of an econometric test of that hypothesis. In section 4, I conclude the discussion, highlight some caveats and suggest some directions for future research. Appendix 1 contains details of the data sources and definitions of key variables used for the analysis in the paper.

2. Evidence of Long Waves in Capitalist Countries

In this section, I present evidence for the existence of long waves of economic activity in 20 capitalist economies since 1848. I measure the pace of economic activity by two measures: (a) the annual rate of growth of real gross domestic product (GDP); and (b) the annual rate of growth of real per capita GDP.[1] I use data on real GDP and per capita real GDP (both measured in 1990 Geary-Khamis dollars) for 20 capitalist countries (in Europe and the New World). The real GDP series comes from Angus Maddison's original data and is relatively complete from 1870 to 2008. The data on real per capital real GDP series comes from the Maddison Project initiated by a group of scholars to update Angus Maddison's original data. These data are relatively complete between 1848 and 2010.[2]

To identify the turning points of long waves before 1980, I draw on qualitative evidence from the historical literature summarized in Mandel (1978; 1995); for turning points after 1980, I draw on qualitative evidence presented in Kotz (2009). Together, this literature highlights the following 4 long waves since the middle of the 19th century:

- Long Wave 1 (1848-1893): composed of the upswing during 1848-1873, and the downswing from 1874 to 1893;
- Long Wave 2 (1894-1948[40]): composed of the upswing from 1894 to 1913, and the downswing from 1914 to 1948 (1940 in non-European countries);
- Long Wave 3 (1949[41]-1982: composed of the upswing from 1949(41) to 1967, and the downswing from 1968 to 1982;

[1] In Gordon, Edwards and Reich (1982), one of the measures used to track long waves is the growth rate of real gross national product (GNP).
[2] More details of the data set are available in the Appendix.

- Long Wave 4 (1983-?): composed of the upswing from 1983 to 2007, and the downswing since 2008.

In Table 1, I present estimates of the average of annual growth rates of per capita real GDP for 20 capitalist countries for the upswing and downswing phases of the 4 long waves identified above. The evidence in Table 1 shows that, in general, the average growth rate of per capita real GDP is higher in the upswing than in the downswing phase of all the 4 long waves. But there are some differences over the long waves too: in the first long wave, 7 out of 20 countries in my sample display lower average growth of per capita real GDP in the upswing than in the downswing phase; in the second and third long waves, 3 and 2 countries, respectively, display this pattern; and in the last long wave, no country has this pattern. Thus, out of a total of 77 country-periods, there are only 12 anomalous cases (when the average growth rate of per capita real GDP is lower in the upswing, than in the downswing, phase of the long wave).[3] In Figure 1, I present the difference in average growth rates of per capita real GDP for long wave downswings and upswings visually using bar charts.

[Table 1 about here]

[Figure 1 about here]

In Table 2, I report results of testing for the equality of mean growth rates of per capita real GDP between upswing and downswing phases of long waves. I conduct this test for five

[3] Data is missing for Ireland for the first long wave and the upswing phase of the second long wave. That is why there are 77 country-periods, instead of 80.

different time periods: 1848-2010, 1860-2010, 1890-2010, 1945-2010, and 1983-2010.[4] The results in the table show that there was a statistically significant difference in the annual growth rate of real per capital GDP between long wave upswings and long wave downswings for all the sample periods other than 1945-2010. Since the difference in the growth rates between upswings and downswings is significant for the period, 1983-2010, this implies that the difference was insignificant in the so-called Golden Age, the period from the end of World War II to the beginning of the 1980s. By this analysis, the so-called Golden Age emerges as an anomalous period to the persistent patterns observed for the history of capitalism since the mid-nineteenth century.

[Table 2 about here]

In Table 3 and 4, I complement the evidence in Table 1 and 2, with results from some simple regressions of the following form:

$$g_{it} = \beta \times USG_{it} + \mu_i + \varepsilon_{it} \qquad (1)$$

where i indexes countries, t indexes years, g_{it} represents the annual growth rate of real per capita GDP, USG_{it} represents an upswing dummy variable that takes the value 1 for years when the country is in the upswing phase of a long wave (as identified by dates in Table 1) and 0 otherwise, and μ_i represents a country fixed effect.

[4] Some countries in the Madison data set have per capita real GDP data only from 1860. Hence, we get a strongly balanced panel for the period 1860-2010. So, I conduct the test for this period to make sure that results do not change from the relatively unbalanced panel for 1848-2010. I run a separate test for the period 1890-2010 because capitalist development, and especially industrialization, was relatively incomplete in many countries prior to 1890. If the long wave emerges with the dominance of capitalist relations of production, the period since 1890 could be seen as the proper period for studying the phenomenon of long waves.

The key parameter in regression in (1) is β, which gives us the average difference in the growth rate in per capita real GDP between upswing and downswing phases of long waves. When (1) is estimated as a pooled OLS regression, $\mu_i = \mu$, so that all the countries have the same intercept; but, when (1) is estimated with the within (fixed effect or FE) estimator, each country has a separate intercept. My preferred estimator is the latter, which estimates the average difference in the growth rates between upswing and downswing phases of long waves after allowing for differences in the average growth rate across countries due to country-specific unobserved factors.

[Table 3 about here]

In Table 3, I report results for the five different time periods that were used in Table 2: 1848-2010 (specification 1), 1860-2010 (specification 2), 1890-2010 (specification 3), 1945-2010 (specification 4), and 1983-2010 (specification 5). For both the pooled OLS and the FE estimators, average growth rates in the upswing phase of long waves is significantly higher than the corresponding average in downswing phases of long waves. The difference was about 1 percentage points in specifications 1 through 3, and increased to more than 3 percentage points in specification 5. For instance, over the period, 1890-2010, average growth rates in the upswing phase of long waves was about 1.17% higher than in the long downswing phase of long waves (using a FE estimator). The significance of the difference is true for all specifications other than specification 4, i.e., for the whole postwar sample years (where the coefficient estimate is about half at about 0.5 and no longer statistically significantly different from zero). Since the difference is significant for specification 5, with sample years 1983-2010, this highlights the anomalous behavior of the so-called Golden Age (when the difference between the upswing and downswing phases was negligible).

In Table 4, I report results analogous to Table 3 but with the growth rate of real GDP as the dependent variable (instead of the growth rate of real per capita GDP). Since relatively complete data on real GDP starts only in 1870, I report results for four time periods: 1874-2008 (specification 1); 1890-2008 (specification 2); 1945-2008 (specification 3); and 1983-2008 (specification 4). The results in Table 4 are similar to those in Table 3. The growth rate of real GDP differs by about 1 percentage points for specifications 1 and 2, and the difference is statistically significant at standard levels of significance. When we come to the postwar period, 1945-2008, the corresponding difference is much smaller (about 0.1) and it is no longer statistically significant. But when we move to the period since the early 1980s, we see the difference emerge as significant once again. This reiterates the anomalous nature of the immediate postwar period (1945-1983).

[Table 4 about here]

The evidence in Table 1 through 4 together suggests that there are long waves of economic activity in the 20 capitalist countries in our sample. The average rate of growth of per capita real GDP is statistically significantly higher for upswing phases of long waves compared to the downswing phases of the long waves for longer historical time periods, 1848-2010, 1860-2010 and 1890-2010, and also for the shorter period since the early 1980s, 1983-2010. The only exception to this pattern is the so-called Golden Age (the two and a half decades after the end of World War II). The causes of this anomalous behavior of the immediate postwar period call for further investigation.

3. Expected Profitability and Long Waves in the US

The analysis and discussion in the previous section takes the dates of the turning points of long waves as given – using qualitative evidence gleaned from the historical literature – and investigates whether there is any systematic difference in the pace of economic activity between the long downswing and upswing phases. Gordon, Weisskopf and Bowles (1983) offer an alternative – more theoretically grounded – method for identifying long waves by linking it to discussions of social structures of accumulation and expected profitability.

3.1 Identifying Long Waves

A social structure of accumulation (SSA) is the set of political and economic institutions that directly impinge on the capital accumulation process – the activity of generating and reinvesting surplus value in capitalist firms – by anchoring expected profitability. These range from institutions that affect all stages of the capital accumulation process like monetary and financial institution, the involvement of the State in the economy and the state of the class struggle, to institutions that have significance for specific stages of the capital accumulation process like those that affect input supplies and the structure of aggregate demand and the labour process. The concept of the SSA is useful because it can help us identify long waves of capitalist development (or what Gordon (1980) called 'stages of accumulation'), each long wave being differentiated by a definite and different matrix of political-economic institutions – the specific SSA.

Once a new SSA is in place, it generates stable and buoyant expectations about profitability. This spurs capital accumulation, and leads to rapid economic growth, typically spanning several business cycles. Over time, the growth process brings to the fore hidden contradictions of the SSA. Gradually, these growing conflicts and contradictions erode profitability expectations and reduce the pace of capital accumulation and economic growth, ushering in a period of a long downswing. The economy can remain in the downswing phase of the long wave for several business cycles, and the next upswing phase of a new long wave only begins with the construction of a new SSA that can revive profitability expectations in a robust manner (Gordon, Edwards and Reich, 1982).

Since expected profitability is the key driver of the process of capital accumulation and economic growth, Gordon, Weisskopf and Bowles (1983) argued that changes in expected profitability over business cycle downturns can be used to identify upswing and downswing phases of long waves. They posited that business cycle downturns in the upswing phase of a long wave are “reproductive” cycles in the sense that endogenous mechanisms associated with the cyclical downturn revive expected profitability. On the other hand, cyclical downturns in the downswing phase no longer serve this function and become “nonreproductive” in the sense that the cyclical downturn does not by itself revive expected profitability. It is only the construction of a new SSA that can revive expected profitability, spur capital accumulation and take the economy out of the downswing phase of the long wave. Thus, Gordon, Weisskopf and Bowles (1983) offer a simple definition to differentiate upswing and downswing phases of long waves, which is summarized as

Definition 1: *If expected profitability increases over a business cycle downturn, then that business cycle is part of the upswing phase of a long wave; otherwise it is part of the downswing phase of the long wave.*

I will operationalize this definition and use it on historical data for the US economy from Duménil and Lévy (2013). But to do so I need to distinguish between actual, full-capacity and expected profit rate.

3.2 Actual, Full-Capacity and Expected Profit Rate

Let us denote the actual, full-capacity and expected profit rates as r^a, r^{fc}, and r^e, respectively. For any period, t, the actual profit rate is defined in a straightforward manner as the ratio of the actual profit flows over the period and the capital stock at the beginning of the period,

$$r^a(t) = \frac{\Pi^{a}(t)}{K(t)} \qquad (2)$$

where Π^a denote actual profit flows over t, and $K(t)$ denotes the capital stock at the beginning of period t. Following Weisskopf (1979), I decompose the actual rate of profit into three components as

$$r^a(t) = s_{\pi}(t) \times z(t) \times u(t) \qquad (3)$$

where $s_{\pi}(\mathrm{t}) = \Pi^{\mathrm{a}}(\mathrm{t})/\mathrm{Y}(\mathrm{t})$ is the share of (actual) profit in output, $z(t) = Y^*(t)/K(t)$ is ratio of full-capacity output and the replacement cost capital stock, and $u(t) = Y(t)/Y^*(t)$is the capacity utilization rate.

For any period t, I define the full-capacity profit rate as the ratio of *full-capacity profit flows* over the period and the capital stock at the beginning of the period:

$$r^{fc}(t) = \frac{\Pi^{\mathrm{fc}}(t)}{K(t)} \quad (4)$$

The full-capacity profit flows and actual profit flows over any period is, in turn, related as follows:

$$\Pi^{fc}(t) = \frac{\Pi^{\mathrm{a}}(t)}{u(t)} \quad (5)$$

where $u(t)$ is the capacity utilization rate in period t. Thus, if in period t, the economy happens to be operating at full-capacity (so that $u(t) = 1$), then the full-capacity profit flow is equal to the actual profit flow over that period. On the other hand, if the economy is operating below full-capacity (so that $u(t) < 1$), then the full-capacity profit flow is higher than the actual profit flow.[5]

Since the full-capacity profit rate is given by

$$r^{fc}(t) \equiv \frac{\Pi^{\mathrm{fc}}(t)}{K(t)} = \frac{\Pi^{\mathrm{a}}(\mathrm{t})/\mathrm{u}(\mathrm{t})}{K(t)} = \frac{\Pi^{\mathrm{a}}(\mathrm{t})}{K(t)} \times \frac{1}{u(t)} \quad (6)$$

we can decompose it as:

[5] Note that "full-capacity profit flow" is, in effect, a hypothetical quantity for periods when the economy is not operating at full-capacity. In such situations, the full-capacity profit income is the answer to the following counterfactual question: what would the profit flow be if the economy were to operate at full capacity? Equation (5) provides an answer to that question and defines the full-capacity profit flow. In general, it seems reasonable to suggest that full-capacity profit income is a function of actual profit income and the capacity utilization rate. Equation (5) assumes a particular functional form for this function, whereby the full capacity profit income is defined as the ratio of actual profit income and the capacity utilization rate. This implies that the ratio of full capacity and actual profit income is a nonlinear and decreasing function of the capacity utilization rate, $1/u$.

$$r^{fc}(t) = \frac{\Pi^{a}(t)}{K(t)} \times \frac{1}{u(t)} = \frac{s_{\pi}(t) \times z(t) \times u(t)}{u(t)} = s_{\pi}(t) \times z(t) \qquad (7)$$

Following Gordon, Weisskopf and Bowles (1983), I will define the expected profit rate as the product of the full-capacity profit rate and expected capacity utilization, i.e.,

$$r^{e}(t) = r^{fc}(t) \times u^{e}(t) \qquad (8)$$

where $u^{e}(t)$ is the expected capacity utilization rate. In (8), the first factor captures the profit rate that would arise if firms had the ability to adjust their capacity utilization to their "desired" levels; the second factor captures the fluctuations in expected profitability driven by changes in expected capacity utilization (as indicators of fluctuations of aggregate demand).

Equation (8) can be written in terms of growth rates as

$$\widehat{r^{e}}(t) = \widehat{r^{fc}}(t) + \widehat{u^{e}}(t) \qquad (9)$$

where the "hat" symbol denotes growth rate, i.e., $\hat{x}(t) = (1/x(t))dx(t)/dt$.

As Gordon, Weisskopf and Bowles (1983) correctly notes, a business cycle downturn is unlikely to have a positive effect on the expected utilization rate. Thus, we can posit that $\widehat{u^{e}}(t) \leq 0$. Hence,

$$\widehat{r^{e}}(t) \leq \widehat{r^{fc}}(t) = \widehat{s_{\pi}}(t) + \hat{z}(t) \qquad (10)$$

where the equality in the second half of (10) comes from using (7).

The logic of (10) is important for the subsequent analysis and worth highlighting: since expected capacity utilization is unlikely to increase over a business cycle downturn, (10) suggests that a cyclical downturn can increase the expected rate of profit only when the full-capacity profit rate increases. Hence, we can operationalize the insight of Gordon, Weisskopf and Bowles (1983) regarding the identification of long wave upswings/downswings using changes in the full-capacity profit rate.

It is useful to note that (10) also shows that the full-capacity profit rate can increase in either of the following ways: (a) the full-capacity profit share increases; or (b) the full-capacity output-capital ratio increases; or (c) both the profit share and the full capacity output-capital ratio increases. On the one hand, the full-capacity profit share can increase by weakening the bargaining power of labour vis-à-vis capital, as the reserve army of labour is replenished during a cyclical downturn.[6] On the other hand, the full-capacity output-capital ratio can increase because high-cost firms are eliminated during a downturn or high-cost processes are not used within surviving firms (Gordon, Weisskopf and Bowles, 1983).

3.3 Long Waves in the US Economy

Table 5 presents data on *changes in the full-capacity rate of profit* (as defined in equation 7) for the 28 cyclical downturns in the US economy since 1869.[7] The criterion in definition 1 is used to classify each downturn, in the last column in Table 5, as either a reproductive cycle (RC=1) or a

[6] A more nuanced story can be developed when we decompose the profit share as 1 – real unit labour cost, where the real unit labour cost is the ratio of the real wage rate and the product of output per unit of effort and effort per hour (see Gordon, Weisskopf and Bowles, 1983, for details).

[7] Following Gordon, Weisskopf and Bowles (1983), I will define a business cycle downturn as the period from the peak of a business cycle to one year after the trough. The addition of a year after the trough is meant to allow time for a possible reproductive cycle to do its work in reviving expected profitability. Business cycle dates have been taken from the website of the NBER: http://www.nber.org/cycles.html

non-reproductive cycle (RC=0).[8] A succession of reproductive (non-reproductive) business cycles makes up the upswing (downswing) phase of long wave.

Using this classification scheme, the US economy has witnessed 7 long waves since 1867. The first long wave ran from 1867 to 1888, with an upswing phase from 1867 to 1880, and a downswing phase from 1880 to 1888.[9] Next, there was a long wave from 1890 to 1908. This was followed by 5 long waves, the latest spanning the period since 1980. Figure 1 displays bar charts of changes in expected profitability and its two components over the 28 cyclical downturns that obtained over these 7 long waves.

[Table 5 about here]

The evidence presented in Table 5 and Figure 1 highlights a pattern of long waves in full-capacity profitability in the US economy. Visual inspection of the three series in Figure 1 confirms that changes in full-capacity profitability and its two components over cyclical downturns display some persistence, so that positive changes are followed by positive changes and negative changes by negative changes. This bunching together of reproductive and non-reproductive cycles – the sequence of 0s and 1s in the last column of Table5– attests to a wave-like nature of profitability that is consistent with the existence of long waves.

[Figure 2 about here]

---

[8] In their empirical analysis, Gordon, Weisskopf and Bowles (1983) ignore the output-capital ratio because of lack of reliable historical data on capital stock. Thus, they effectively reduce profitability to the profit share, which is a possible limitation of their results. Since capital stock data is now available, we can address this limitation by analyzing expected profitability (and both of its components).

[9] According to NBER data, the business cycle which peaked in 1869 had its beginning in 1867.

3.4 The GWB Hypothesis

After developing the innovative method for identification of long waves using reproductive and non-reproductive business cycle downturns, Gordon, Weisskopf and Bowles (1983) offer a hypothesis about a possible mechanism the operation of which could distinguish reproductive and non-reproductive business cycle downturns. This relates to the restorative effect of changes in the reserve army of labour on profitability.

Since reproductive cycles are part of the upswing phase of long waves, they expect a positive relationship between peak-to-trough (with trough defined as NBER trough plus one year) changes in the unemployment rate (as a measure of the increase in the size of the reserve army of labour) and full-capacity profitability, especially the full-capacity profit share, for reproductive cycles. Thus, increases in the size of the reserve army of labour are sufficient, in reproductive cycles, to depress the power of labour and restore full-capacity (and expected) profitability. On the other hand, no such association is expected between changes in the unemployment rate and expected profitability for non-reproductive cycles. Thus, changes in reserve army of labour are not able to restore profitability during non-reproductive cycles. I call this the Gordon-Weisskopf-Bowles (GWB) hypothesis and test it econometrically.

3.4.1 The Econometric Model

To test the Gordon-Weisskopf-Bowles (GWB) hypothesis I use the following regression model:

$$g_t^{FCP} = \beta_0 + \beta_1 g_t^{UN} + \beta_2(BCD_t \times g_t^{UN}) + \beta_3(RC_t \times BCD_t \times g_t^{UN}) + \beta_4 RC_t + \beta_5 BCD_t + u_t \qquad (11)$$

where t indexes years, g_t^{FCP} denotes annual growth rate of full-capacity profitability (or its two components), BCD_t denotes a business cycle downturn dummy variable (which takes the value 1 for years that fall in the period between a business cycle peak and one year after the trough, other than the case when that coincides with the next peak, and 0 for other years), RC_t denotes a dummy variable that takes a value of 1 if the year fall within a business cycle downturn that is a reproductive cycle (and 0 otherwise), and g_t^{UN} is the annual growth rate of the unemployment rate.

While testing for the effect of changes in the reserve army of labour on the growth rate of expected profitability, the regression model in (11) controls for two important sources of variation that could confound the result. First, inclusion of the reproductive cycle dummy (RC_t) and the business cycle downturn dummy (BCD_t) controls for factors that vary over the upswing phase of long wavess and over business cycle downturns, respectively, and might be correlated with changes in the reserve army of labour and expected profitability, like the behavior of financial markets, behavior of the Central Bank, etc. Second, we also include a set of dummy variables defined over the long waves – one dummy variable for each of the seven long swing since 1890. This is meant to control for factors that change only across long waves, like institutional factors relating to the regulation of financial markets, capital-labour relations, and the role of the State in the economy.

Even after these controls, there remains an obvious problem: the possibility of endogeneity. While increases in the size of the reserve army of labour over business cycle downturns – captured by the growth rate of unemployment rate – is expected to have an impact on expected profitability, as suggested by the GWB hypothesis, it is difficult to rule out the reverse causal effect. It is equally possible for changes in expected profitability to have an effect on the size of the reserve army of labour through the impact of the former on the rate of capital accumulation: if expected profitability falls, it might lead to a fall in the pace of capital accumulation, which would lead to an increase in the size of the reserve army of labour because of a decline in the demand for labour-power. To block off this obvious channel of reverse causality, I include the growth rate of real investment as an additional control in the regression model in (11). Thus, I estimate the following model to test the GWB hypothesis:

$$g_t^{FCP} = \beta_0 + \beta_1 g_t^{UN} + \beta_2(BCD_t \times g_t^{UN}) + \beta_3(RC_t \times BCD_t \times g_t^{UN}) + \beta_4 RC_t + \beta_5 BCD_t + \beta_6 g_t^{INV} + u_t \quad (12)$$

where g_t^{INV} is the growth rate of real investment, and all other variables are as defined in (11).

The GWB hypothesis entails two propositions about the parameters in the regression model in (12):

$$\text{(a) } \beta_1 + \beta_2 \leq 0, \text{ and (b) } \beta_1 + \beta_2 + \beta_3 > 0. \quad (13)$$

To see the first part, note that the partial effect of the growth rate of the unemployment rate on the growth rate of full-capacity profitability over a business cycle downturn ($BCD_t = 1$) when the economy is in a non-reproductive cycle ($RC_t = 0$) is given by

$$\frac{\partial}{\partial g_t^{UN}} E(g_t^{FCP} | BCD_t = 1, RC_t = 0) = \beta_1 + \beta_2$$

where $E(y|x)$ refers to the conditional expectation of y given x. Since a non-reproductive cycle does not restore profitability, the GWB hypothesis implies that this partial effect must be non-positive, i.e., $\beta_1 + \beta_2 \leq 0$.

To see the second part, note, in an analogous manner, that the partial effect of the growth rate of the unemployment rate on the growth rate of full-capacity profitability over a business cycle downturn ($BCD_t = 1$) when the economy is in a non-reproductive cycle ($RC_t = 1$) is given by

$$\frac{\partial}{\partial g_t^{UN}} E(g_t^{FCP} | BCD_t = 1, RC_t = 1) = \beta_1 + \beta_2 + \beta_3.$$

Since a reproductive cycle is meant to revive full-capacity profitability, the GWB hypothesis implies that this partial effect must be positive, i.e., $\beta_1 + \beta_2 + \beta_3 > 0$.

3.4.2 The Results

To begin the discussion of results, I show time series plots of the key variables used in this analysis in Figure 3: growth rates of unemployment, full-capacity rate of profit, profit share, and capacity-capital ratio. The data for this analysis covers the years from 1890 to 2010. I could not use the years before 1890 for the regression analysis because the unemployment series starts in 1890, i.e., I did not have data for the years 1869-1890.

[Figure 3 about here]

There are two important features that are worth noting. First, the growth rate of unemployment and the growth rate of the capacity-capital ratio display higher volatility in pre-war period than in the subsequent years. Second, there is a period in the early 1930s – the years 1932 to 1934 – that is an outlier in terms of the growth rates of the profit share and expected profit rate. To take account of the first feature, I use heteroskedasticity and autocorrelation consistent standard errors; to make sure that the results are robust to the second feature, I re-do the analysis by including a dummy variable for the outlier years, and also do a sub-sample analysis by dropping the outlier years.

In Table 6, I report results of estimating three variants of the regression model in (12). In columns 1 through 3, I report results for the regression model with full-capacity profit share, full-capacity output-capital ratio, and the full-capacity profit rate, respectively, as the dependent variable. Our interest is in testing the two parts of the GWB hypothesis and not in the values and significance of individual parameter estimates. Thus, even though I report the individual parameter estimates in Table 6 for completeness, I will restrict my comments to the results of the hypothesis tests that are reported in Table 7.

[Table 6 about here]

Panel A in Table 7 reports results of hypothesis tests for the model in (12) for the full sample period, 1890-2010. The first part of the GWB hypothesis is that $\beta_1 + \beta_2 \leq 0$, i.e., that the impact of changes in the unemployment rate on full-capacity profitability over business cycle downturns is non-positive for non-reproductive cycles. The top part presents results of testing the null hypothesis that $\beta_1 + \beta_2 = 0$ against the alternative that $\beta_1 + \beta_2 \neq 0$. The sum of the two coefficients is negative and statistically significant for specifications 1 (-0.218) and 3 (-203). Thus, if we use either the profit share or the full-capacity profit rate as the dependent variable in (12), the first part of the GWB hypothesis is supported by the data, i.e., that the impact of changes in the unemployment rate on profitability over business cycle downturns is non-positive for non-reproductive cycles. For instance, the results suggest that for each percentage point increase in the growth rate of the unemployment rate, the growth rate of full-capacity profit rate falls by 0.203 percentage points per year over business cycle downturns in non-reproductive cycles.

[Table 7 about here]

The second part of the GWB hypothesis is that $\beta_1 + \beta_2 + \beta_3 > 0$, i.e., that the impact of changes in the unemployment rate on full-capacity profitability over business cycle downturns is positive for reproductive cycles. The bottom part of Panel A presents results of testing the null hypothesis that $\beta_1 + \beta_2 + \beta_3 = 0$ against the alternative that $\beta_1 + \beta_2 + \beta_3 \neq 0$. The first thing to note is that the sum of the coefficients is positive for all specifications, but it is statistically significantly different from zero only for specification 2, i.e. when we use the capacity-capital ratio as the dependent variable. This suggests that the internal mechanism of a business cycle downturn, as captured by increases in the growth rate of the unemployment rate, manages to increase the growth rate of the profit share, the capacity-capital ratio and the full-capacity profit rate over reproductive cycles. But this effect is precisely estimated only for the full capacity-capital ratio (p-value = 0.002); for the profit share and the full capacity profit rate, the effect, while positive, is not very precisely estimated (both have large p-values).

The last part of panel A of Table 7 reports results of jointly testing both parts of the GWB hypothesis. To do so we test the joint null hypothesis $\beta_1 + \beta_2 = 0$ and $\beta_1 + \beta_2 + \beta_3 = 0$, against the alternative that $\beta_1 + \beta_2 \neq 0$ and $\beta_1 + \beta_2 + \beta_3 \neq 0$. From the last row of panel A in

Table 7 we see that we can reject the null hypothesis against the alternative for specification 2. Taken together, the results in Table 7 provide evidence in support of the GWB hypothesis, either separately or jointly.

In Panels B and C in Table 7, I report results to make sure that the results are not impacted by the presence of outlier years (1932-1934). In Panel B, I control for the effect of outliers by including a dummy variable that take a value of 1 for the years 1932-1934 and 0 otherwise. In Panel C, I re-do the analysis by dropping the outlier years. Both sets of results are similar to the results of Panel A. This suggests that the presence of outlier years do not have an oversize impact on the main results.

4. Discussion and Conclusion

The hypothesis of long waves of capitalist development that span several business cycles has been of some interest to Marxist political economists since the late 19th century (see Mandel, 1978; 1995). In this paper, I contribute to this literature in two ways.

First, I have used data for a group of 20 (now advanced) capitalist countries to investigate if there is a systematic difference in the growth rate of real per capita GDP (and real GDP) between the upswing and downswing phases of long waves. Using turning points of long waves from the historical literature summarized in Mandel (1995), I find evidence for the existence of long waves: there is a systematic difference in the average growth rate of per capita real GDP (and real GDP) between the upswing and downswing phases of long waves for the group of capitalist countries in my sample. In addition to this positive result, I also find the puzzling result that this difference was small and might have disappeared altogether in the immediate post-war period. But the difference has re-emerged once again in the data for the period after the 1980s. Thus, while the anomalous behavior of the immediate postwar period calls for further investigation, it is safe to conclude that the historical evidence lends support to the hypothesis of long waves of capitalist development.

Second, I revisit the analysis in Gordon, Weisskopf and Bowles (1983) which proposes a method of identifying and offer a mechanism underlying long waves. Their method rests on identifying a business cycle downturn – the period from a business cycle peak to a year after the trough – as a reproductive cycle if expected profitability increased over that period. A cyclical downturn that does not lead to an increase in expected profitability is classified as a non-reproductive cycle. Long waves are identified by breaks in the sequence of reproductive and non-reproductive cycles.

Using their method on historical data for the US economy compiled by Duménil and Lévy (2013) and business cycle dates computed by the National Bureau of Economic Research, I identify 7 long waves in the US economy since 1869. These are composed of 19 reproductive and 10 non-reproductive cycles. Visual inspection suggests an alternating and persistent pattern in the sequence of reproductive and non-reproductive cycles, i.e., bunching together of reproductive and non-reproductive cycles (see Table 5 and Figure 1).

Using this historical data for the US economy since 1890, I also test a two-part hypothesis advanced by Gordon, Weisskopf and Bowles (1983) regarding the mechanism underlying non-reproductive cycles: (a) that changes in the unemployment rate should be positively associated with changes in expected profitability over business cycle downturns in reproductive cycles, and (b) that there should be no such positive association between change in the unemployment rate and profitability over business cycle downturns in non-reproductive cycles. I find evidence that increases in the growth rate of unemployment over business cycle downturns increases the full capacity-capital ratio (a key component of expected profitability) during the upswing phase of long waves. On the other hand, increases in the unemployment rate over business cycle downturns reduce the profit share (a component of expected profitability) and the expected rate of profit during long wave downturns.

Empirical evidence for the existence of long waves, using turning points either from the historical literature (Mandel, 1995) or using a more theoretically-grounded method of distinguishing reproductive and non-reproductive cycles (Gordon, Weisskopf and Bowles, 1983), suggest that the phenomenon of long waves does exist in the historical data. While the evidence on the existence of long waves is certainly there, the theory to explain them calls for more research.

An interesting possible mechanism suggested by Gordon, Weisskopf and Bowles (1983) that operates through changes in the size of the reserve army of labour seems important during non-reproductive cycles but less so over reproductive cycles. The fact that the change in the reserve army of labour is associated with negative changes in full-capacity profitability might be pointing towards the importance of the effect of aggregate demand, a point that has typically not been emphasized in this literature. While increases in the reserve army of labour has a positive impact on expected profitability because it reduces cost pressures for capitalist firms (by reducing the real unit labour cost), it might also have a negative impact because it reduces aggregate demand. It might be the case that the second effect dominates the first during non-reproductive cycles, but only balances out the second during reproductive cycles. This is a hypothesis worth exploring in future research.

I would like to end with some caveats about and possible extensions of the analysis in this paper. First, to test for the presence of long waves, I have used only two measures: (a) growth rate of per capita real GDP, and (b) growth rate of real GDP. One natural extension would be to see if we find similar results using other measures like volume of exports, relative length of business cycle upswings versus downswings, rate of inflation, long term interest rates. Second, the identification of long waves that we get from using the historical literature is different from the one we get using the methodology of Gordon, Weisskopf and Bowles (1983). Hence, a question that will require some attention is how to reconcile the long wave periodization from these two methods.

Third, the econometric analysis of the GWB hypothesis can be extended in several directions. To build the econometric model, I have defined the full capacity profit rate (in section 3.2) as the ratio of the actual profit rate and the capacity utilization rate. This is only one way to relate the full capacity profit income to the actual profit income and the capacity utilization. One could explore alternative relationships between these three variables. Moreover, the analysis used time series data for the US economy. So, a natural extension would be use a panel data set of many capitalist countries, which would also allow the researcher to control for possible unobserved country-level confounding factors.

References

Carter, Susan B. 2006." Labor force, employment, and unemployment: 1890–1990 [Weir]." Table Ba470-477 in *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition,* edited by Susan B. Carter, Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright. New York: Cambridge University Press. http://dx.doi.org/10.1017/ISBN-9780511132971.Ba340-65110.1017/ISBN-9780511132971.Ba340-651

Davidson, R., and MacKinnon, J. G. 1993. *Estimation and Inference in Econometrics.* New York: Oxford University Press.

Duménil, G., and Lévy, D. 2013. *United States Long Term Database. Version January 2013.* Available from: http://www.jourdan.ens.fr/levy/uslt4x.txt (accessed October 20, 2015).

Gordon, D. M. 1980. Stages of Accumulation and Long Economic Cycles. In Terence K. Hopkins and Immanuel Wallerstein (eds.), *Processes of the World-System.* London: Sage Publications.

Gordon, D. M., Edwards, R., and Reich, M. 1982. *Segmented work, divided workers: The historical transformation of labour in the United States.* Cambridge: Cambridge University Press.

Gordon, D. M., Weisskopf, T. W., and Bowles, S. 1983. Long Swings and the Nonreproductive Cycle. *American Economic Review*, 73(2), Papers and Proceedings of the Ninety-Fifth Meeting of the American Economic Association, 152-157.

Kondratieff, N. D., and Stolper, W. F. 1935. The Long Waves in Economic Life. *The Review of Economic Statistics*, 17(6), 105-115

Kotz, D. 2009. "The Financial and Economic Crisis of 2008: A Systemic Crisis of Neoliberal Capitalism." *Review of Radical Political Economics*, 41(3), 305-317.

Lange, O. 1941. Review of "Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process", by Joseph A. Schumpeter. *The Review of Economics and Statistics*, 23(4), 190-193.

Mandel, E. 1978. *Late Capitalism.* London: Verso.

---. 1995. *Long Waves of Capitalist Development: A Marxist Interpretation.* London: Verso.

Schumpeter, J. A. 1939. *Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process.* 2 Volumes. New York: McGraw-Hill Book Co.

The Maddison-Project. 2013. http://www.ggdc.net/maddison/maddison-project/home.htm, 2013 version.

Weisskopf, T. E. 1979. "Marxian crisis theory and the rate of profit in the postwar US economy." *Cambridge Journal of Economics*, 3(4), 341-378.

Appendix 1: Data Sources

In this appendix, I provide details of the data sources used for the analyses in this paper.

1. For the analysis of long waves for a group of 20 capitalist countries, I use data from The Maddison-Project (2013) for the period 1848-2010. The Maddison-Project builds on the pioneering work of Angus Maddison and makes available consistent historical data for a large group of countries going back all the way to 1AD. I use the following variables:
    a. real GDP (measured in 1990 Geary-Khamis dollars).
    b. per capita real GDP (measured in 1990 Geary-Khamis dollars).
2. For the analysis of expected profitability and long waves in the US economy, I use data from Duménil and Lévy (2013), Carter (2006), and the website of the Bureau of Labour Statistics (BLS). Below, I provide definitions of variables and their sources:
    a. Profit Share: This is defined as 1 minus the ratio of the wage bill and the nominal net domestic product. The wage bill is defined as the product of the hourly wage and the total hours worked. All data series are from Duménil and Lévy (2013).
    b. Output-Capital Ratio: This is defined as the ratio of the nominal net domestic product and the replacement cost capital stock. Both data series are from Duménil and Lévy (2013).
    c. Capacity Utilization Rate: To compute the capacity utilization rate, I first calculate the ratio of real net domestic product and its trend, where the trend is computed by fitting a Hodrick-Prescott filter and the data series is from Duménil and Lévy (2013), and call this c_t. I define capacity utilization rate (u_t) as follows: $u_t = c_t - (\max_t c_t - 1)$. The adjustment factor $\max_t c_t - 1$ ensures that the capacity utilization rate u_t always lies below 1.
    d. Full-Capacity Output-Capital Ratio: This is defined as the ratio of the output-capital ratio and the capacity utilization rate.
    e. Full-Capacity Rate of Profit: This is defined as the product of profit share and the full-capacity output-capital ratio.
    f. Unemployment Rate: This series is taken from two sources. For the period 1890-1947, the data series is Ba476 and is taken from Carter (2006). For the subsequent years, data is taken from the website of the Bureau of Labour Statistics (series id is UNRATE). In both sources, the unemployment rate is measured in the standard manner as the ratio of the unemployed persons and the total civilian labour force (employed + unemployed).

Table 1: Average Annual Growth Rate of Per Capita Real GDP, 1848-2010

	Long Wave 1		Long Wave 2		Long Wave 3		Long Wave 4	
	Upswing	Downswing	Upswing	Downswing	Upswing	Downswing	Upswing	Downswing
	1848-1873	1874-1893	1894-1913	1914-1948	1949-1967	1968-1982	1983-2007	2008-2010
Australia*	2.358	-0.154	1.215	0.662	2.053	1.965	2.189	0.888
Austria	0.891	1.388	1.489	-0.646	5.784	3.469	2.206	-0.192
Belgium	1.9	1.016	0.97	0.498	3.11	3.115	1.938	0.0854
Canada*	2.779	1.183	2.995	0.697	2.683	2.358	1.888	-0.476
Denmark	0.974	1.227	1.95	1.285	3.28	2.054	1.905	-2.125
England	0.828	0.622	1.173	0.901	2.098	1.693	2.63	-1.674
Finland	1.681	0.583	2.382	1.796	3.67	3.525	2.413	-1.893
France	0.914	1.384	1.595	0.662	4.28	2.824	1.534	-1.106
Germany	1.463	1.248	1.858	-0.722	6.309	2.677	1.523	0.185
Greece	1.259	0.131	-0.428	1.211	5.33	3.895	2.312	-2.483
Ireland				0.901	2.657	3.331	4.265	-5.063
Italy	-0.109	0.859	1.41	0.489	5.564	3.377	1.672	-2.297
New Zealand*	7.061	-0.0559	1.449	0.745	1.955	1.307	1.575	-0.668
Netherlands	0.92	0.543	1.092	0.87	3.333	2.157	2.198	-0.617
Norway	1.94	0.887	1.641	2.123	3.186	3.164	2.537	-0.671
Portugal	1.93	0.54	0.667	1.407	4.126	4.093	2.278	-0.813
Spain	1.708	0.311	0.713	0.175	4.696	3.701	2.611	-2.024
Sweden	1.395	0.981	2.495	2.179	3.154	1.962	2.088	-0.0926
Switzerland	0.606	3.094	1.843	0.717	2.625	1.415	1.195	0.0107
USA*	1.283	1.447	1.676	1.035	2.648	1.639	2.186	-1.248

Notes. (1) Growth rates are calculated using data from the Angus Madison Project (http://www.ggdc.net/maddison/maddison-project/home.htm). (2) * For these countries, the turning point between the downswing phase in long wave 2 and the upswing in long wave 3 is 1940.

Table 2: Test of Difference in Mean Growth of Per Capita Real GDP in Pooled Samples

	Mean for Long Downswings	Mean for Long Upswings	Difference in Means between Downswings and Upswings	T-Stat
1848-2010	1.19 (N=1381)	2.15 (N=1685)	-0.96	-4.68***
1860-2010	1.19 (N=1381)	2.22 (N=1537)	-1.03	-4.98***
1890-2010	1.23 (N=1077)	2.38 (N=1311)	-1.15	-4.83***
1945-2010	2.25 (N=422)	2.70 (N=896)	-0.44	-1.47
1983-2010	-1.11 (N=60)	2.16 (N=500)	-3.27	-11.93***

Notes. This table reports results of testing for the equality of mean growth rate of per capita real GDP for pooled samples. The last column reports the t-statistic for the null hypothesis that the difference in the mean growth rate of per capita real GDP is the same for long upswings and long downswings. Dates of long upswings and downswings are as reported in Table 1. Significance levels: *** $p<0.001$, ** $p<0.01$, * $p<0.05$.

Table 3: Pooled and Fixed Effect Panel Regression Results using Growth Rate of Real Per Capita GDP, 1848-2010

	(1)	(2)	(3)	(4)	(5)
Panel 1: Pooled Regression					
UPSWING	0.960***	1.028***	1.150***	0.444	3.271***
	(7.98)	(7.98)	(8.23)	(1.15)	(8.05)
Panel 2: Country Fixed Effects Regression					
UPSWING	0.975***	1.038***	1.170***	0.496	3.271***
	(7.92)	(7.97)	(8.36)	(1.30)	(8.05)
Observations	3066	2918	2388	1320	560
Countries	20	20	20	20	20

Notes. This table reports results for a regression of the annual growth rate of per capita real GDP on an UPSWING dummy. The UPSWING dummy variable takes the value 1 for years that fall in the upswing phase of long waves, and 0 otherwise. The table reports the coefficient on the UPSWING dummy. T-statistics, clustered by country, appear in parentheses below the coefficient estimates. Specification (1) use the full sample of years, 1848-2010; specification (2) use the years, 1860-2010; specification (3) use the years, 1890-2010, specification (4) use the years, 1945-2010, and specification (5) uses the years 1983-2010. Dates of long upswings and downswings are as reported in Table 1. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.

Table 4: Pooled and Fixed Effect Panel Regression Results using Growth Rate of Real GDP, 1874-2008

	(1)	**(2)**	**(3)**	**(4)**
Panel 1: Pooled Regression				
UPSWING	1.209***	1.235***	0.103	1.985***
	(7.39)	(6.74)	(0.23)	(4.83)
Panel 2: Country Fixed Effects Regression				
UPSWING	1.184***	1.224***	0.116	1.985***
	(7.26)	(6.69)	(0.26)	(4.83)
Observations	2594	2324	1280	520
Countries	20	20	20	20

Notes. This table reports results for a regression of the annual growth rate of real GDP on an UPSWING dummy. The UPSWING dummy variable takes the value 1 for years that fall in the upswing phase of long waves, and 0 otherwise. The table reports the coefficient on the UPSWING dummy. T-statistics, clustered by country, appear in parentheses below the coefficient estimates. Specification (1) use the full sample of years, 1874-2008; specification (2) use the years, 1890-2008, specification (4) use the years, 1945-2008, and specification (5) uses the years, 1983-2008. Dates of long upswings and downswings are as reported in Table 1. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.

Table 5: Profitability in Cyclical Downturns in the US Economy, 1869-2010

Business Cycle	Peak	Trough	PEAK TO TROUGH CHANGE (% PER ANNUM) Full-Capacity Profit Share	Full Capacity Output-Capital Ratio	Full-Capacity Profitability	Unemployment Rate	Reproductive Cycle
1	1869	1871	3.53	2.88	0.64		1
2	1873	1880	4.23	4.19	0.04		1
3	1882	1886	-15.42	-11.22	-4.73		0
4	1887	1889	-1.85	-1.02	-0.84		0
5	1890	1892	1.15	1.08	0.07	4.19	1
6	1893	1894	4.40	5.24	-0.80	37.08	1
7	1895	1898	4.81	3.21	1.55	-2.79	1
8	1899	1901	6.85	4.68	2.08	-15.88	1
9	1902	1905	10.19	11.37	-1.05	4.08	1
10	1907	1909	-5.44	-3.36	-2.16	35.66	0
11	1910	1912	4.49	4.94	-0.43	0.00	1
12	1913	1915	6.64	6.26	0.36	25.50	1
13	1918	1919	7.39	-0.62	8.06	88.71	1
14	1920	1922	-5.05	-2.48	-2.64	28.80	0
15	1923	1925	6.65	5.74	0.86	4.08	1
16	1926	1928	-9.16	-6.24	-3.12	27.85	0
17	1929	1934	-11.96	-8.71	-3.56	41.16	0
18	1937	1939	7.26	-1.42	8.81	10.80	1
19	1945	1946	-15.92	-9.09	-7.52	104.66	0
20	1948	1950	-2.40	0.77	-3.14	16.98	0
21	1953	1955	0.31	2.42	-2.05	23.18	1
22	1957	1959	2.73	1.67	1.04	13.10	1
23	1960	1962	5.59	3.12	2.40	0.90	1
24	1969	1971	-1.40	0.38	-1.77	30.93	0
25	1973	1976	-1.84	0.13	-1.96	16.26	0
26	1980	1983	2.27	0.90	1.35	10.06	1
27	1990	1992	3.26	0.30	2.95	15.73	1
28	2001	2002	5.55	4.96	0.56	23.40	1
29	2007	2010	1.16	1.29	-0.12	27.79	1

Note: Business cycle dates are from the NBER. Trough = NBER trough year+1 unless it coincides with the next peak. Output is measured by nominal net domestic product. Profit share is the ratio of profit income and the nominal net domestic product; full capacity output-capital ratio is the ratio of the output-capital ratio and the capacity utilization rate; expected profitability is the product of the profit share and the full capacity output-capital ratio. Unemployment rate is measured by the civilian unemployment rate. A reproductive cycle is a cyclical downturn where the expected rate of profit changes by a positive amount. The basic data is from Duménil and Lévy (2013).

Table 6: Regression Results with Annual Data, 1890-2010

	Dependent Variable		
	Profit Share	Full Capacity Output-Capital Ratio	Full-Capacity Profitability
GUNR	-0.195*	-0.105*	-0.300**
	(0.051)	(0.097)	(0.028)
BCD	3.176	-1.267	1.909
	(0.494)	(0.322)	(0.699)
RC	1.500	3.631***	5.131
	(0.685)	(0.000)	(0.178)
GUNR X BCD	-0.023	0.120*	0.098
	(0.827)	(0.080)	(0.494)
GUNR X BCD X RC	0.270*	0.025	0.295*
	(0.058)	(0.315)	(0.058)
GINVR	0.411	0.023	0.435
	(0.142)	(0.698)	(0.160)
Constant	-4.530	-1.883**	-6.414*
	(0.129)	(0.045)	(0.056)
F-Stat	2.106	6.244	2.154
N	121	121	121

Notes. GUNR = growth rate of the unemployment rate; BCD = business cycle downturn dummy variable; RC = reproductive cycle dummy variable; GINVR = growth rate of real investment. All specifications include dummy variables for long waves. HAC standard errors are in parentheses. Significance levels: *p<0.1; **p<0.05; ***p<0.01

Table 7: Results of Hypothesis Tests

	Profit Share (1)	Full Capacity Output-Capital Ratio (2)	Full-Capacity Profitability (3)
Panel A: Basic Model			
	GUNR + GUNR * BCD = 0		
Sum of Coefficients	-0.218	0.015	-0.203
P-Value	0.037	0.613	0.084
	GUNR + GUNR * BCD + GUNR * BCD * RC = 0		
Sum of Coefficients	0.052	0.040	0.093
P-Value	0.370	0.002	0.118
	(GUNR + GUNR * BCD = 0) & (GUNR + GUNR * BCD + GUNR * BCD * RC = 0)		
P-Value	0.110	0.003	0.162
Panel B: Using Outlier Dummy as a Control			
	GUNR + GUNR * BCD = 0		
Sum of Coefficients	-0.200	0.015	-0.185
P-Value	0.022	0.618	0.071
	GUNR + GUNR * BCD + GUNR * BCD * RC = 0		
Sum of Coefficients	0.051	0.040	0.092
P-Value	0.379	0.002	0.121
	(GUNR + GUNR * BCD = 0) & (GUNR + GUNR * BCD + GUNR * BCD * RC = 0)		
P-Value	0.071	0.003	0.139
Panel C: Excluding Outlier Observation			
	GUNR + GUNR * BCD = 0		
Sum of Coefficients	-0.118	0.020	-0.098
P-Value	0.003	0.623	0.059
	GUNR + GUNR * BCD + GUNR * BCD * RC = 0		
Sum of Coefficients	0.004	0.036	0.040
P-Value	0.909	0.018	0.260
	(GUNR + GUNR * BCD = 0) & (GUNR + GUNR * BCD + GUNR * BCD * RC = 0)		
P-Value	0.012	0.048	0.090

Notes. This table reports results of hypothesis tests based on the parameter estimates and standard errors given in Table 6. For the model that is being estimated, see (12) in the text and for the hypotheses being tested see the discussion after (12) in the text. GUNR = growth rate of the unemployment rate; BCD = business cycle downturn dummy variable; RC = reproductive cycle dummy variable; GINVR = growth rate of real investment. For panels A and B, HAC standard errors are in parentheses. For panel C, we use Davidson-MacKinnon (1993) standard errors. Significance levels: *p<0.1; **p<0.05; ***p<0.01

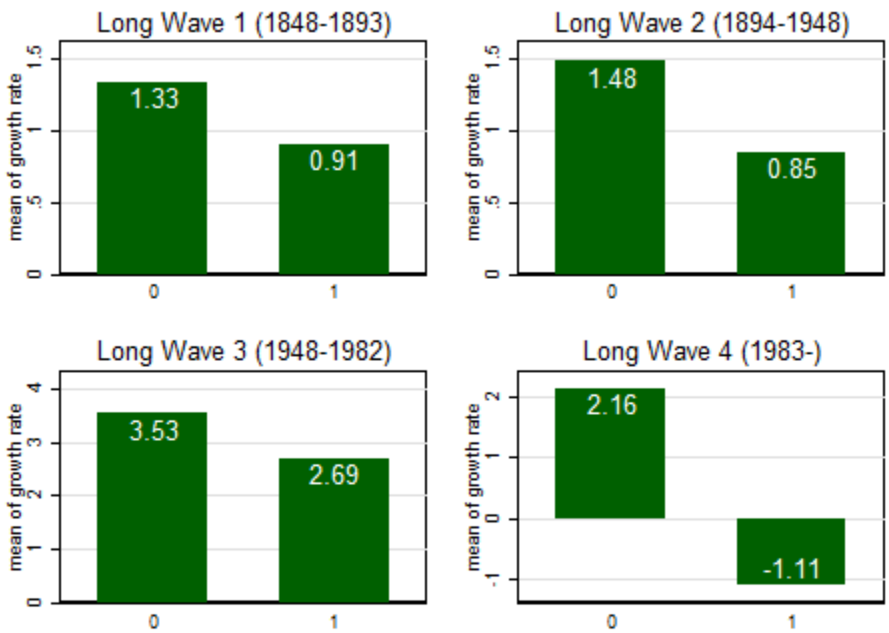

Figure 1: Mean of the growth rate of per capita real GDP in the upswing (denoted by 0) and downswing (denoted by 1) phases of the four long waves of capitalist development since 1848 for a sample of 20 advanced capitalist countries. For a list of the countries see Table 1.

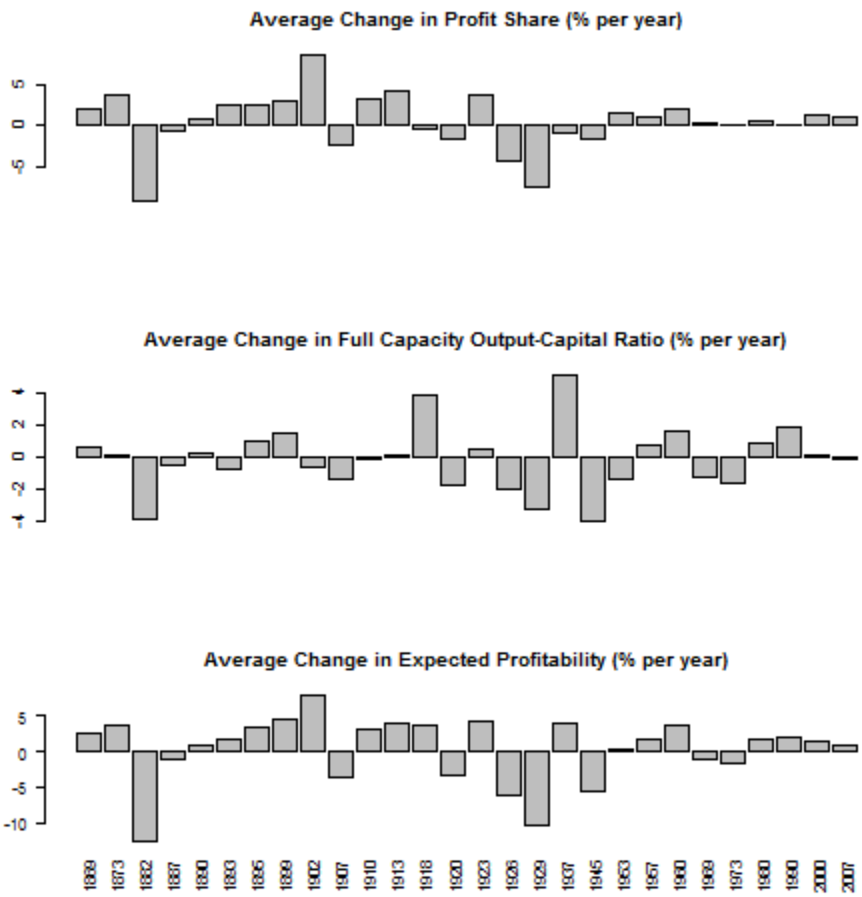

Figure 2: Average Annual Change in Profit Share (top), Full Capacity Output-Capital Ratio (middle) and Full-Capacity Profitability (bottom) during cyclical downturns in the US Economy, 1869-2010.

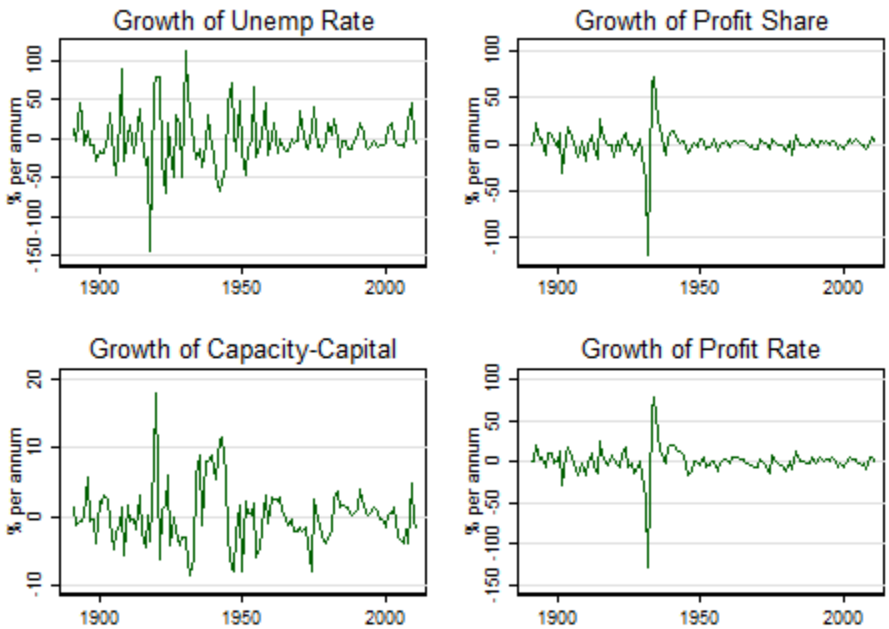

Figure 3: Time series plots of the growth rates of the unemployment rate, the profit share, the capacity-capital ratio and the full-capacity rate of profit.