PROFIT RATE DYNAMICS IN US MANUFACTURING

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Abstract

Profit rate convergence is an important feature of standard theory. However, its evidence base is weak. Its key propositions were tested for US manufacturing, 1985-2016. The findings demonstrate strong evidence of convergence, but weak inter-sectoral capital flows, and no diminishing returns. Considerable dispersion remained even after three decades of strong convergence, and this was symmetrical; macro shocks, such as the financial crisis, had only a transient impact. Four of the existing theories in the literature are found to be compatible with these findings, and a hypothesis is suggested that synthesizes them in a realistic manner.

Key words: Rate of return on capital, Profit rate, Convergence, Diminishing returns, Market power, Risk, Managerial capacity, Intangible assets, Entrepreneurial profit.

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I. Introduction

> "There is no more important proposition in economic theory than that, under competition, the rate of return on investment tends toward equality in all industries." George Stigler (1963, 54).

1.1. *The research problem*

Standard theory predicts that the profit rate has an inherent tendency to converge towards a single value. The mechanism is that capital flows preferentially towards more profitable uses. Diminishing returns then lowers the profit rate where capital has become abundant, and raises it where capital is scarce, leading to convergence. The tendency towards diminishing returns is generally regarded as axiomatic, and has been assumed in such classic contributions as the standard neoclassical theory of growth (Solow, 1956), and modern endogenous growth theory models (Romer, 1986; Aghion and Howitt, 1998) – in which spillovers are just sufficient to overcome diminishing returns. It is also the basis for the Lucas "puzzle" (Lucas, 1980).

However, the evidence base for the occurrence of profit rate convergence is weak. The classic major study that tested this hypothesis, covering the United States in 1938-1956, found that in fact the rate of return *diverged* (Stigler, 1963). Subsequent evidence on this has been mixed. Furthermore, empirical studies of the hypothesis of diminishing returns provide only mixed support in the context of physical production (Brue, 1993), and none at all when applied to capital in a financial sense (Nell and Thirlwall, 2017; 2018).

This paper presents tests of these hypotheses for US manufacturing in the period since the mid-1980s. In contrast with Stigler (1963), I find rather rapid convergence. Secondly, the flow of new capital towards (away from) relatively profitable (unprofitable) sectors, is found to be small. Thirdly, I find no evidence for diminishing returns. In addition, I examine the characteristics of the profit rate distribution, and find that they are incompatible with some of the classic hypotheses in the literature, at least in their original formulations.

The paper is structured as follows. After some initial methodological observations, I outline the patterns that would be predicted from standard neoclassical theory, and the main factors that could lead to deviations from these predictions, as well as Schumpeter's entrepreneurial theory.

I then analyze data on US manufacturing at industry level for 1985-2016. After describing the dataset, I present the observed distribution, and demonstrate appreciable symmetric dispersion throughout the period, but little skewness. I demonstrate a convergent trend, and estimate the speed of adjustment. I then examine the differential flow of new capital in each sector. Finally, I analyze the relationship of the profit rate to the capital stock.

I end by discussing the puzzle of substantial convergence but without its normally assumed mechanism, together with other empirical features that do not fit with the standard accounts, and generate a new hypothesis that is compatible with the data.

1.2. *Preliminary observations on methodology*

Firms assess the potential and the opportunity cost of investments according to their likely profitability, ex ante, often using such measures as the Internal Rate of Return (IRR) or the increase in Net Present Value (NPV). But it is difficult to obtain data that accurately reflect the ex-ante calculations of firms.

An alternative is to examine the achieved rate of return on capital, ex post, using available data on the operating surplus (total revenue minus total costs) and on the cost of investments. Although this may not reflect firms' ex-ante calculations with complete accuracy, it has the advantage that it reflects the objective reality of actual economic events, to the extent that the limitations of data quality allow. For example, it allows account to be taken of macro shocks such as the dot-com boom and crash, China's accession to the WTO and the financial crisis, the effects of which are unknowable to firms ex ante.

Such an analysis can be at industry or firm level. Each has its advantages and its limitations, so that a comprehensive analysis of the issue needs to include both. Firm-level analyses face the problem of firms' entry and exit, so that it is difficult to assemble a cohesive data series on the profits for each firm; in some cases, survivor bias can also be a serious issue (Cubbin and Geroski, 1987). On the other hand, many (although not all) of the causal forces operate at firm level, so that an industry-level analysis is an aggregation of the influence of the actions and fortunes of many firms, which could attenuate the results. A corollary is that it is more difficult to obtain robust findings.

In general, one would expect to find less dispersion at the industry level than the firm level, because of the within-industry heterogeneity of firms. However, a convergent trend would be visible at either level, because theory states that the tendency towards convergence

should be pervasive across the whole economy. A further possible issue is that the reclassification of a single large firm could temporarily distort the observed profit rates of the industries involved (Stigler, 1963).

The availability of data over this long time period, nationally representative of US manufacturing, is a key advantage of these analyses. It is possible to assess long-term trends in the profit rate and in its dispersion, the trajectories of each industry, patterns of capital flow between industries and the magnitude of diminishing returns, as well as to evaluate the effects of macro shocks. The paper therefore provides important evidence concerning this hitherto-neglected research area, and generates a more specific hypothesis that will be tested in the planned complementary analysis of firm-level data.

2. Predictions from Theory

2.1. *Standard Theory*

Profit rates across industries (and across firms) tend to converge to a single rate at any given time. Those with the higher rates of return should attract capital, and those with lower rates fail to attract it; this could be because capital is withdrawn from less profitable sectors and invested in more profitable ones, and/or because over a long period the amount of capital flowing towards failing industries dries up, while thriving sectors attract the available finance. This process ensures the allocation of capital to its most efficient uses across the economy.

Diminishing returns then ensures that the copious inflow to dynamic industries brings their profit rate down towards the average for the whole economy and *vice versa* for struggling industries. The economy thus moves towards an equilibrium with a single rate of return. At any given moment, the degree of dispersion may not be zero, because shocks may have caused them to diverge. These may be economy-wide macro shocks, such as a financial crisis, or they may be industry- or firm-specific innovations that affect profitability, e.g. via a change in costs, the introduction of a new and/or superior product, or an industry-specific tax. The overall picture is thus of an economy subject to alternation between shocks that generate divergence away from a uniform equilibrium profit rate, and forces that produce convergence towards it.

2.2. *Deviations from the Tendency to Convergence*

The observed behavior of an economy can deviate from this theoretical account, if the conditions assumed by standard theory are not met. These include a perfectly competitive market and the ability of capital to flow freely from a less profitable to a more profitable use, equal risk, identical technology and uniform ability to make it profitable. The assessment of such behavior may also be distorted by systematic errors in the measurement of capital expenditure and/or of its profitability.

(i) Market power. In standard theory, all firms in a perfectly competitive market earn zero economic profits, i.e. the observed accounting profit rate is equal to the currently-prevailing rate of return on capital. All firms are price takers, and there is free entry and exit, etc.

In practice, however, firms may well have some degree of market power, and therefore economic profit rates above zero. This could be due to barriers to entry and exit, collusion, economies of scale, sunk costs, etc. Market power would lead to a higher rate of return than obtains under perfect competition, which corresponds to zero market power. There is no equivalent force acting in the opposite direction, i.e. negative market power leading to a less-than-standard profit rate, so that the distribution of rates of return will have the standard rate of return as its lower bound, and is likely to be positively skewed.

(ii) Risk. In business as well as in finance, the degree of risk varies: the prospect of getting a return on one's investment is less certain in some sectors than others. In finance, a frequent definition of risk is the probability that an actual return on an investment will be lower than the expected return, possibly due to interest rate risk, exchange rate risk, liquidity risk, etc. A higher expected profit rate would thus be needed to induce the investment. This would imply a baseline of zero risk, plus a variable positive degree of risk, suggesting a profit rate distribution with the standard rate as lower bound, and likely positive skewness. However, other ways of thinking about risk are more symmetric, and they may be more realistic for a sector such as manufacturing (see below).

*(iii) Heterogeneity in managerial capacity or talent***.** In standard theory, identical technology across firms is often assumed, and this is taken to imply also a common cost structure as well as an exogenously given price, so that the rate of return is equal. In practice, however, substantial between-firm heterogeneity is observed in productivity growth

(Bartelsman and Doms, 2000) and in a large variety of other measures including efficiency, the degree of innovativeness and market performance; this is true even in the presence of the same input prices, and irrespective of the level of industry disaggregation (Dosi *et al*., 2015). The evidence also supports considerable heterogeneity in participation in export markets (Bernard *et al*., 2012; Melitz and Trefler, 2012). This can plausibly be attributed to variations in managerial capacity between firms (Penrose, 1959; Bloom *et al*., 2012).

It is less certain whether the same explanation applies to profit rate heterogeneity between industries. This would occur if there were a systematic tendency for some branches of manufacturing to attract and retain more competent entrepreneurs and managers. There is some evidence to suggest that this may be so, at least to some extent; for example, export propensity is associated with managerial competence (Driver and Temple, 2013).

*(iv) Neglect of intangible assets***.** Estimation of the rate of return on capital necessarily depends on the accurate measurement of the capital outlay. In principle, this could be either under- or over-estimated. In practice, the literature is silent on overestimation and focuses entirely on underestimation, specifically on the grounds that firms' expenditure includes items that contribute to future output and/or sales, but which are conventionally listed under current rather than capital spending. Such items are collectively grouped under the heading of intangible assets (Haskel and Westlake, 2017), and they include advertising, R&D (Megna and Mueller, 1991; Görzig and Gornig, 2013), and organizational capital (Görzig and Gornig, 2013), as well as software and intellectual property. Sometimes land, inventories and natural resources are also counted as part of intangible assets (OECD, 2001). Neglect of any or all of these understates the true capital expenditure, so the implication is that the *observed* rate of return is higher than is actually the case, i.e. skewed to the right.

A classic study was carried out by Megna and Mueller (1991): they investigated the neglect of R&D and advertising in the US (1967-1988), focusing on pharmaceuticals, distilled beverages, cosmetics and toys at the firm level. Inclusion of advertising spend in capital had little impact, either on the estimated rates of return or on the inter-industry differences. However, inclusion of R&D for pharmaceuticals substantially altered the estimated profit rate; despite this, the differences between the firms remained large. More recently, Görzig and Gornig (2013) have found that the observed (unadjusted) rate of return was reduced by about 20% in Germany 1999-2003, once they allowed for own-account production of ICT, R&D and organizational capital – in other words, after a proportion of specialized labor was reclassified as capital spending.

*(v) Inter-industry differences in monetary or non-monetary rewards***.** Another possibility is that compensating differentials affect the observed profit rate, either because the work is so unpleasant or hazardous that an additional monetary reward is required, or conversely that the experience of the work is sufficiently pleasant that lower remuneration is needed to attract people into that line of business (Stigler, 1963). However, this is probably not relevant in the present context. In manufacturing at least, the profit primarily accrues to firms, i.e. the employers, whereas it is the workers who would experience any unpleasantness or health risk, or conversely pleasure. Owners of coalmines are unlikely to develop silicosis or to be injured in underground accidents, and it also appears unlikely that the owners or managers of manufacturing firms vary greatly in the degree of pleasure they get from the particular branch of manufacturing that they happen to be in. Furthermore, even if such differences do exist, they are unlikely to vary significantly over time.

2.3. *Schumpeter's Theory of Entrepreneurial Profit*

According to Schumpeter, "Entrepreneurial profit is a surplus over costs", these costs being taken to include rent of the land needed for production, risk, and "an appropriate wage for labor performed by the entrepreneur" (Schumpeter, 1983, 128). Schumpeter contrasts this with circular flow, a static condition in which "the total receipts of a business – abstracting from monopoly – are just big enough to cover outlays"; "since the new combinations which are carried out if there is 'development' are necessarily more advantageous than the old, total receipts must in this case be greater than total costs" (*ibid*., 129).

In terms of the implied profit rate distribution, Schumpeter is here proposing a dualistic structure: the static part of the economy that has zero economic rent, i.e. equal to the standard rate of return, and the industries that have some degree of supra-normal profit. The implied distribution is therefore semi-continuous, with a spike at the standard rate of return plus a positive distribution. Statistically, this would also register as positive skewness rather than symmetric dispersion.

According to Schumpeter's theory, it is not essential that the identity of the industries characterized as "more advantageous" remain the same. They could vary over time, with specific industries having a static circular-flow nature with zero entrepreneurial profit at certain times, and a positive profit at others. The existence of a group of more dynamic

industries at each moment could be regarded as providing a divergent force in the profit rate distribution that counterbalances the prevailing tendency towards convergence.

2.4. *Additional Factors*

In his classic study, Stigler (1963) found that during the period 1938-1956, industry-level profit rates had tended to diverge rather than to converge as expected (see below). He suggested a number of possible explanations for this finding. These included some of the arguments already outlined above, as well as two possibilities that have not so far been considered here.

As already mentioned, standard theory regards capital as readily transferable from one activity to another. However, as Stigler pointed out, in practice capital assets are likely to have a degree of specialization and durability that impedes such mobility. Equalization of profit rates depends on the ability of agents to switch funds from one use to another. When the capital is embodied in a particular asset such as a piece of machinery or other equipment, the funds can no longer be switched rapidly without incurring costs (Stigler, 1963). This idea is now supported by evidence (e.g. Asplund, 2000).

Secondly, even when this is not the case, switching from an existing use to a more profitable one depends on the information available on the possible returns from an alternative investment. If this is imperfect, another rigidity is introduced (Stigler, 1963).

In addition, the patterns of depreciation and the importance of intellectual property may vary between industries, as may advantages or disadvantages in relation to tax. And different industries may be differentially impacted by changes in international trade flows and/or in tariff changes.

3. Literature

The analyses presented in this paper primarily relate to two literatures. There are empirical studies of profit rate convergence, in addition to standard theory; and there is a limited empirical literature on diminishing returns.

3.1. *Convergence*

There is a large literature, primarily within macroeconomics, that investigates the extent to which capital is allocated efficiently across the economy, and the economic impact of misallocation (e.g. Hsieh and Klenow, 2009; Eisfeldt and Shi, 2018). The starting point is that capital reallocation plays a central role in growth. The view has recently been proposed that in fact this role is small (Hsieh and Klenow, 2018), although an earlier version of this paper has been criticized (Haltiwanger, 2017).

The current paper takes a complementary approach, which is more direct in the sense that the analysis makes no assumptions about causal processes that may or may not be operating, and imposes little model structure. Instead, it directly investigates the profit rate at industry level, with a view to assessing what causal processes are compatible with the data.

The previous literature in this tradition is comparatively sparse. Much of the historical evidence is at the firm level. In many cases, the samples then available to the researchers constituted a relatively small and possibly unrepresentative sample of the economy.

The earliest analysis of US profit rates was at the industry level, and covered the period 1938-1956 (Stigler, 1963, 57-58). Greater dispersion was observed for 1947-56 than for 1938-47, indicating the occurrence of divergence rather than convergence, with a coefficient of variation of 21.9% and 31.5% in the earlier and later periods, respectively; this analysis was restricted to "unconcentrated" industries, but did not take account of barriers to entry. Stigler's interpretation was that the smaller dispersion in the earlier period could have been due to "extremely heavy corporate excess-profits taxation".

Qualls (1974) investigated the persistence of the gradient of rates across concentration classes, rather than the distribution of rates of return as such, for 1950-65. The aim was specifically to investigate the effect of market power and how it may change. He found that the concentration-related dispersion of the profit rate persisted.

Mueller (1977) found a considerable degree of movement in the ranking of firms' profit rates, using a firm-based sample for 1949-1972. Contrary to expectations, firms that started at the top or the bottom of the rankings were less likely to change position than those in the center of the distribution. Risk was considered not to explain the persistence of relatively high profit rates. It is unclear whether there was overall convergence or divergence.

A similar analysis was carried out by Connolly and Schwartz (1985) for 1963-1982. They confirmed the finding of persistence of the high rates, but indicated that firms with low profit rates tended to converge towards the average rate.

In a later analysis comparing 1964 and 1980 (Mueller, 1990), the degree of persistence of abnormal profit rates was observed to be much lower, although some persisting advantage in the top group (out of six) remained. Convergence had therefore occurred between these two periods. This contrast remained essentially unaltered when the comparison was confined to the 397 firms that were present in both samples, indicating that it was an actual change rather than an artefact of sample selection.

Similarly, convergence was observed at the industry level for 197 industries between 1963, 1967 and 1972 (Levy, 1987). The speed of convergence was quite fast when separate industry intercepts were included, but slow in their absence. Jacobsen (1988) also found convergence at the firm level, albeit relatively slow, in 1970-1983.

Overall, the differences in the findings could be due to the different methods used, or to differences in the details of the particular samples in each study – especially the firm-based analyses, in which the included firms might not be representative of the economy.

Alternatively, the differences may be real. There is a suggestion, albeit tentative given the methodological issues, that in the US there was divergence of profit rates between 1938-47 and 1947-56, relatively little change in the late 1950s and early 1960s, and then convergence starting sometime in the 1960s and continuing into the later period covered by the analyses presented in this paper.

3.2. *Diminishing Returns*

The law of diminishing returns has a venerable history, dating back to Turgot in the eighteenth century and to Ricardo and others in the early nineteenth century (Brue, 1993). It has been applied to two very different situations: in production, and in international comparisons of growth rates.

The classical descriptions focused on production, and relied on implicit *physical* properties. They were initially applied to the fertility of land. With a fixed quantity of land, the addition of increasing quantities of inputs, e.g. of labor and/or capital, was not followed by a proportionate increase in the yield. Many of these pioneering contributions were defined imprecisely and inconsistently, and "often confused average and marginal returns, homogeneous and heterogeneous inputs, short-run and long-run returns, and more" (Brue, 1993). In 1888, John Bates Clark extended this argument beyond agriculture, introducing the now-familiar concept of capital as a fixed factor of production, with labor as the sole variable

factor. Subsequently, the concept of diminishing returns in the context of physical production has become accepted as an axiom, even if the theoretical proofs of it have sometimes been unsatisfactory, and the empirical evidence for it is mixed, even in agriculture (Brue, 1993).

In the international context, diminishing returns no longer has its roots in a physical relationship, as with the addition of more labor or more fertilizer to an existing plot of land. Rather, the concept of capital is broader, and different types of capital goods are mutually substitutable, allowing them to be aggregated at national level. This plays a central role in the canonical Solow neoclassical growth model, and underlies its prediction that relatively poor countries with low capital endowments are destined to grow faster than rich countries with abundant capital, other things being equal. An implication is that whatever the original level of capital in an economy, it will tend to revert to the equilibrium levels of output and capital indicated by the economy's underlying features.

There is some informal evidence, albeit patchy, for this idea. The rapid postwar recovery of Germany and Japan is sometimes cited as indicating that the destruction of their capital stock did not greatly affect their long-term growth trajectory. However, apart from the charge of possible cherry picking, other explanations are possible for this observation, including the "advantage of backwardness" idea that they were able to rebuild with modern technology, an advantage at a time of rapid change. A more granular example is that the more heavily-bombed regions of Vietnam in the late 1960s and early 1970s were not more likely to be disadvantaged when assessed decades later in 2002 (Miguel and Roland, 2011).

The repeated finding in cross-country growth regressions of a negative coefficient on initial income levels is often taken as conditional convergence, and therefore a confirmation of the Solow model. However, it is equally likely to result from a catch-up effect, e.g. from the adoption of technology from abroad (Benhabib and Spiegel, 1994). Nell and Thirlwall (2017; 2018) have directly estimated the productivity of investment for 84 rich and poor countries over the period 1980–2011, as the ratio of long-run GDP growth to a country's gross investment ratio, enabling them to distinguish these two possibilities. They found no significant evidence of diminishing returns.

4. Data

Data were obtained from the Bureau of Economic Analysis (BEA, n.d.). Gross operating surplus (GOS) was derived from the table of the components of value added by industry, for 1987-2015. These data do not take account of depreciation, tax, etc. Table 3.3ESI provided the net stock of private fixed assets by industry for 1986-2014, at historical cost. These are year-end estimates of the running total of investments, net of depreciation. Table 3.7ESI provided data on investment in private fixed assets by industry for 1985-2016. These data are classified in 62 sectors; the 19 manufacturing sectors are the focus of the present study. See the data appendix for further details.

The categories used in compiling the data do not necessarily correspond perfectly with standard theory, which involves theoretical concepts appropriate to its own domain (Stigler, 1963). The issues include the deviation of historical and replacement costs; the impact of high inflation on the historic cost of capital, with older assets being less expensive in nominal terms and therefore artificially associated with a higher rate of return; the omission of the "wages" of the owners of small businesses, in sectors where such firms are predominant; and the omission of noncorporate businesses from the data. Depreciation is likely to have varied between industries and over time. The same is true of taxation. These are likely to have introduced non-differential measurement error. Furthermore, there are controversies over the correct calculation of capital and land, and over the measurement of goodwill and whether it is depreciated. To the extent that these generate non-differential measurement error bias, they would have a diluting effect, making it more difficult to obtain clear-cut findings. Nevertheless, these imperfections mean that findings should be regarded as provisional until confirmed by further research.

The analysis covered manufacturing only. Additional issues would arise if services were included. For example, inspection of the data revealed that Legal services had profit rates in the range 271.6 to 376.0%, far in excess of any manufacturing sector. Other service sectors with notably high rates included Funds, trusts and other financial vehicles, and Administrative and support services. The inclusion of services would clearly add extra sources of heterogeneity, making interpretation difficult.

5. The Range of Observations and their Implications for Theory

The data allow the following types of observation to be made. These can be used to evaluate each of the theoretical propositions outlined above, from an empirical viewpoint.

(a) The profit rate distribution. According to pure theory, at equilibrium there should be a single economy-wide rate of return on capital, with minimal dispersion. In practice, however, as mentioned above, it is likely that deviations would be observed, due to factors described in sections 2.2 (i) through 2.2 (v) and to entrepreneurial profit. In addition, shocks could lead to further divergence, temporarily at least.

The most informative measures are the standard deviation/variance/coefficient of variation and the skewness of the profit rate distribution. It is not possible to use these to distinguish the different explanations, except that some of the theoretical propositions might be expected to correspond more to symmetric dispersion or to skewness, as previously noted.

In addition, measurement error can occur giving the false impression of dispersion. If non-differential, the resulting dispersion would be symmetric.

(b) Industry-specific movements. As part of the examination of heterogeneity, it is possible to observe the trajectories of each industry over time. This could provide some preliminary indication that industry-specific shocks are present. However, additional information would be needed to illuminate the nature of any such shock. This complementary evidence could be quantitative and/or qualitative.

In addition, the pattern of industry-specific movements could provide some information relevant to the possible hypotheses outlined earlier. For example, some of them might be expected to produce differences in profit rates that vary little over time, including Inter-industry differences in monetary or non-monetary rewards.

(c) Impact of macro shocks. Due to the panel structure of the dataset, the effects of macro-level shocks would be visible as a change in dispersion following a known macroeconomic event, after a suitable lag period. During the period covered by this dataset, the obvious candidates are the dot-com bubble and crash at the turn of the century, China's accession to the WTO in 2001 and the accompanying change in US trade policy (Pierce and Schott, 2016), and the financial crisis of 2007-08, plus possibly also NAFTA, which came into force in 1995.

(d) Convergence. It is possible to test both for σ- and β- convergence using these data, by analogy with the literature on economic growth.[1] Here, σ denotes the standard deviation of

[1] If measurement error changed over time, e.g. if assessment techniques have improved, this could affect the estimates of convergence. This is unlikely to be of major importance.

the rates of return, and β indicates the regression coefficient when the profit rate is regressed on its lagged value.

(e) Response of investment to the profit rate. By regressing the quantity of investment on the lagged profit rate, the magnitude of inter-industry flows can be assessed. This provides an indication of the degree of fluidity (interchangeability) of items of capital between sectors.

(f) Impact of the quantity of capital on its rate of return. Similarly, the rate of return can be regressed on the lagged quantity of capital. This gives information on the presence of diminishing returns.

6. The Observed Profit Rate Distribution

The rate of return is calculated as the Gross Operating Surplus for each sector in each year, divided by the Fixed Assets for the previous year, expressed as a percentage. A lag is appropriate because the profit is realized after the investment has been made. The results presented here are for a one-year lag. Sensitivity analyses (not presented) show that the use of other lag structures, e.g. the average of three or five years, makes little difference. In addition, the use of a one-year lag enables a longer time series to be included.

In order to visualize the distribution of the rates of return, the data for all years, as well as for all sectors, were pooled. With more than 500 observations, a stable distribution was thus obtained, which can be characterized quite precisely.

The mean profit rate was estimated as 38.7%, with a median of 35.9% (Figure 1, panel (a)). This difference suggests right-skewness, which is confirmed by a skewness statistic of 2.2. The standard deviation was 18.9%, and the coefficient of variation was 0.49. The kurtosis was 8.5. The number of observations lying outside the range 25 to 50% was 198 (35.9%).

FIGURE 1 ABOUT HERE

Inspection of the time course for each of the sectors indicated that one particular sector, Petroleum and coal products, was an extreme outlier (see section 7.1). After exclusion of this sector, the distribution appeared more symmetrical (Figure 1, panel (b)): the mean was now estimated as 36.6%, with the median little changed at 35.2%. The skewness was now

only 0.9. The standard deviation was 14.5% and the coefficient of variation 0.40. The kurtosis was now down to 1.7. The number of observations lying outside the range 25 to 50% was 178 (34.1%).

7. Profit Rate Movements Over Time

7.1. *Descriptive Statistics*

The evolution of the profit rate for all manufacturing sectors is shown in figure 2 (a). The most striking feature is that one sector, Petroleum and coal products, is very different from all the other sectors: from early in the twenty-first century, its profits rose sharply to a level quite outside the range of the other sectors, reaching 158.6% in 2005 and staying above 80% for the succeeding ten years.

FIGURE 2 ABOUT HERE

It is therefore prudent to examine the behavior of the profit rate after excluding this outlying sector. The sensitivity of the analysis of convergence to such a course of action was assessed by repeating the analysis after sequential removal of each of the next most profitable three sectors (Apparel and leather and allied products; Furniture and related products; Food and beverage and tobacco products). Only the exclusion of Petroleum and coal products had a major impact on the findings (details available on request).

The profit rates for all the remaining sectors are shown in figure 2 (b). Considerable dispersion is visible, especially in the period up to the year 2000. The visual impression is that the degree of dispersion diminishes over time. The mean rate of return also appears to fall slightly, although this impression is due to supra-normal profits in two sectors during the early part of the period covered.

The position of individual industries is subject to considerable variation. Apparel and leather and allied products starts with the highest rate, but declines in the second half of the 1990s and the 2000s, ending with the lowest rate. Furniture and related products starts high, plunges to mid-range after 2006, then rises again in the 2010s. At the other end, Primary metals starts with the lowest profit rate and stays low, apart from a surge in 2004 through

2008. In general, sharp year-to-year volatility is not a dominant feature; rather, industries tend to maintain their relative position for several years, or even a decade or more, often without any obvious reason for this, e.g. a technical change or a new product.

The impact of the financial crisis is clearly evident, with a large dispersion in 2009 – although most industries do not show any obvious effect. Remarkably, the recovery is immediate: by 2010 the degree of dispersion visible is no longer increased. This is statistically confirmed by the variance returning to within the normal range. No other macro shocks are clearly visible, e.g. of NAFTA, the dot-com boom and crash, or China's accession to the WTO.

7.2. *σ-convergence*

Figure 3 shows the evolution of the variance over time. In panel (a), there is a large departure from the previous range of values, starting in 2003. The regression line shows an upward trend. After exclusion of the Petroleum and coal products sector (panel (b)), a much lower degree of volatility is observed, and a clearly downward trend over time. Thus, the impression of convergence from figure 2 (b) is confirmed. Again, the impact of the financial crisis is visible in 2009, and by 2010 the variance of profit rates is down to just below the regression line. If the regression line is extrapolated into the future, i.e. assuming the current trend continues and no shocks occur, the variance is predicted to reach zero in mid-2022.

FIGURE 3 ABOUT HERE

The speed of convergence, while large, was not observed to have brought about a single rate of return on capital across all of manufacturing. At the end of the study period, the rates still varied from 17.0% (Apparel and leather and allied products) to 51.6% (Food and beverage and tobacco products) – even without the Petroleum and coal products sector, which was over 80%. Also, it would be expected that firm-level dispersion would be greater than industry-level dispersion.

7.3. *β-convergence*

Beta-convergence implies that the change in profit rate in a particular year is a negative function of the level in the previous year. A relatively high rate will tend to be followed by a fall, and a low rate will be followed by a rise. This can be expressed in the following equation, in which a negative value of β^C indicates convergence.

$$\Delta R = R_{it} - R_{i,\,t-1} = \alpha^C{}_t + \beta^C{}_t R_{i,\,t-1} + \gamma^C X_{it} + \epsilon^C{}_{it} \qquad (1)$$

where R is the rate of return on capital, and X is a vector of covariates; α^C, β^C and γ^C are parameters to be estimated, and ϵ^C is the error term.

This can be rearranged as

$$R_{it} = \alpha^C{}_t + (1 + \beta^C{}_t) R_{i,\,t-1} + \gamma^C X_{it} + \epsilon^C{}_{it} \qquad (2)$$

Convergence could be to a common rate, or to a sector-specific rate. Accordingly, this equation was estimated using both Ordinary Least Squares and Fixed Effects regression. This approach follows the method of panel convergence used in the literature on economic growth. Robust standard errors were used for all regression analyses. The results are shown in Table 1 (a) for all sectors, and Table 1 (b) after exclusion of Petroleum and coal products.

TABLE 1 ABOUT HERE

Both tables show highly significant β-convergence. Focusing on table 1 (b), the rate of convergence is 9.9% (100*(1 – 0.901)) for OLS, and 15.5% (100*(1 – 0.845)) for FE. When individual-sector intercepts were included in the FE regression (data not shown), the robust test using Welch's F-statistic was far from significant, with p=0.80. The time variation was not large, with only 5 out of 27 years being significantly different at the 5% level; addition of the two largest deviations, 2002 and 2009, as dummy variables scarcely altered the main findings. When the average profit rate was added in addition, the estimate of β^C in the OLS regression was 10.9% (95% CI 7.2, 14.6), and that in the FE regression was 18.2 % (95% CI 5.3, 31.1). Convergence to the all-manufacturing mean rate was 14.9% (95% CI 2.2, 27.6) for the OLS analysis, and 25.3% (95% CI 10.6, 40.0) for the Fixed Effects analysis.

The results when all sectors were included (table 1 (a)) were similar: the estimates of β^C were respectively 7.4 and 14.9% for OLS and FE, and Welch's F-statistic gave a value of

p=0.97. With addition of the average profit rate, the estimates of β^C scarcely altered to 7.7 and 15.7%. The estimate of the magnitude of convergence to the all-manufacturing mean rate was similar to that obtained when the Petroleum and coal products sector was omitted, but the standard error was far higher, so that in this case it was not significant.

The Schwarz criterion, with Petroleum and coal products excluded, was 3189.263 for the pooled OLS regression, 3277.708 for the FE regression, and 3373.589 for the FE regression when time dummies were included. This clearly indicates that the OLS regression is the preferred analysis. It means that the sectors are all converging to a single common rate of return, not a sector-specific rate. Taking column 4 of Table 1 (b) as the definitive analysis, this common rate of return is given by $\alpha^C/(1 - \beta^C) = 3.791/(1 - 0.898) = 37.2\%$.

8. Response of Investment to the Profit Rate

A standard proposition in economic theory is that investment should flow towards the more profitable sectors (and firms), and away from those that are less profitable. This can be expressed in the following equation, in which the proportional change in investment depends on the rate of return in the previous year:

$$\Delta I / I_{i,t-1} = (I_{it} - I_{i,t-1}) / I_{i,t-1} = \alpha^R_t + \beta^R_t R_{i,\,t-1} + \gamma^R X_{it} + \epsilon^R_{it} \qquad (3)$$

(where I is investment in private fixed assets)

The findings are shown in table 2. The estimate of the coefficient is 0.0011 for the whole sample. After exclusion of the Petroleum and coal products sector, the coefficient is 0.0012 for the whole sample, both with and without the dummies for 2002 and 2009. This means that for a 1% change in profit rate, e.g. from 38.0% to 39.0%, the percentage change in investment is 0.12% (95% CI 0.06, 0.18).

TABLE 2 ABOUT HERE

An alternative specification, regressing the log of investment on the log of the lagged profit rate, was also estimated. The results were not statistically significant, with p=0.385 for

the whole sample, and p=0.547 after the Petroleum and coal products sector had been excluded.

In addition, a more disaggregated set of regression analyses was carried out to show the response of investment to the profit rate in different sectors for each year (Table 3). The findings fluctuate markedly from year to year. The expected positive relationship is seen slightly more often (15) than a negative one (13). Positive coefficients greater than 0.2 are more frequent (8) than negative ones less than –0.2 (2). There is no obvious clustering of years with respect to the direction of flows, nor any obvious impact of major macro events such as NAFTA, the dot-com bubble and crash, China's accession to the WTO, or the financial crisis and ensuing great recession. One can therefore say that investment is attracted to the more profitable sectors, but only in an irregular fashion. Clearly other causes are operating as well.

TABLE 3 ABOUT HERE

Table 4 shows the response of investment to the previous year's rate of return, separately for each sector across the whole period of study. Almost all the coefficients are positive, some strongly so. Only four sectors had negative coefficients, with substantially negative values for Food and beverage and tobacco products, and for Printing and related support activities. Within most sectors, therefore, a higher profit tends to be followed by more investment in the following year.

TABLE 4 ABOUT HERE

9. Impact of the Quantity of Capital on its Rate of Return

Standard theory proposes that as more capital accumulates, its rate of return will inevitably decrease – the hypothesis of diminishing returns. The magnitude of this effect can be estimated as a regression of the profit rate on the lagged quantity of capital:

$$R_{it} = \alpha^I_t + \beta^I_t K_{i,\,t-1} + \gamma^I X_{it} + \epsilon^I_{it} \qquad (4)$$

(where K is fixed assets)

The regression coefficient was found to have the expected negative sign, but it was not significant and its magnitude was small (Table 5). Excluding the Petroleum and coal products sector, in which the very high profit in the latter part of the period may have diluted the effect, the largest estimate (without the year dummies for 2002 and 2009) was that for each billion dollars invested, the rate of return decreases by 0.0081% (95% CI –0.0400, +0.0239). It is essentially zero.

TABLE 5 ABOUT HERE

10. Discussion

The analyses reported in this paper were designed to test one of the core propositions of standard theory. The analysis of profit rate convergence clearly vindicated this aspect of theory. However, this finding raises more questions than it answers. How could it have occurred when the mechanism, involving a combination of capital flows and diminishing returns, was apparently not operating? – what other forces could bring about convergence? Why is so much dispersion observed, at the end of the study period and especially at its start? And why is this symmetrical rather than skewed? An attempt at answering these questions is attempted in this Discussion section, but this should be regarded as a hypothesis that requires further research.

In contrast with some of the early literature on the topic, no assumption was made concerning the predominant causal factor that might explain any observed dispersion or asymmetry in the profit rate distribution, such as market power. Rather, the approach taken here emphasizes that multiple causal processes may be operating, seeking to document what has actually occurred before attempting to attribute the findings to specific causes.

The dataset covers the years from 1987 to 2015. This is a sufficiently long period to allay the worry that the findings could be distorted by business-cycle fluctuations. It also covers the dot-com bubble/crash and China's accession to the WTO, as well as the financial crisis. Their effects were detectable in the econometric analysis; inclusion of the relevant year dummies did not affect the main findings, and the disturbances attributable to these events were remarkably transient. In fact, the major time-related disturbing factor was the trajectory

of the profit rate of the Petroleum and coal products sector in the second part of the period covered (which could easily have been missed if the sector-specific time series had not been visualized). This was presumably due to specific factors affecting that sector, e.g. relating to changes in the global oil price and/or to changes in imports to the US. Its exclusion altered the findings on σ-convergence and on skewness, but not on β-convergence, response of investment to the profit rate, or diminishing returns.

The analyses presented here were restricted to manufacturing. Similar analyses could be carried out for services. However, as mentioned above, inspection of the profit rates in these sectors raised the issue that for some of them at least, additional factors would need to be considered. In the case of such sectors as Legal services, it is likely that capital in the usual sense plays a rather minor role in their cost structure, which is primarily driven by expertise (Biery, 2015), undermining the use of fixed assets as the (sole) denominator. In addition, small service firms often rent the capital necessary for production, rather than purchasing capital goods. These expenditures are counted as intermediate consumption in the firm's accounting system (Görzig and Gornig, 2013).

The disadvantages of a crude measure such as gross operating surplus (GOS) are well known. It is a measure of the accounting rate of return, rather than the economic concept which focuses on the difference between that and the normal profit rate that prevails at any one time. In addition, the Internal Rate of Return (IRR) is generally regarded as the concept that best corresponds to economic theory.

Accounting data can certainly be seriously in error when used to assess the return on an individual investment initiative by a particular firm, due to the time patterns in the returns to investment and in the depreciation schedule, and to inflation (Fisher and McGowan, 1983). Such problems would tend to even out in the context of the present sector-level analysis and long timespan. In the current context, the main problem with the use of accounting data is that conservative accounting conventions tend to lead to the measured value understating the present value of future profits. The resulting bias would mean that high (low) measured rates are overvalued (undervalued), which could at least partly explain the persistence of dispersion (Mueller, 1990, 9-10). This implies that the present finding of substantial convergence is, if anything, underestimated.

In addition, non-differential measurement error occurs due to year-to-year variation in the relationship between the growth rates of the measured capital stock and of the present value of future profits (Mueller, 1990, 9). Such non-differential error would lead to

attenuation of the findings on convergence, implying that the clear convergence reported in this paper would have been even more marked if a more accurate measure had been used.

On the other hand, if the measure of GOS used here is subject to unrecognized sources of *systematic* bias, this would be unlikely to explain the observed convergent trend, because it would imply a sharp trend *in the sources of bias*. More likely is that the degree of bias in the profit rate estimates is relatively constant, and that the trend corresponds to an actual change in the economy.

10.1. *Convergence*

The findings on convergence were quite clear-cut, once the Petroleum and coal products sector was excluded. Both σ- and β-convergence were observed. The magnitude of σ-convergence was somewhat dependent on the composition of the sample, in that sequential omission of the most profitable sectors altered the estimate of the rate of change of σ, but this procedure did not change its sign. The analysis of β-convergence indicated that the sectors are all converging to a single common rate of return of approximately 37.2%.

The standard account of the *mechanism* of convergence is that capital migrates from less profitable to more profitable sectors. As Stigler said (1963, 54): “Entrepreneurs will seek to leave relatively unprofitable industries and enter relatively profitable industries, and with competition there will be neither public nor private barriers to these movements.” … [without this] “the immobility of resources would lead to catastrophic inefficiency”. However, the analysis presented above showed that this effect was weak: entrepreneurs apparently stick to the line of business that suits their expertise, even if this means accepting a lower rate of return; and financial capital follows profitability only to a limited extent, possibly indicating the major role of retained profits in investment (O’Sullivan, 2007). Furthermore, diminishing returns was not observed.

The observation of convergence without its postulated mechanism presents a puzzle. Inspection of figure 2 (b) suggests that a small number of industries have had supra-normal profits in the past, lasting approximately a decade, but this effect had disappeared by 2015. It is unclear why they should have had this apparent advantage (if it is not due to measurement issues), and equally unclear why it has disappeared; industry-specific evidence of a complementary nature, quantitative and/or qualitative, could illuminate this issue.

Despite the apparently strong convergent tendency, the ratio between the highest and lowest sectors was still greater than 3-fold at the end of the study period, even after the exclusion of the Petroleum and coal products sector. A 29-year period of rather rapid convergence has still left a substantial degree of variation. It remains to be seen whether or not the convergent tendency will continue into the future. The causes of the persistent wide distribution are discussed in section 10.3.

10.2. *Was Convergence a Response to Shocks?*

According to standard theory, convergent forces act on the degree of dispersion brought about by shocks. These could be at macro or micro (e.g. industry or firm) level. It is highly unlikely that the convergence observed here was a response to a macro shock. The impact of the 2007-08 financial crisis was clearly evident in the dispersion of profit rates in 2009, but its effect had completely disappeared by 2010. No other macro shock is a credible candidate for this time period.

More plausible is that industry- and firm- specific shocks are continually occurring. These must have been quite considerable to have brought about the degree of dispersion observed at the start of the study period.

This raises the question of the trajectory of profit rates before the study period started. If the observed convergence rate were a permanent feature of the US economy, a simple extrapolation backwards in time would be appropriate. This would suggest that the dispersion in, say, the mid-twentieth century or earlier was even more extreme than the more than 5-fold ratio observed in 1987, which appears to be unlikely. And if one followed the same trend backwards in time, still wider dispersion would have to have been present.

The question can be explored by examination of the previous empirical literature. In principle, if the studies of earlier periods had used comparable data and methods, it would have been possible to have a consistent analysis over a much longer timespan. Unfortunately, this was not the case in the literature reviewed in section 3.1. In fact, a number of different approaches were used, so that direct comparability between those studies is also not achievable, apart from the internationally comparable studies reported in Mueller (1990). As argued above, the evidence tentatively suggests divergence in the mid twentieth century, a short period of stability, and then convergence starting in the 1960s.

If true, such a pattern could be explained either by endogenous factors, e.g. the increased importance of intangibles, or alternatively long cycles, or by changes in the structure or the environment of the US manufacturing sectors. Taking these in reverse order, the environmental factors could include the increased global competition that occurred during this period, although that appears unlikely because many of the sectors do not involve internationally traded goods. The period of convergence coincides with the technological revolution accompanying the rise of information and communications technology, but there is no obvious reason why this would have caused profit rate convergence across manufacturing sectors that had previously been absent. It is true that it might possibly have facilitated better knowledge of the available investment opportunities, and therefore increased the extent of switching between sectors in pursuit of higher profits, but the analysis of the response of investment to the profit rate (section 8) did not suggest that this process was of sufficient magnitude. Macroeconomic conditions could be relevant, although their nature is hard to discern, given that a major macro shock, the financial crisis, was observed to have an impact that only lasted one year. The oil shock of the early 1970s appears to have occurred after the shift from persistence to convergence began.

Structural factors could have changed over time. Convergence could occur because it became more difficult to maintain market power, but this would require a decrease in the extent of concentration, or lower capital needs, or decreased importance of economies of scale. These appear unlikely, especially as there is some evidence of increasing market power since 1950 (De Loecker and Eeckhout, 2017).[2] In any case, the extent of churning – movement of particular sectors between higher and lower parts of the distribution, as seen in figure 2 – suggests that structural factors are either less important or less stable than is often thought. Market power therefore appears not to have played a major role in bringing about the observed profit rate distribution.

[2] Consistency with the findings of De Loecker and Eeckhout would be possible, if inequalities *between industries* have been (partly) replaced by inequalities *between firms but within industries*. One possibility is that one or more firms within each industry produce higher-end goods, e.g. luxury goods, targeted at less price-sensitive customers. They could therefore maintain higher margins and use their profits to fund product development, marketing, etc, thus consolidating their advantageous position. This suggestion is also consistent with the previous empirical literature on firm-level profit rate convergence, which found persistence mainly at the higher rates of profit (section 3.1).

It is generally agreed that the importance of intangible capital has increased over time. The quantity of capital would therefore be increasingly underestimated, and the measured profit rate should therefore have increased over time. This is not what is observed. Moreover, the industries that were found to have periods of relatively high rates of return (apart from Petroleum and coal products) were Apparel and leather and allied products, Furniture and related products, and Food and beverage and tobacco products. These industries do not have high levels of intangible assets, apart from advertising.

If the alternation of periods of divergence and convergence is a true reflection of the actual movement of historic US profit rates, this could be compatible with the existence of long cycles, e.g. Kondratieff waves (Korotayev and Tsirel, 2010). However, this does not appear to be likely, because the early part of "post-Kondratieff wave 4" coincided with the *divergence* of profit rates observed by Stigler, whereas the early part of "post-Kondratieff wave 5" coincided with the rapid *convergence* found in the present analysis.

Alternatively, it could be that it is the divergence and/or lack of convergence earlier in the twentieth century that should be the focus of any attempt at explanation. This would be the implication of the theoretical assumption that profit rates have an inherent tendency to converge towards a single rate of return. Stigler's suggestion of the influence of the tax regime is possible, but there is no specific evidence for it. Possibly more likely is that industry- or firm-specific shocks were more frequent and/or larger during this earlier period. This was the Golden Age of American manufacturing, and the patchy nature of dynamism could have been accompanied by stronger divergent forces.

10.3. *The Form of the Dispersion*

The observed distribution of the rate of return showed a substantial degree of dispersion. More than a third of observations lay outside the two-fold range of 25 to 50%, even at the end of the observed period of convergence, whether or not the Petroleum and coal products sector was excluded. While the shortcomings of GOS plus measurement error could have played a role here, it is highly unlikely that they are mainly responsible for this observation. The extent of this dispersion may appear to conflict with the expectations of standard theory. However, it is not surprising in empirical terms, because a considerable degree of heterogeneity is consistently found in a range of attributes of firms, such as growth rates and

productivity (e.g. Davis *et al*., 1996; Bartelsman and Doms, 2000; Foster *et al*., 2008; Dosi *et al*., 2012; Dosi *et al*., 2015; Decker *et al*., 2016; Foster *et al*., 2017).

With all manufacturing sectors included, a substantial positive skew was observed, with a skewness equal to 2.2. However, figure 2 (a) strongly suggests that the Petroleum and coal products sector should be excluded, as its magnitude and trajectory are clearly anomalous in a way that is not true of any of the other sectors. After its exclusion, the profit rate distribution is far more symmetric, the skewness now being only 0.9.

This rather symmetric dispersion is intriguing in the light of the major factors that could affect the rate of return, especially in some of the classic accounts. Standard theory views market power as a factor that can increase the profit rate above the baseline of the competitive market. Some accounts of risk also imply that it raises the required rate of return in an asymmetric fashion. Intangible assets imply that the capital stock is undervalued, and therefore that the *observed* profit rate is biased upwards (although this depends on the growth rate of the hidden capital being below the market return rate on capital (Gornig *et al*., 2014)). Schumpeter's view of entrepreneurial profits similarly postulated a baseline ("circular flow") plus some positive returns in successful new sectors. These four accounts all imply that the distribution should be positively skewed, but not that it should show substantial symmetric dispersion.

One possibility is that the classic accounts do not provide the best expression of the underlying ideas. In the case of risk, an alternative conception is simply that types of business differ in their reliability, so their rates of return vary in their degree of predictability. This would generate a more symmetric dispersion of the profit rate distribution. It is possible that the measurement of capital due to the neglect of intangibles can be biased upwards as well as downwards, although it is not obvious how this could come about. And the idea of entrepreneurial profit could readily be formulated not as an excess over a normal rate, but rather in terms of varying success, which could well be symmetric (see below).

Another possibility is that the baseline rate may actually be substantially lower than the observed mean, and that the observed distribution is in fact a distribution of the magnitude of market power, risk, bias due to omission of intangible assets and/or entrepreneurial profit. However, inspection of figure 2 indicates that this explanation is unlikely: the relative positions of the different sectors change markedly over time – e.g. Apparel and leather products has the highest rate of return until 1995, but among the lowest from 2003. This changing of relative positions is unlikely to be due to concomitant variation

in the degree either of market power or of intangible assets, which would not be expected to change so rapidly. Entrepreneurial profit could well change rapidly, although it is notable that this industry would be hard to characterize as "more advantageous" in the sense of being innovative, as Schumpeter specified. Similar remarks apply to other industries that show considerable movement such as Furniture and related products, or Electrical equipment, appliances, and components – these would appear to be mature industries that were not subject to major innovations during this period.

Of the other factors listed in section 2, it is implausible that inter-industry differences in monetary or non-monetary rewards can explain the wide profit rate distribution, given the distinct roles of workers and employers, as previously argued. Heterogeneity in managerial capacity or talent could well be a factor explaining the different profit rates, although such an effect is likely to be weaker at the industry, as contrasted with the firm, level.

10.4. *Diminishing Returns*

In the context of the present analysis, the focus is on diminishing returns to the accumulation of capital at the industry level. Similar issues would arise at the firm level. As with the international context, this involves the broad rather than the physical sense of "capital": investment takes a physical form, but it would be funded from retained profits and/or from e.g. loans or equity. This means that at the time the investment decision is being made, it is an essentially financial concept. Diminishing returns would imply that a high level of profits leading to the accumulation of more capital would be followed by a lower rate of return, but this is not observed.[3]

One possibility is that diminishing returns would have occurred, if it were not for the actions of firms that oppose this tendency. The implication would be that the consequences of these actions are almost exactly equal to the magnitude of the underlying tendency to diminishing returns, so that they cancel out. Another possibility is that there is no such underlying tendency to diminishing returns. Further research on this topic is needed.

[3] The distinction between the financial and the physical meanings of "capital" is important also in relation to the movement of capital between industries. For example, Stigler (1963) argued that the durability and degree of specialization of capital assets would impede the free inter-industry flows assumed by standard theory. He used this to explain why convergence was not observed in his study.

11. Conclusion

The analyses presented here provide a foundation for further empirical work on this hitherto neglected area. The same approach could readily be adapted for use at firm level, and applied to other countries.

The observation of a marked degree of profit rate convergence is in line with theoretical expectations. However other features of the evidence suggest that certain aspects of standard theory need to be reconsidered.

The hypotheses that remain compatible with the evidence presented in this paper are managerial capacity, risk, (reformulated) entrepreneurial profit, and industry- or firm-specific shocks. These ideas can be combined into the following account. Firms take initiatives. Their quality depends on the degree of managerial ability. But their achieved outcome, in terms of the rate of return, is not guaranteed, because the initiative is taken under conditions of risk (or perhaps more likely, Knightian uncertainty). In practice, attempts at innovation vary greatly in their degree of success: many fail altogether, and the rate of return even among those that survive can be lower than the prevailing rate as well as above it. There is thus a broad range of possible outcomes in terms of the profitability of the entrepreneurial initiatives. These can be described as firm-specific shocks, or in the case of the present analysis, an aggregated industry-specific version. However, it may be misleading to refer to these as "shocks", as if they were generated from outside the system. This is because they result from firms following the clear incentive structure present in the modern capitalist economy (Joffe 2015; 2020).

This interpretation implies that success in business involves the degree of efficacy or relative strength of entrepreneurs, directors and managers – their ability to bring something about. This is one meaning of the word "power", with the implication that market power is not the only type of power that is relevant to the profit rate. The existence of positive (negative) profit above (below) the standard rate of return indicates a relatively high (low) level of entrepreneurial and/or management ability involved in taking previous investment initiatives; or more accurately, the degree of success in making a profit reflects (albeit imperfectly) the quality of the business plan as manifest in the investments made – ex ante strength. In addition, achieved profit can be regarded as a source of ex post strength, as it

provides the resources that can be used to fund future investment, or for other expenditure that is intended to improve the future position of the firm.

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Table 1 (a)

The Response of the Change in Profit Rate to the Lagged Value of the Profit Rate, All Manufacturing Sectors

	OLS (1)	FE (2)	OLS (3)	FE (4)	OLS (5)	FE (6)
Intercept	2.727***	5.609***	2.881***	5.739***	–2.871	–2.214
	(0.446)	(1.279)	(0.472)	(1.220)	(3.414)	(4.256)
R_{t-1} (lagged profit rate)	0.926***	0.851***	0.926***	0.852***	0.923***	0.843***
	(0.015)	(0.033)	(0.016)	(0.031)	(0.020)	(0.034)
2009 dummy			–5.037**	–4.935**	–4.467*	–4.126*
			(1.669)	(1.626)	(1.828)	(1.765)
Average profit rate					0.162	0.229
					(0.102)	(0.122)
Observations	532	532	532	532	532	532

* p < .05.

** p < .01.

*** p < .001

Table 1 (b)

The Response of the Change in Profit Rate to the Lagged Value of the Profit Rate, Excluding the Petroleum and Coal Products sector

	OLS (1)	FE (2)	OLS (3)	OLS (4)	FE (5)	FE (6)	OLS (7)	FE (8)
Intercept	3.345***	5.406*	3.584***	3.791***	5.716*	5.941*	–1.411	–2.499
	(0.736)	(2.199)	(0.731)	(0.737)	(2.154)	(2.168)	(2.529)	(2.734)
R_{t-1} (lagged	0.901***	0.845***	0.899***	0.898***	0.841***	0.840***	0.891***	0.818***
profit rate)	(0.019)	(0.060)	(0.019)	(0.019)	(0.058)	(0.059)	(0.019)	(0.066)
2009 dummy			–4.643*	–4.833*	–4.799*	–4.991*	–4.291*	–4.100*
			(1.708)	(1.717)	(1.738)	(1.743)	(1.833)	(1.851)
2002 dummy				–5.091***		–5.128***	–4.010**	–3.305*
				(1.314)		(1.268)	(1.278)	(1.254)
Average							0.149*	0.253**
profit rate							(0.065)	(0.075)
Observations	504	504	504	504	504	504	504	504

* p < .05.

** p < .01.

*** p < .001

Table 2

The Proportional Change in Investment, in Response to the Lagged Profit Rate

	OLS (1)	OLS (2)	OLS (3)
Intercept	–0.000608	–0.00456	0.00302
	(0.00562)	(0.00945)	(0.00994)
R_{t-1} (lagged profit	0.00108***	0.00122***	0.00119***
rate)	(0.00016)	(0.00030)	(0.00030)
2009 dummy			–0.0721*
			(0.031)
2002 dummy			–0.108***
			(0.019)
Petroleum and coal	Yes	No	No
products sector			
Number of	551	522	522
observations			

* p < .05.

** p < .01.

*** p < .001.

Table 3

Percentage Investment Flow Change by Year

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
β^R	– 0.05	– 0.01	– 0.01	0.08	0.34	0.07	– 0.01	0.29	– 0.05

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
– 0.14	0.09	0.25	– 0.05	0.15	0.52	0.16	– 0.12	0.26	– 0.02

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0.28	0.07	0.17	– 0.09	– 0.42	0.33	0.32	– 0.34	– 0.10	0.00

Table 4

Percentage Investment Flow Change by Sector

Sector	β^R
Wood products	0.76
Nonmetallic mineral products	0.43
Primary metals	0.49
Fabricated metal products	0.06
Machinery	0.40
Computer and electronic products	0.77
Electrical equipment, appliances, and components	0.35
Motor vehicles, bodies and trailers, and parts	– 0.02
Other transportation equipment	– 0.08
Miscellaneous manufacturing	0.20
Textile mills and textile product mills	0.25
Paper products	0.92
Printing and related support activities	– 0.33
Chemical products	0.77
Plastics and rubber products	0.48
Food and beverage and tobacco products	– 0.49
Apparel and leather and allied products	0.09
Petroleum and coal products	0.13

Table 5

The Response of the Profit Rate to the Lagged Quantity of Capital

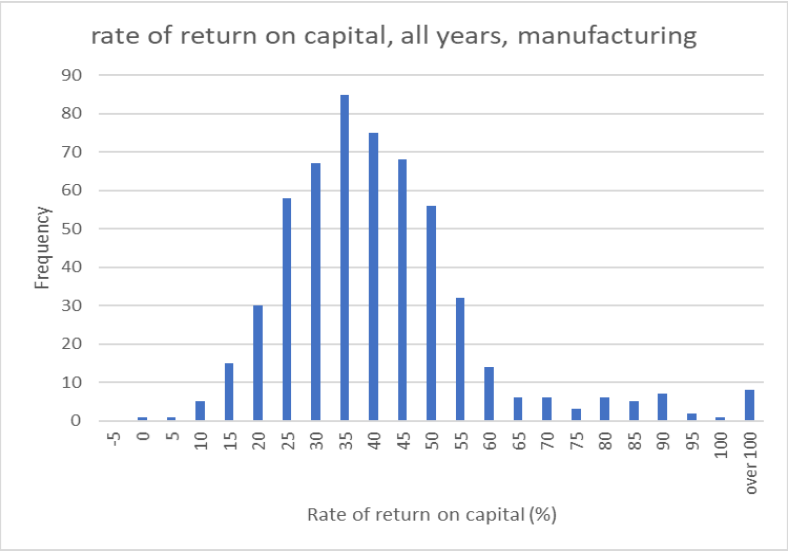
	OLS (1)	OLS (2)	OLS (3)
Intercept	39.14***	37.34***	37.74***
	(3.53)	(3.17)	(3.21)
$K_{i,\,t-1}$ (lagged fixed capital quantity)	–0.00519	–0.00806	–0.00740
	(0.0159)	(0.0163)	(0.0161)
2009 dummy			–7.28*
			(3.28)
2002 dummy			–5.84***
			(1.42)
Petroleum and coal products sector	Yes	No	No
Number of observations	551	522	522

* $p < .05$.

** $p < .01$.

*** $p < .001$.

A



B

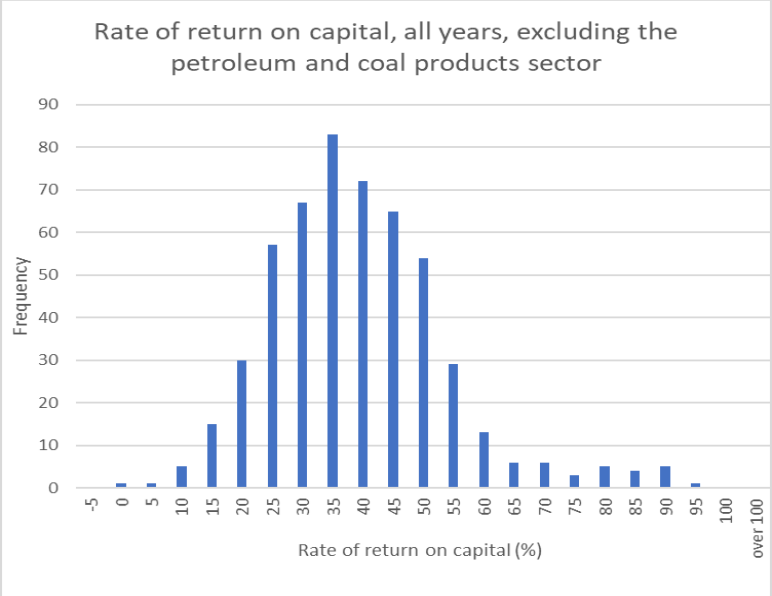
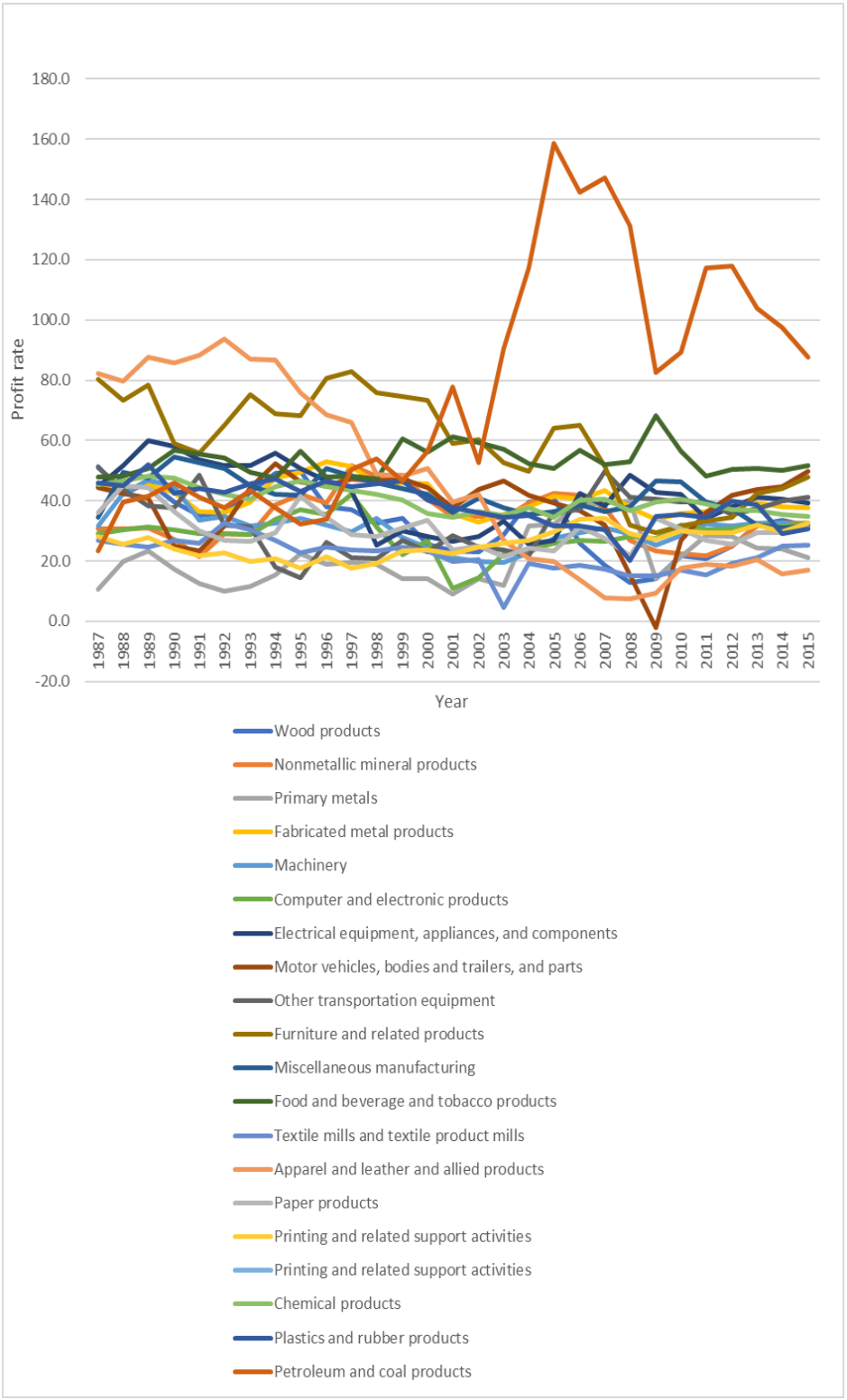


Fig. 1. *The observed profit rate distribution in US manufacturing sectors, 1987-2015 (pooled)*, for all manufacturing sectors (panel A), and for all manufacturing sectors, excluding Petroleum and coal products (panel B) (the reason for this is given in section 7.1).

A


180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
Profit rate
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year
Wood products
Nonmetallic mineral products
Primary metals
Fabricated metal products
Machinery
Computer and electronic products
Electrical equipment, appliances, and components
Motor vehicles, bodies and trailers, and parts
Other transportation equipment
Furniture and related products
Miscellaneous manufacturing
Food and beverage and tobacco products
Textile mills and textile product mills
Apparel and leather and allied products
Paper products
Printing and related support activities
Printing and related support activities
Chemical products
Plastics and rubber products
Petroleum and coal products

B

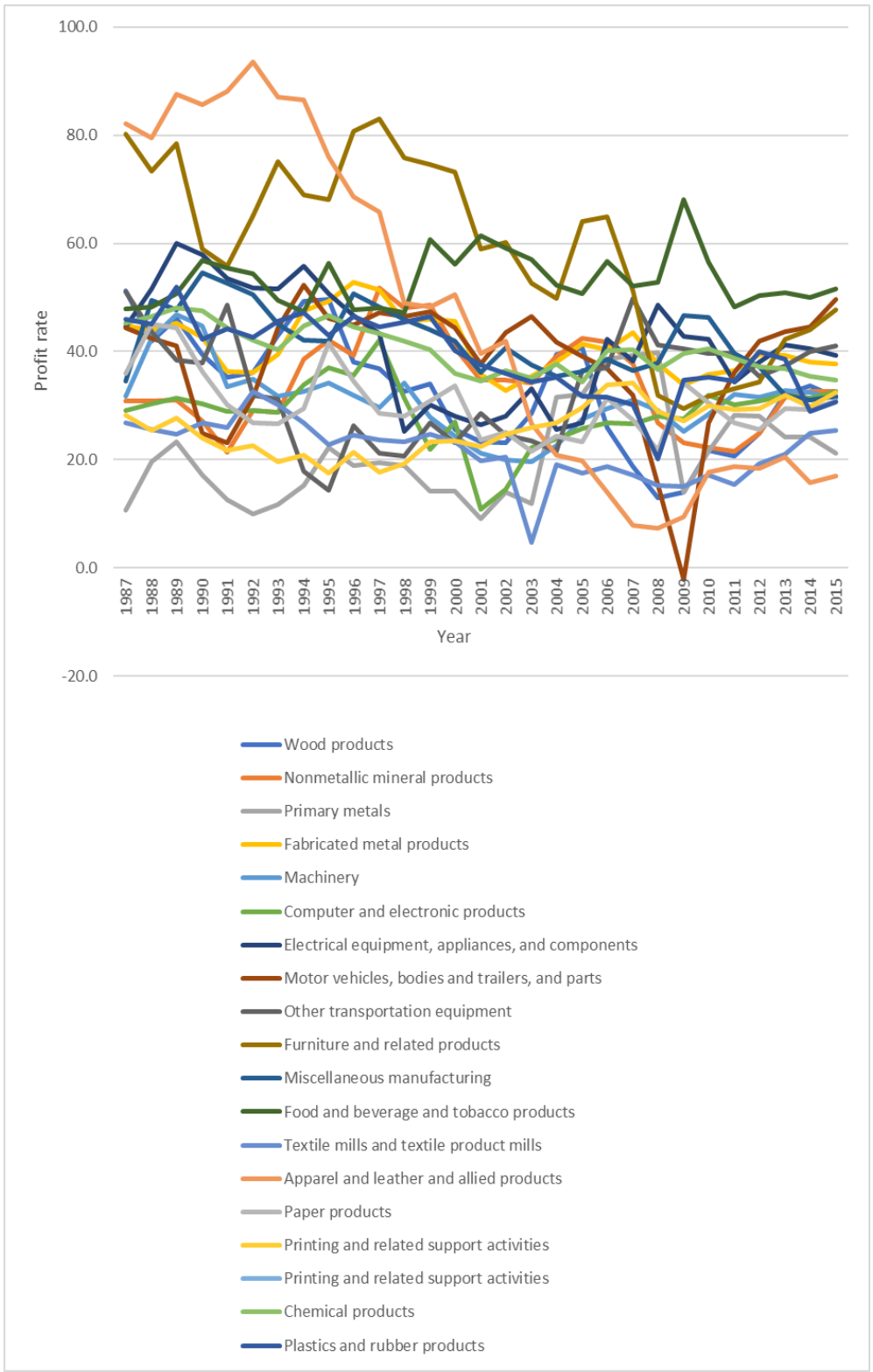
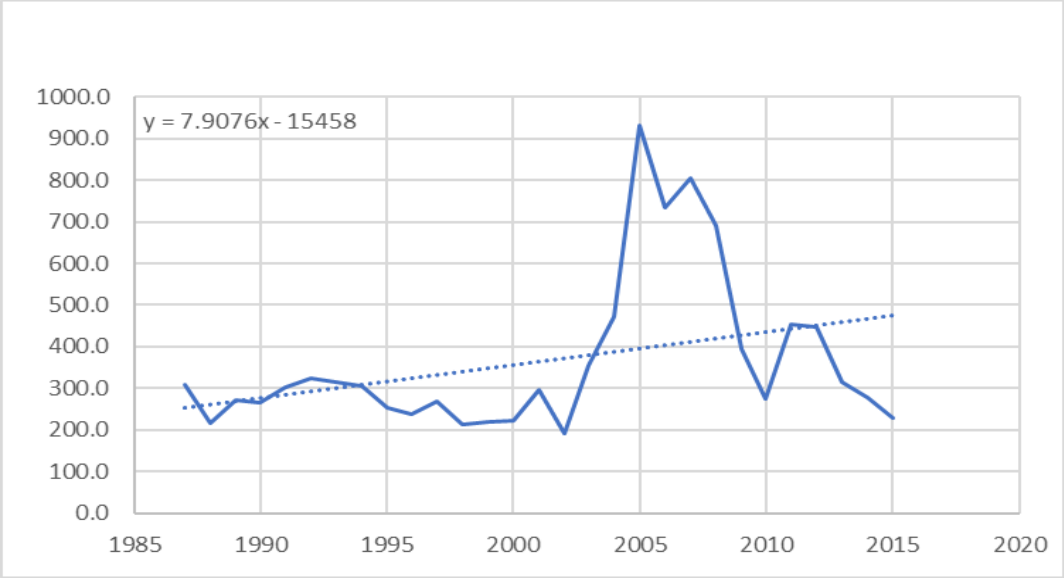


Fig. 2. *The evolution of profit rates by sector, 1987-2015*, for all manufacturing sectors (panel A), and for all manufacturing sectors, excluding Petroleum and coal products (panel B).

A



B

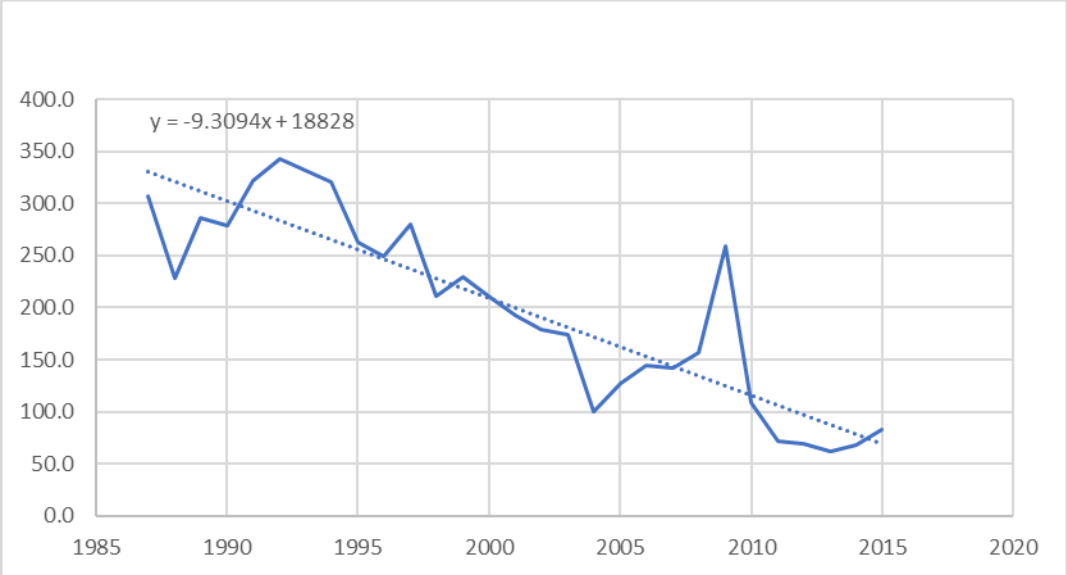


Fig. 3. *The variance of the profit rate over time*, for all manufacturing sectors (panel A), and for all manufacturing sectors, excluding Petroleum and coal products (panel B).

Data appendix

Gross operating surplus is the amount remaining after the wage bill and taxes on production and imports less subsidies have been deducted from the total revenue. It includes corporate profits and proprietors' income as well as depreciation, net interest, and business transfer payments (Bureau of Economic Analysis, 2011). Thus, it is a relatively rough measure of annual profit.

The stocks of fixed assets include estimates of durable equipment, structures and software, using the perpetual inventory method (Bureau of Economic Analysis, 2003). This cumulates past investment flows to indirectly estimate the value of the stock, calculating the net stock in each year as the cumulative value of gross investment through that year less the cumulative value of depreciation through that year. The Bureau of Economic Analysis assumes that most assets have depreciation patterns that decline geometrically over time, an assumption that has strong empirical support, although the actual depreciation rates are of uncertain accuracy.

The data come primarily from the economic censuses conducted every five years by the Bureau of the Census, the Annual Survey of Manufactures, and the Annual Capital Expenditures Survey (e.g. for software). New non-residential structures are derived from the National Income and Product Accounts (NIPA); all the data sources are reconciled with NIPA data (Bureau of Economic Analysis, 2019). Data collected on the historical-cost basis were used in this analysis.

BUREAU OF ECONOMIC ANALYSIS. Fixed Assets and Consumer Durable Goods in the United States, 1925–99. Washington, DC: U.S. Government Printing Office, September, 2003. https://www.bea.gov/system/files/methodologies/Fixed-Assets-1925-97.pdf

BUREAU OF ECONOMIC ANALYSIS. (2011). Measuring the nation's economy: an industry perspective https://www.bea.gov/sites/default/files/methodologies/industry_primer.pdf

BUREAU OF ECONOMIC ANALYSIS. NIPA Handbook 2019, chapter 6 on Private Fixed Investment https://www.bea.gov/system/files/2019-05/Chapter-6.pdf

Sectors covered by the data

Wood products
Nonmetallic mineral products
Primary metals
Fabricated metal products
Machinery
Computer and electronic products
Electrical equipment, appliances, and components
Motor vehicles, bodies and trailers, and parts
Other transportation equipment
Furniture and related products
Miscellaneous manufacturing
Food and beverage and tobacco products
Textile mills and textile product mills
Apparel and leather and allied products
Paper products
Printing and related support activities
Petroleum and coal products
Chemical products
Plastics and rubber products