Measures of firm performance and concentration: stylized facts and a dilemma of data reproduction

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Measures of Firm Performance and Concentration: Stylized Facts and a Dilemma of Data Reproduction

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Abstract

Economists and policy makers have used the increase in the concentration of return on invested capital (ROIC) in publicly-traded US firms over the last decades as evidence for the decline of competitiveness in the broader economy. Principle support for this claim is a graph presented by the Council of Economic Advisors (CEA, 2016) that reproduces data from the McKinsey and Company's book on Corporate Valuation. We demonstrate that the key findings associated with the evolution of the ROIC cannot be broadly reproduced using Compustat data and established accounting measures and calculations. Further, we find that the ad-hoc selection of firms used in the study can result in discarding nearly 90% of the available firm-level data. Rather than rejecting the results of the CEA altogether, we correct their story in its core statement and contribute to it by presenting the full dataset. As the CEA finds an increasing concentration in the upper end of the distribution, we find increasing concentration for low-ROIC firms. The concentration increase for the top 10% of firms that we find is lower than the one presented by the CEA and limited to large firms. The presented results in this paper are satisfyingly robust, regardless of whether we use only 'large firms' or the complete, available sample of data. We conclude that the original story of an increased concentration of ROIC must be handled with care. Drawing macroeconomic conclusions from firm-level data should include all available and relevant information.

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1 Introduction

Increased firm concentration in the economy is widely considered a threat to competition and the related benefits for consumers and customers (see Keil (2017) for a detailed discussion). As the Council of Economic Advisers (2016) points out, the concentration of firms is an indicator of market power that opens the door for excessive profitability through behaviors that abuse it. The main exhibit that the Council of Economic Advisers (2016) presents to underline this development is the time evolution of Return on Invested Capital (ROIC) for large publicly-traded firms. For this sample of firms, ROIC has "become increasingly concentrated within a small segment of the market [...], the 90th percentile firm sees returns on investments in capital that are more than five times the median" (Council of Economic Advisers 2016, p. 5).

Note: The return on invested capital definition is based on Koller et al (2015), and the data presented here are updated and augmented versions of the figures presented in Chapter 6 of that volume. The McKinsey data includes McKinsey analysis of Standard & Poor's data and exclude financial firms from the analysis because of the practical complexities of computing returns on invested capital for such firms.

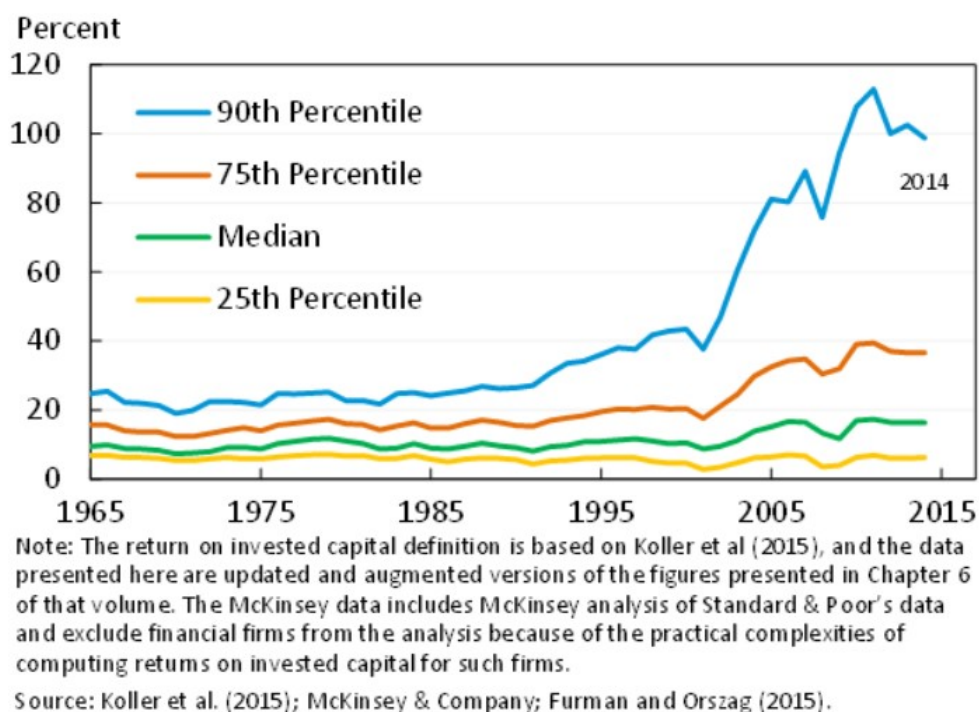Source: Koller et al. (2015); McKinsey & Company; Furman and Orszag (2015).

Figure 1: The original graph presented by Council of Economic Advisers (2016, p. 5), including the corresponding notes. The graph is identical to the one in Furman & Orszag (2015) and can be used exchangeably. Furman & Orszag (2015, p. 10) give a detailed insight into the origin and calculation of ROIC, stating that the graph is an "updated and augmented version" of the one presented in Koller et al. (2015). The original data comes from Standard & Poor, which excludes financial firms and is treated along with the definitions of Koller et al. (2015). The exclusion of goodwill avoids distortion in the data through premiums paid for acquisitions (Koller et al. 2015, p. 107).

Much like Carmen Reinhart and Kenneth Rogoff's widely touted association between

growth and debt (Reinhart & Rogoff 2010, Herndon et al. 2014) this specific measure of firm performance has come to enjoy an authoritative status in informing government policy and academic research. In this paper we demonstrate that the patterns presented in Figure 1 are the result of sample bias produced by opaque adjustments to the available data and examine the viability of broad macroeconomic claims about the state of competition based on such limited data. The ad hoc adjustments and the deliberate disposal of available and relevant information in the calculation of an established metric like the ROIC has the unintended outcome of undermining such macroeconomic claims. We argue instead that macroeconomic claims about competition based on firm-level data should be based in robust statistical patterns and should include all relevant and available information. To this end, we examine the use of statistical equilibrium methods that study the distributional outcomes of competition as a possible bridge between microeconomic processes and macroeconomic outcomes.
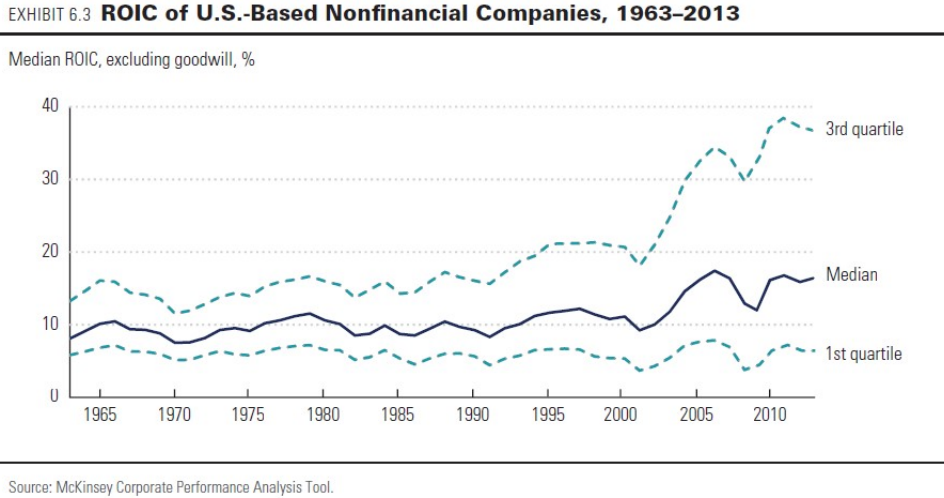

Figure 2: The original graph in Koller et al. (2015, p. 107) high-lightening the dispersion of ROIC over time.

2 The Road to a Stylized Fact

While Koller et al. (2015) is a standard textbook in corporate valuation, the concentration of ROIC became the center of discussions about market power with the publication of the brief of the Council of Economic Advisers (2016). In the same year, the managing director of the International Monetary Fund, Christine Lagarde (2016), referenced the work of Furman & Orszag (2015) as an indicator of the increased market concentration in advanced economies. The "lack of vigorous competition" must be addressed to "boost economic fair-

ness to rebuilt trust and bolster support for reforms." By 2018, Van Reenen (2018) was referring at the annual Jackson Hole Economic Symposium to the wide acceptance "that there is enormous cross-sectional heterogeneity in establishment performance" (p. 19). Worrisome for Van Reenen (2018) is the "significant consolidation" (p. 28) of firms and "increased dispersion of [...] firm measures such as rates of return on investment in public firms" (p. 37) that is outlined in the brief of the Council of Economic Advisers (2016). The importance of this result was highlighted by Rosenberg (2021), claiming that neo-liberalism failed by its own measures and gave the Obama administration the theoretical foundation to push back on "market fundamentalism."

The political discourse of firm concentration echos in academic analysis where the Council of Economic Advisers (2016) brief and the presentation by Furman & Orszag (2015) both enjoy an authority of stylized fact. Philippon (2019, p. 46-48) references the result to support his analysis with Census data, showing that the top 50 companies in the US have a higher concentration. Berry et al. (2019) regard the work as an essential step in presenting alternative approaches to the structure-conduct-performance approach (Tan 2016) as used in the field of industrial organization. The concept of "superstar firms" by Autor et al. (2020, footnote 5) builds on precisely this relation that concentration and dispersion result from the existence of changes in the market power. Like many others, Autor et al. (2020) do not investigate the increased ROIC for a few firms but instead rely on the results as a stylized fact consistent with their model and analysis.

Carl Shapiro (2018) is the only author discussing the increased ROIC due to abused market power, and he takes a critical stand on the underlying data. He discusses the "growing gap between leaders and laggards" in the larger context of declining firm entry rates and a productivity slowdown in the US. In footnote 41, Shapiro (2018) describes that the data which is used by Furman & Orszag (2015) and the Council of Economic Advisers (2016) was "compiled by the McKinsey Corporate Analysis tool in a manner that is opaque to me."

In this paper we will outline step-by-step the definition and calculations that the original literature refers to and show that not-disclosed assumptions and ad hoc adjustments to the data must have been made along the way. Not only does the additional manipulation of the data stand in stark contrast to the recommendation of Koller et al. (2015, p. 203) that adjustments shall only be made if they "will further your understanding of a company and its industry [as] an unnecessarily complex model can sometimes obscure the underlying economics that would be obvious in a simple model," but they significantly change the economic conclusions one might draw from the analysis of the data.

Parsimony may sometimes deliver clarity, but it is possible to discard too much information resulting in distortion of the story. Competition concerns the interplay of firms with

one another. Firm-level variation is a feature of competition that needs to be studied and understood as revealing the underlying dynamics, not minimized or discarded altogether. The choice of a sub-sample of available data is at least as important as the choice of model and should be subject to a similar level of scrutiny as choice of model.

Broad macroeconomic claims about the state of competition using firm-level data are best substantiated with the use of all relevant information and should be robust to similar variations in measurable variables. What we find is that ad hoc procedures for discarding a substantial number of relevant data observations and non-trivial information about the state of competition is far too common in the literature. In this paper we examine the implications of various ad hoc methods for filtering firm-level data for the calculation of firm rates of return. We first examine a detailed derivation of the ROIC measure for the broadest possible set of firm observations, then, following the literature, make common adjustments to the data for comparison. We show that the conclusions about the current and historical state of competition in the United States are highly sensitive to the measure of firm performance as well as the methods used for filtering large firm-level datasets.

Competition is a fundamental institutional constraint to firm dynamics in a decentralized system of commodity production and exchange. Competition delimits the bounds of firm behavior and can create strong statistical patters and distributional outcomes that can be informative about the nature of competition. Broad macroeconomic claims about the state of competition should be robust to various measures and mechanisms for analyzing firm-level data. In the last section we discuss an alternative statistical methodology for conceptualizing competition from a macroeconomic perspective using a distributional approach informed by the insights of statistical mechanics.

3   Replication of the Method

In this section we discuss the procedure which Furman & Orszag (2015) and Council of Economic Advisers (2016) disclose on their data processing. We outline in extreme detail how the presented variables are derived from the raw data. As we discuss every assumption of these adjustments and how it is reasoned in the literature, this section can be skipped by the inclined reader and returned to at a later point for additional insight on the justifications.

Furman & Orszag (2015) and Council of Economic Advisers (2016) both refer to Koller et al. (2015) as the theoretical foundation for their analysis; we accordingly reconstruct the provided definitions, match them with the respective data from the original data source (Standard & Poor's Compustat database), and disclose any adjustments we made to the data or were not able to reproduce based on the available definitions and/or data. The original

analysis of Koller et al. (2015) examines data from 1965 to 2015 using the same Compustat database, albeit mapped in an undisclosed way to the proprietary approach of McKinsey & Co. While we restrict our direct comparisons to the same time frame, we examine data over a longer time period 1962-2020 given the current availability of data. Similar to the original data, we exclude financial firms. As the authors do not specify how they define financial firms, we follow the convention and exclude firms with a SIC code between 6000 and 6999. While they do not state explicitly, the graphs by Furman & Orszag (2015) and the Council of Economic Advisers (2016) likely follow the convention of Koller et al. (2015), whose analysis is limited to firms with revenue exceeding \$1 billion (inflation-adjusted).

It is important to point out that this common ad-hoc adjustment to the data has no methodological basis other than reducing the variance in the remaining sample of observations. While it might be possible to establish a basis for such a procedure, such as a statistical cluster analysis that would suggest important differences in firms with \$1 billion or more in revenue, such practices are rarely found in the literature.[1] The \$1 billion cutoff deviates from official definitions, such as the one provided by OECD (2022), that orient themselves at the number of employees and consider firms that employ 250 or more people as "large." Further, in analyzing the quantiles of an empirical distribution it is unnecessary to discard small firms, since the behavior of the lower quantiles does not affect the overall trends of the upper quantiles. As we discuss below, there are strong theoretical reasons to include firms of all sizes when assessing the macroeconomic state of competition. Lastly, discarding nearly 90% of the data attributed to being representative of "small" firms departs significantly from earlier empirical research that attempted to do the opposite. For example, the widely cited Fama & French (1992) set a standard of discarding earlier decades of observations from the Compustat database precisely because they were biased towards large firms and were not representative of the broader population of competitive firms.

As Koller et al. (2015) adjust for inflation using the CPI, we will do the same for replication purposes and use 2013 as the year of reference to determine "large firms." The complete data set over consisting of all meaningful observations[2] from 1962-2020 has, on average, about $3,600$ firms per year, the reduced sample of large firms about 445 per year. This initial data filter results in the discarding of nearly 88% of the available data.[3] Koller et al. (2015) report 1246 observations for 2013 (p. 106, footnote 4), while our data set consists of 974 large firms and 2730 for the complete sample in the same year. The total number of distinct firms over the 59 years available is $2,314$ for the reduced sample and $17,233$ for the complete sample.

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[1]See Scharfenaker & Semieniuk (2015) for an alternative methodology for filtering noisy firm-level data.
[2]No firms with negative revenues (*revt*), working capital (*wcap*), operating costs (*xopr*), or net property plant and equipment (*ppent*).
[3]This number is 89% for the time frame 1965-2015 used by Koller et al. (2015).

All page references in the following section refer to Koller et al. (2015), if not stated otherwise, and shall guide the interested reader to further and more detailed resources. The italic letters in brackets state the corresponding key for this variable in Compustat.

ROIC is the ratio of after-tax net operating income (NOPLAT) over invested capital (p. 172). Neither of these variables are directly available in Compustat and must be computed manually.

Invested Capital can be derived through two methods (p. 170), either the financing method or the operating method. The first is expressed by the sum of all debt and equity, the latter by the difference between operating assets and operating liabilities. We follow the detailed description of p. 174-180 and apply the corresponding operating method. The respective procedure is visualized below. We add up operating working capital (*wcap*), fixed assets in the form of net property, plant, and equipment (*ppent*), and other assets (*ao*). A component of invested capital that we discussed earlier is the aspect of goodwill (*gdwl*) and acquired intangibles (*intan*). It is essential to acknowledge that the theoretical discussion combines goodwill and intangibles, but none of the presented graphs in the literature includes intangibles. We, therefore, can ignore intangibles as a possible variable in our analysis. As these assets are significant in determining the origin of growth (either organic or through acquisition, p. 179), invested capital and the corresponding ROIC are presented with and without goodwill. The last and final component which requires attention are other operating assets and net liabilities (p. 178). The presented case study of UPS names warranty issues, "unfunded pension liabilities, unfunded postretirement medical costs, restructuring reserves, and deferred taxes" (p. 179) in this category.

$$
\begin{aligned}
\text{Invested Capital} &= \text{Debt} + \text{Equity} \\
&= \text{Operating Assets} - \text{Operating Liabilities} \\
&= \text{Operating working capital} + \text{Fixed assets} \\
&+ \text{Other long-term operating assets} + \text{Goodwill} \\
&= wcap + ppent + (gdwl) + ao
\end{aligned}
$$

The after-tax net operating income (NOPLAT) is a bit more challenging to calculate, as the main component, earnings before interest, taxes, and amortization (EBITA), is not available in Compustat. We will concentrate first on the derivation of EBITA.

Similar to the net operating profit (p. 186), EBITA equals the revenue (*revt*) less the operating expenses a firm has, such as costs of goods sold (*cogs*), selling costs, general and administrative costs (*xsga*), and depreciation (*dfxa*). One has to "dig through the notes to

weed out nonoperating items" to achieve an EBITA that "better reflects the underlying operating performance of the company" (p. 188). Those adjustments would include nonoperating items like pension, embedded interests from leases, restructuring charges, and asset sales.

$$
\begin{aligned}
EBITA = {} & \text{Revenue} - (\text{Cost of Goods sold} \\
& + \text{selling costs, general and administrative costs} + \text{Depreciation}) \\
= {} & revt - (cogs + xsga + dfxa)
\end{aligned}
$$

The second manual calculation necessary before calculating NOPLAT is to derive the Operating cash tax (p. 191). Operating cash taxes are the adjusted tax payments representing an all-equity operating level. The Operating tax ($utxfed$) must be reduced by the increase in Operating deferred tax liabilities (net assets) from the previous year. This change is the one-year lag in the variable $txndb$.

$$
\begin{aligned}
\text{Operating cash tax} = {} & \text{Operating tax} - \Delta\text{Operating deferred tax liabilities (net assets)} \\
= {} & utxfed - \Delta txndb
\end{aligned}
$$

The sum of EBITA and Operating cash tax must be reduced by the net nonoperating income ($unopinc$) and accounted for any adjustments made, especially severance charges and nonoperating tax shields. These adjustments require a full assessment of the footnotes.

We can now define ROIC, as described in Koller et al. (2015), based on Compustat variables:

$$
\begin{aligned}
ROIC = {} & \frac{\text{NOPLAT}}{\text{Invested Capital}} \\
= {} & \frac{revt - (cogs + xsga + dfxa) + utxfed - \Delta txndb - unopinc}{wcap + ppent + ao}
\end{aligned}
$$

The denominator $wcap + ppent + ao$ does not include goodwill but can easily be expanded by adding the variable to $wcap + ppent + ao + gdwl$.

4 Comparison of results

As Furman & Orszag (2015) and the Council of Economic Advisers (2016) do not specify if they analyze only large firms or all available data, we will compare our reproduced data to both samples. Our data includes additional years, which shall not be held against the

original authors, but will paint a different picture for the distribution of ROIC.

The reduction of the available dataset to large firms reduces the informative value of the analysis. It excludes the majority of firms and reduces the sample for some years to an amount that an analysis is based on noise rather than data. While Koller et al. (2015, p. 106) report 1246 (large) companies in their sample for 2013, our sample consists of less firms (974). As for many aspects of this analysis, it was not possible for us to further investigate the discrepancy between Koller et al. (2015) and our work. By limiting the analysis to large firms only, over 87% of the available data is discarded and not included in the description of the overall trend discussed. While this procedure already raises serious questions about the validity of the overall analysis and broader macroeconomic claims, it is even worse for some years than others. Statistics based on the earlier years of the analysis consist of only a few observations. All years prior to 1970 have fewer than 10 observations, while all years prior to 1979 have fewer than 100. For comparison, the full dataset has about 2,000 firms on average for each year prior to 1970.

Koller et al. (2015) use the time period 1965-1967 as their benchmark of comparison for the distribution of ROIC over time. These years have only three to six observations. The vastly different sample sizes and composition of firms across the sample that are routinely being compared in distributional terms make broad macroeconomic conclusions about the evolution of the state of competition questionable. It remains unclear why the authors discard such a large amount of information and settle in their analysis with few observations that resemble more of a case-study than an analysis of a general economic trend.

Reproducing the development of the percentile of ROIC over time shows significant differences between our work and the one used in the literature. Our comparison will refer to the manually extracted values from Furman & Orszag (2015). We compare our results graphically to the original graph in Figure 4, expressed by lighter coloring of the percentiles in the background. Concerning the full sample, three differences are striking; one of them can be found in the reduced sample as well. The 90th percentile does not exceeds the 60% mark in our calculations. While the maximum in the reduced sample stays below 70% at all times, the original graph reaches nearly 120%.

The increasing dispersion starts with our calculations for the reduced sample earlier than the one presented by Furman & Orszag (2015). As we see a rise of the 90th percentile, early as the late 1980s or early 1990s at the latest, the original graph does not report such behavior until the new millennium. Considering the full sample of all firms, such an increase cannot be observed. The other aspect is that the 25th percentile reaches a negative ROIC for several years in the full sample, an observation which does not occur in the original data.

The increasing concentration of ROIC at the upper end cited by the Council of Economic

Advisers (2016) only appears in our data as increase at the upper end for large firms only. The disruption of competition is not a general story which can be applied to all firms, but appears to hold only for very small subset of firms. In fact, if one were to draw any broad conclusion about competition from a visual inspection of the data it would be that competition leads to quite stable patterns across the distribution. The increase in the negative ROIC can only be observed if all firms are taken into consideration.
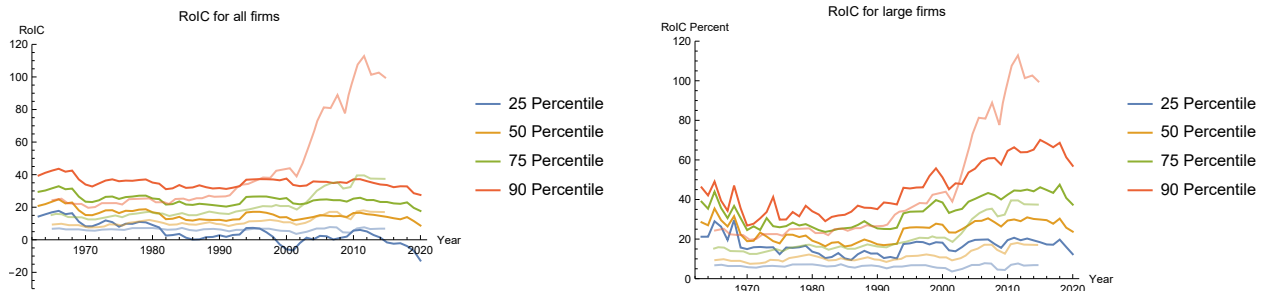
Figure 3: The 25th, 50th, 75th, and 90th percentile of ROIC with goodwill excluded. The original data by Furman & Orszag (2015) has been extracted and is plotted in the background.
Left: The full sample, our calculation.
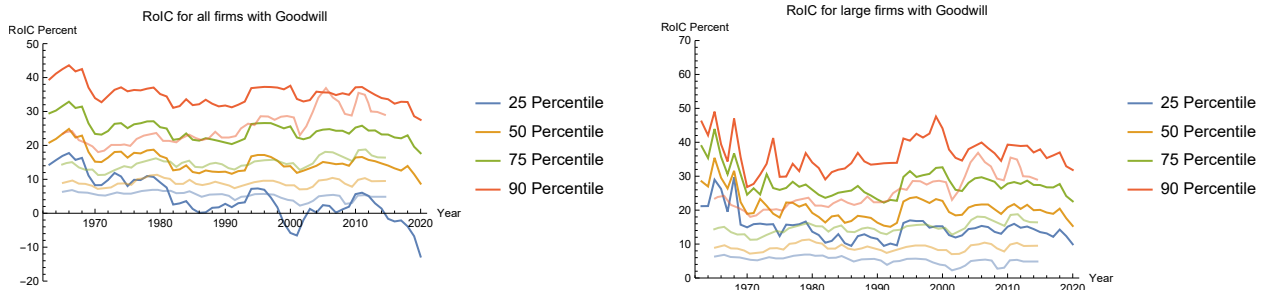Right: Reduced sample of large firms, our calculation

Figure 4: The 25th, 50th, 75th, and 90th percentile of ROIC with goodwill included. The original data by Furman & Orszag (2015) has been extracted and is plotted in the background.
Left: The full sample, our calculation.
Right: Reduced sample of large firms, our calculation

We compare our results if we incorporate goodwill (see Figure 4) as well. This time, our dispersion is larger than the original graph. The 90th percentile constantly exceeds the 30% ROIC mark for the full sample for all years and if only large firms are considered for most of them. While the full sample has, again, a trend to reach negative ROIC for at least a quarter of its firms, the reduced sample has a significantly higher trend (and stable trajectory) for the low-performance firms.

While the observation of a constant concentration over time is robust to incorporating goodwill, the increase for large firms is not. The increase of firms in the negative area of ROIC

is robust for incorporating goodwill into invested capital. It can be argued that goodwill has a significant effect on ROIC for large firms but not on the economy as a whole. Such an argument is reasonable as firms require a large amount of assets to be able to acquire other firms for a price which exceeds the current market value and incorporates future revenue streams.

5 Distributional Analysis

As a final point of the investigation, we will compare the distribution of ROIC for the original calculations and ours. As the distributional form of data is a good indicator for the underlying data generating process (Jaynes 2019, Golan 2017), we want to emphasize the discrepancy between Koller et al. (2015, p. 108) and our reproduced data. As it remains unclear how the authors "simplified for readability," we want to be as transparent as possible with our approach.

In the original graph, we assume that the years under consideration have been pooled to calculate the percentage of firms in each bracket. Even though a histogram might be the most appropriate form of representation for this kind of data, we smooth our data as well, accepting the loss of information with this manipulation. We continue with the approach of Koller et al. (2015) and top and bottom code our data for all values that exceed 50% or are below 0%, respectively. While this maneuver accentuates the tail behavior of the distribution we believe it is not necessary or helpful to top code data because it risks discarding important information. The long standing problems of top coded income and wealth data for the study of the income and wealth distribution clearly illustrate this point (Jenkins et al. 2009, Schneider 2015, Schneider & Scharfenaker 2020, Schulz & Milaković 2021).

The data excludes goodwill, and assumes that the earlier made statement of Koller et al. (2015, p. 106) only to consider large revenue firms applies here as well. For completeness and transparency we provide the results for both samples. We want to repeat that the years 1965 to 1967 include only 12 observations of six different firms if the analysis is limited to large firms. Such a small sample can barely be justify a such important and far-reaching conclusion as proposed by the Council of Economic Advisers (2016) or Koller et al. (2015) and leads to the observed and uninformative multi-peak probability function.

The visual inspection itself shows the discrepancy between the original and reproduced data. In neither of the samples is it justified to omit the distributions between 1965 and 1995, despite the claim that "the distributions are similar" (p. 108). While the distribution of the full sample (Figure 5 on the top) flattens out significantly over the years, the sample of large firms shifts further to the right, with an increase in the > 50-bracket.
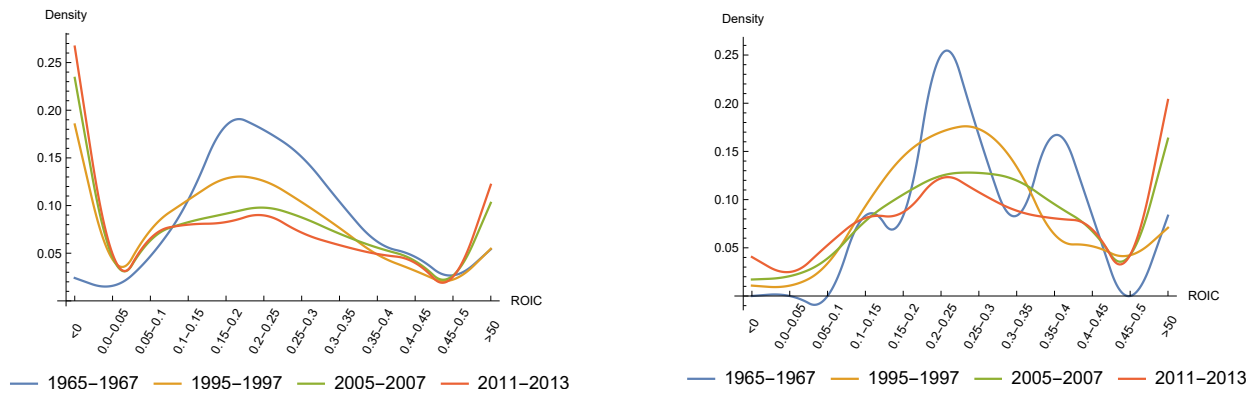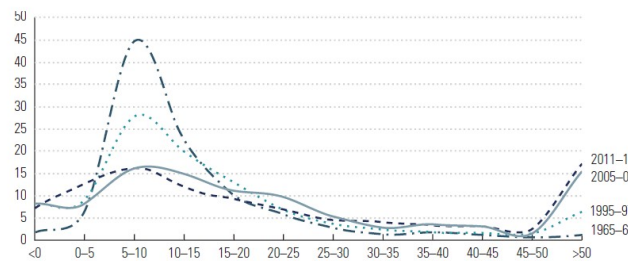
Figure 5: The distribution of ROIC for selected time periods.
Top left: The full sample, our calculation.
Top right: Reduced sample of large firms, our calculation
Bottom: Koller et al. (2015, p. 108)

Koller et al. (2015, p. 108) claim that in "the 1965–1967 period, only 14 percent of companies earned more than a 20 percent ROIC, compared with 53 percent in 2011–2013. At the same time, the share of companies earning less than 10 percent has declined from 53 percent to 26 percent." does not hold either. Table 1 visualizes the significant differences and different trajectories between the original and reproduced data. While we have shown earlier that a large discrepancy exists between the original and reproduced data, the reverse trend between those two data sets is more troubling. While our analysis does not challenge the claim of increasing dispersion on the return of invested capital, we show that it occurs at a different place in the distribution than expected. The dispersion is happening at the bottom and not the top. The implications for economic models like the one presented by Autor et al. (2020) and political anti-trust enforcement as recommended by Lagarde (2016), Van Reenen (2018), and Philippon (2019) are far-reaching.

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	ROIC below 10%		
	Koller et al.	Large Firms	All Firms
1965-1967	53%	0.0%	8.7%
2011-2013	26%	11.8%	26.7%
Trend over time	↓	↑	↑
	ROIC above 20%		
	Koller et al.	Large Firms	All Firms
1965-1967	14%	83.3%	62.3%
2011-2013	53%	71.4%	45.6%
Trend over time	↑	↓	↓

Table 1: Comparing the original claims by Koller et al. (2015, p. 108) with the reproduced data.

5.1 The Frequency Distribution and Statistical Considerations

The display of the distribution of ROIC is an important contribution to the literature to allow a more detailed discussion about the trends and developments over time. The study of the distribution of rates of return facilitates a statistical equilibrium analysis of the general competitive process that is a promising "meso-level" alternative to purely micro and macroeconomic approaches to understanding competition (Syverson 2019). The statistical equilibrium model of markets developed by Foley (1994) and extended to the study of firm rates of return in Scharfenaker & Semieniuk (2017), Scharfenaker & Foley (2017), Alfarano et al. (2012) offers a view of competition as a central organizing process that generates persistent statistical patterns of organization in measurable observables that arise from micro-level competitive interactions. From the statistical equilibrium view, the persistent observation of cross-sectional frequency distributions suggests that the difficult to aggregate micro-level dynamics may be expressible in terms of a much simpler set of macro-level and behavioral constraints.

These constraints define a statistical equilibrium model of competition that predicts both the central tendencies of the system, for example the strong modality in measured ROIC, and the endogenous fluctuations that define the higher moments of the distribution. A key feature in these models is that the shape and scale of the dispersion of the ROIC, not evolution of arbitrary quantiles, is a measure of the competitive pressures in the broader economy that reveal the underlying mirco-dynamics. Evidence of any significant changes to the broader competitive landscape can be inferred through large changes in the parameters of the statistical model, or through new residual variation that is not well explained by the constraints in the model.

A first look at the frequency distributions of ROIC in Figure 5.1 shows a strong tendency

of firm rates of return to organize in a statistical equilibrium distribution. The process of competition that drives entry and exit behavior of firms puts a strong constraint on the way the ROIC distribution can be configured. Entry and exit dynamics tend to keep these measures close to the modal value, but also result in the endogenous fluctuations around the central tendency that define the higher moments of the distribution.
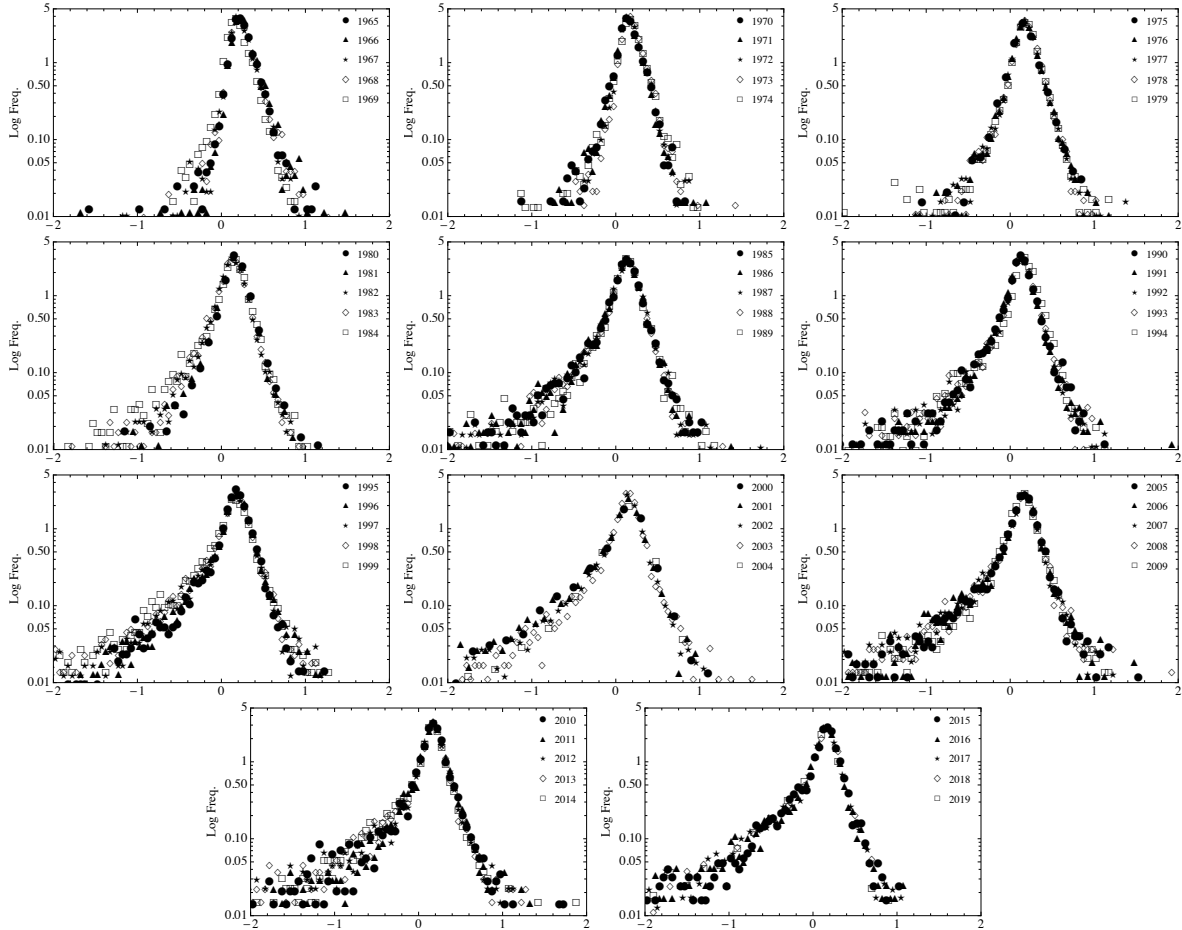

Figure 6: The distributional form of ROIC for selected on a semi-log scale. The "tent shape" of the log-frequency distribution is characteristic of a double-exponential distribution.

As Scharfenaker & Semieniuk (2017) have shown for profit rates with the same dataset that the left tail gets fatter and leads to an asymmetric development, it is not surprising to observe a similar pattern in our data. Deconstructing the calculation of the profit rate shows that the numerator is similar in both cases. In contrast, the denominator in the case of the profit rate is the sum of the capital invested into operating and non-operating business segments.

While the asymmetric development is not as severe as in the case of the rate of profit, the same dynamics can be assumed to drive this development for ROIC. The discussion of

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Scharfenaker & Semieniuk (2017) regarding the origin of the distributional form points at the "classical" theory of competition. Firms with a high ROIC would experience an increase in invested capital, lowering their ROIC in the following period. Firms below the general ROIC, especially if their ROIC is negative, face not only the pressure to become more profitable but also the acute threat of market exits.

6   Discussion

We want to highlight the most important differences between the original and reproduced data. First, the dispersion of ROIC at the upper end can only be observed under specific conditions on the underlying data. These are the exclusion of goodwill as a relevant factor in invested capital and the requirement that a firm requires a specific size. While the first assumption is worth a theoretical discussion and a legitimate constraint depending on the research question under investigation, the second assumption with regard to firm size is questionable. The selection of large firms to draw a conclusion for the whole economy suffers from an unconfirmed prior that only large firms are worth to consider in macroeconomic analyses. This statement has been debunked with respect to concerns about competition and competitiveness by Horowitz & Horowitz (1968). Secondly, the ROIC has been higher than originally reported over the whole period under investigation. The exclusion of early recordings of ROIC may be a reason for the sudden increase in dispersion in the original data but are a dangerous and false claim. Third, in counter with the original calculations, the most apparent trend observable is not the increase of ROIC for the top 10% of firms, but rather the constant and severe reduction for the lowest quarter. Many firms reporting a negative return on their invested capital require a solid theoretical foundation as it would be expected that those firms exit the market. Fourth, the distribution of ROIC is changing before the mid-1990s, and while it is flattening, the trajectory for most firms is different than reported. This leads to the fifth and final result of our analysis. We have shown that the trend of dispersion is facing another direction than assumed in the literature. Instead of having more firms with a high ROIC, we see an increase of firms with a low ROIC. The fact that the trend is reversed to what has been previously been reported is troubling and a concern for the applied data adjustments by the original authors.

The fact that we have additional years of observation compared to the original authors allows us to make an additional statement about the data. It seems as if the claim of increasing dispersion to the top has been made around a peak of such behavior. Over the last years, we can show that the 90th percentile has begun to drop for large firms and reached levels similar to those from the late 1990s for the case without goodwill and the 1980s with

goodwill. The fall of ROIC for the lower 25th percentile is worsening further and requires additional investigation, which exceeds the purpose of this paper. The grace of time allows us this statement, as future generations of economists will naturally have a better understanding of the current trend and developments.

These results do mitigate and alter the story told by the Council of Economic Advisers (2016) in different aspects. The concern of Lagarde (2016) about a "lack of vigorous competition" in the US economy is supported as a widening of the distribution towards both ends indicates that the mechanisms of the market with respect to entry and exit, and challenging high returns through competition. The disturbed entry/exit possibilities keeps firms which experience a negative ROIC active in the economy that might have been forced to exit in previous time periods. A similar change of market mechanisms applies to the challenge of high ROIC through competition. Especially the Chicago school argues that high returns for firms will always be challenged by their competitors. The rise of the share of large firms which observe a high ROIC indicates that such a 'challenge through competition' is either not happening at all or the time in which such a challenge occurs has widened. While all of these theoretical underpinnings would be troubling with respect to the functionality of competition and how it is perceived by the economic profession, a final evaluation of these claims is beyond the scope of this work and requires a more detailed analysis.

7 Conclusion

We have shown that the original claims are a perfect example of using judgment with adjustments, as Koller et al. (2015) recommended. Creating an "unnecessarily complex model can sometimes obscure the underlying economics" by using "unimportant adjustments" and can stand in the way of providing "a strong context for good financial decision making and robust forecasting" (p. 203).

To summarize our work, we want to highlight that our adjustments to the data are the same as described in Koller et al. (2015) if the necessary information was available to us through Compustat. As it remains unclear if Furman & Orszag (2015) and the Council of Economic Advisers (2016) use the full dataset available through Compustat or limit their analysis to firms whose revenue exceeds \$1 billion (inflation-adjusted), we compare the results to both datasets. However, this does not change our conclusion: The initial results cannot be reproduced with the disclosed information.

Our contribution to the literature is twofold. First, we argue against an ad-hoc or arbitrary selection of available data as such a procedure may create misleading or wrong results. Including the full available into the analysis does not just provide robust results but also a

more informed picture of the development of ROIC and the economy. Secondly we show a widening at both ends of the distribution and emphasize that the increased concentration at the upper end is not as large as described by Furman & Orszag (2015) and the Council of Economic Advisers (2016) but rather limited to the selection of a small subset of firms. We conclude that their claim regarding the dispersion of ROIC towards the upper end of the distribution must be handled with care until the underlying data manipulation is fully disclosed by the authors. Due to the extensive public exposure and widely referenced results, intransparent and non-reproducible claims may be causing wrong policy advice with a non-negligible impact on the economic profession.

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