On the Formation of Capital and Wealth: IT, Monopoly Power and Rising Inequality

by

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Abstract

Our underlying hypothesis is that technological progress (even neutral) has a big effect on distribution, not only on growth, since rising waves of technical progress cause rising monopoly power. We test it by showing that, since the 1970's, information technology (in short IT) has caused rising monopoly power, which explains rising inequality, slow growth of wages and low level of investment since the 1970's. This monopoly power is legally protected by patent laws, intellectual property rights and by our policy which aims to promote innovations. Our reasoning proceeds in five steps.

Step 1 examines surplus wealth - the difference between firm's wealth (equity and debt) and capital employed. Surplus wealth rose from -$0.59 Trillion in 1974 to $24 Trillion in 2015 which is 82% of total stock market value, reflecting sharply increased monopoly power 1974 - 2015. In step 2 we test the hypothesis surplus wealth is associated with IT transformed firms, establishing an empirical link of IT with monopoly power. Step 3 is *theoretical,* explaining why theory shows we should expect these results, by studying IT properties that enable erection of barriers to entry and facilitate their maintenance and, once a monopoly power is established, these properties support expansion and consolidation of that power. In step 4 we show why monopoly power causes rising *functional* inequality and explain that the unique properties of IT also cause rising *personal* inequality. In step 5 we show that rising monopoly power explains more than rising inequality; it also explains other observed microeconomic phenomena. To carry this out we develop a general equilibrium model where firms have rising monopoly power. For simplicity of analysis monopoly power is exogenous since the link between technology and monopoly power is not essential here. Three independent methods estimate the share of monopoly profits in output to be about 21%-23% in 2015, rising from 0 in early 1980s. Using the model we *prove* that rising monopoly power *lowers permanently* equilibrium wage rate, investment, capital stock, output and consumption. In an economy with embodied technical change it also lowers the growth rate of the economy and its equilibrium interest rate.

JEL classification: D31, D33, D42, D43, D62, E22, E25, L1.
Keywords: surplus wealth; Information Technology; monopoly pricing power; income inequality; wealth inequality; relative shares; monopoly surplus; monopolistic competition; technical change and TFP.

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Income and wealth inequality has risen sharply since the 1970's (see Piketty and Saez (2003), Saez and Zuchman (2015)), while real wages have grown slower than productivity implies and the rate of capital formation declined. Although widely discussed, a consensus explanation of these facts is yet to emerge. Textbooks offer many possible causes for inequality, but most explain changes in it as outcomes of government actions (e.g. Stigliz (2012)). Monopoly power is a potential cause, but the typical view is that in advanced economies it arises either from government granting it to wealthy supporters or from government failing to enforce laws against anti-competitive behavior (e.g. Stiglitz (2012), Ch. 2). Apart from land, monopoly rent is capitalized by the market into *Monopoly Wealth* or *Surplus Wealth*, which is the difference between *capital* and *wealth.*

This paper explains the above phenomena with a unified paradigm: they are primarily caused by the Information Technology (IT in short) revolution. IT effects on labor markets via automation and trade are well known (e.g. Acemoglu and Restrepo (2017) and references). The theoretical novelty of this paper is its demonstration *technological progress (even neutral) has a big effect on distribution, not only on growth,* which results from the fact that IT has caused rising monopoly power. This result is an application of a broader view that all major innovation waves cause rising monopoly power, profits and wealth, whereas slowing innovation rates cause a slowing or declining monopoly power, therefore income and wealth distribution fluctuate with rates of technological change. Exploring the distributional effects of IT is our first test of these ideas.

Our reasoning consists of five steps. In *asset valuation* step 1 (Section 1) we demonstrate the rise of monopoly power by showing that surplus wealth has grown dramatically since the 1970's,

[1] The author benefitted from extensive conversations with Kenneth J. Arrow, before his passing away, on an earlier 2016 draft of this paper and many of his suggestions are incorporated in this final version. He thanks Kenneth Judd and Maurizio Motolese for detailed comments; Robert Solow for constructive suggestions and for sharing with the author his personal note entitled "Monopoly Rent and the Functional Distribution of Income" on the subject at hand, with implications which are further discussed in the text, and Gavin Wright for helpful suggestions and for making available his paper which is cited. He also thanks Adi Gamon for insightful suggestions and detailed discussions about the nature and history of information technology; Zina Shapiro who provided invaluable help with WRDS Compustat data files and Linda Kurz for many helpful discussions and comments throughout this work. This paper is a revised version dated May 5, 2018 of our earlier paper entitled "On the Formation of Capital and Wealth."

reaching 82% of the value of all stocks and in the last 40 years it grew faster than capital. There are other explanations for wealth being larger than capital but a sharp rise in monopoly power *is the only plausible explanation for such magnitude of surplus wealth*. In step 2 we test the hypothesis surplus wealth is associated with IT transformed firms, establishing an empirical link of IT with monopoly power. Since monopoly profits result from limited competition, our step 3 is a *theory* explaining why we should expect these results, by studying IT properties that enable erection of barriers to entry and facilitate their maintenance and, once a monopoly power is established, they support expansion and consolidation of that power. Steps 2-3 are contained in Section 2. In step 4 (Section 3) we show why monopoly power causes rising *functional* inequality and explain that unique properties of IT also cause rising *personal* inequality. In step 5 we construct a growth model with monopoly power, study macroeconomic effects of rising monopoly power and show that rising monopoly power explains the empirical facts noted earlier. In this step we *assume* IT causes rising monopoly power, take it to be exogenous since the causal link between IT and monopoly power is not essential. We show that rising monopoly power explains rising share of monopoly profits - with falling shares of labor and capital incomes - reaching 23% of non financial firms' income in 2015, slow growth of output and wages, and has other macroeconomic implications.

Our goal is to measure the monopoly power effects of IT, therefore *magnitudes matter*: conclusions should be drawn only from significant magnitudes. We prefer to use standard tools but this is not always possible. Since we study IT and monopoly power, each part of the paper intersects with large literature related to it. We therefore clarify, *within each part,* where our work differs from or complements contribution of others. The most significant area of disagreement is the treatment of "Intangible Capital" or "Knowledge Capital" which we explain in detail in the next section.

1. Asset Valuation: The Evolution of Surplus Wealth 1950-2015

1.1a Conceptual issues, methodology and related literature

To compute any measure of wealth we usually think of a political entity, like a nation, as a unit of measurement, which is the way the Federal Reserve and the BEA aggregate US wealth in Table B.1 of *"Z.1 Financial Accounts of the United States"* (in short, Z.1), which reports net wealth of US residents. *This is not our approach*. Our unit of measurement is the firm and we ask two questions: how much capital does it employ and how much wealth does it create for its owners, *regardless of who they are and where they live.* Since we assess the market value of wealth the firm creates, our firm needs to have securities that trade on public exchanges with market prices. Such a firm employs capital which consists of assets valued in the firm's financial reports. The wealth created by the firm, shared by stockholders and bondholders,[2] is then deduced from the market value of the firm's securities. Hence, surplus wealth fluctuates over time.

Given the above criteria, we decided to use the WRDS Compustat data files for 1950-2015 that provide standard financial reports on all firms with securities trading on public exchanges. The number of firms reporting and coverage of files change from year to year for various reasons: not all firms respond, some firms provide incomplete information, new firms go public and old firms disappear either due to mergers or failure, etc. These problems are more pronounced in the earlier years of 1950-1970, when the number of reporting firms is relatively smaller. After 1970 our sample sizes exceed 3,000 firms; they contain all significant US corporations and the aggregates are reliable. We study only US based firms for which equity values are either available or could be constructed. Since the Compustat universe focuses on corporate business, it may appear it covers the combined sectors of "Nonfinancial Corporate Business" and "Financial Corporate Business" in the Z.1 report. This is not the case since the Z.1 reports cover *all* corporations, including private corporate firms with securities that do not trade publicly and, therefore, their values are imputed by Z.1 staff. Nevertheless, since our key arguments are based on order of magnitudes of the phenomena at hand, comparison with aggregates of the Z.1 reports show that *aggregates* of firms with traded securities in our Compustat samples' are very representative of the entire corporate private sector.

The complex accounting of *financial intermediaries* and the multiple participants in risk bearing of such firms raise deep conceptual issues. Viewing a firm as jointly owned by stockholders and bondholders is not applicable to a bank since the FDIC, the Federal Reserve and the General Public share, with stockholders and bondholders, its default risk. Such risk sharing is recognized by the market; it has an effect on the bank's "output" and is incorporated in its equity market value. Therefore, construction of "capital employed" in the bank's production function is a task beyond this paper. We thus avoid the Compustat individual balance sheets of financial intermediaries and

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[2] To that end we adopt the convention, common in the finance literature, that considers the firm a joint enterprise of stockholders and bondholders. The rules of ownership stipulate that bondholders are promised a specific return and stockholders receive all residual profits and take all residual risk. Assets of the firm and profits of stockholders constitute the collateral of the bondholders.

exclude from our samples all firms with SIC codes 6000 - 6499 (i.e. wider than just banks). Instead, we compute surplus wealth of "Financial Corporate Business" by using only the aggregates in Z.1 (Tables S.6.a and B.1). This procedure deprives us of detailed individual firm information we have for nonfinancial firms. Whenever possible, we report results for *combining* non-financial Compustat aggregates with Z.1 financial aggregates. When estimated asset values and capital are needed, results are deduced only for Compustat samples of non-financial firms. We will show, however, that our key results are virtually the same for the two sectors.

Since we use accounting data, we present first some accounting identities that explain our methodology and discuss adjustments we make in the financial reports to approximate surplus wealth. We then present in Table 1 several examples of these magnitudes for individual firms.

Start with standard accounting terms of total assets, intangible assets, total liabilities and market value, which is the market values of common stock at the date of the annual report plus book value of preferred stock. Net worth = Total Assets - Total Liabilities then leads to the definition of

(1) Excess Market Value = Market Value of Equity - Net Worth.

Absent any other factor, Excess Market Value = Surplus Wealth. The fact is, however, that surplus wealth is not necessarily equal to (1), since other factors are at work and some items on the balance sheet need to be taken into account. Our natural proxy for Capital is

(2) Capital = Real Tangible Assets = Total Assets - Intangible Assets - Redundant Assets

and we explain later why these two items are excluded. The definition of surplus wealth is then

(3) Surplus Wealth = Excess Market Value + Intangible Assets + Redundant Assets.

Total wealth created by the firm is the sum of the wealth of stockholders and bondholders

(4a) Total Wealth = Market Value of Equity + Liabilities

hence, by (1)

(4b) Total Wealth - Total Assets = Excess Market Value

and combining (2) and (3) and (4b) we have

(5) Surplus Wealth = Total Wealth - Capital Employed.

Intangible and redundant assets are surplus wealth *already on the balance sheet* of firms, and we later explain these data items, including the question of "Current Price" adjustment of total cost.

In a fully flexible Walrasian competitive economy *surplus wealth=zero* holds at all dates or, in a random setting, the surplus fluctuates around zero. The fact that the market value of a firm can be different from replacement value is, obviously, well known. It is the basis of Tobin's q (Brainard and Tobin (1968), Tobin (1969)), meant to measures *adjustment* potential in a competitive economy hence such difference is only temporary and over time the zero surplus equilibrium condition holds. Since we exclude from capital some assets, deep conceptual differences exist between our surplus wealth and Tobin q. Nevertheless, a large body of research uses the Tobin q as a tool to study problems related to surplus wealth. These studies show q fluctuates and explains concentration of economic activity. Such conclusions are often derived in the context of competitive economy (e.g. Salinger (1984), Wright (2004), Gonzalez and Trivín (2016), Gutiérrez and Phillipon (2016) and Peters and Taylor (2017)). We note particularly Wright's (2004) important observation that Tobin q's historical average over 1900-2002 is less than 1 but, in its fluctuations, *it rose in 1999 to the highest level in the 20th century of about 1.8.* Other papers show increased concentration without using Tobin's q. (e.g. Bessen (2016), Azar et. al. (2016a), Azar et. al. (2016b), Grullon et. al. (2016)) and some of them explain that increased market power of firms has *caused* the rising concentration.

The above empirical results support the core idea of this paper by providing vital empirical evidence for growing economic concentration and rising market power. Naturally, our perspective is different. When firms have market power, fluctuations of Tobin q does not reflect adjustment of a competitive economy to shocks and the three measures of (i) rising Tobin q, (ii) increased market concentration and (iii) rising pricing power, *are all endogenous outcomes* of the growing impact of IT. Being correlated is a result predicted by arguments developed in the theoretical part below.

1.1b The problem of Intangible Capital

Our exclusion of intangibles from "capital employed" is a deviation from recent literature. To explain it we note that the problems discussed at the outset, with emphasis on asset valuation, have puzzled many scholars, and one literature explained the high asset values (and other problems) by arguing that *intangible assets constitute a new form of capital*. A simple statement of their main argument says that intangible capital or, "knowledge capital", has high competitive returns hence it explains high asset valuation. High returns cause a shift towards intangible capital and away from labor and physical capital, explaining the decline in labor and tangible capital shares. (e.g. Hall (2001),(2003), Atkeson and Kehoe (2005), Hansen et. al. (2005), Hulten and Hao (2008), Eisfeldt and Papanikolaou (2013), Peters and Taylor (2017)). In addition, McGrattan (2016), and McGrattan and Prescott (2004), (2005) are papers that focus only on market values.

To evaluate the above argument we resort to standard competitive theory. Intangible Capital are assets which constitute ownership rights to patents, inventions, trade secrets or other forms of knowledge, hence "Knowledge Capital" and "Intangible Capital" are interchangeable. To check if a valuable patent owned by a firm is a "capital," we perform a hypothetical experiment. Imagine the patent expires at date t; hence, the firm has all prior knowledge but *not the ownership* of that knowledge. The revenue of the firm will fall not because the firm's productive capacity declines, but because the firm loses control of the price and competition brings it down. The patent has nothing to do with the productive capacity of the firm and its removal from the firm's balance sheet does not alter its productive capacity. The patent expiration alters the ownership of knowledge, and the value of the patent is actually *the market value of the right of the firm to prevent other firms from using this knowledge*. In a pure competitive economy knowledge is a public good; it is valuable but not owned by anyone, therefore the value of this patent is part of surplus wealth. Indeed, the market value of any intangible asset is exactly the market value of the right of the owning firm to prevent others from using the knowledge associated with that intangible asset. It is often legal for a firm to own property rights on knowledge or trade in them, and this only shows surplus wealth is valuable but not a factor of production. Consequently, a firm may purchase a patent or a trade secret, or it may purchase another firm that already owns some rights over some knowledge. In both cases the firm will record the value of these purchased assets as "intangible assets" on its balance sheet.

Suppose, next, that a firm purchases a software, with virtually zero marginal cost and price which reflects a monopoly power of the owner. Once the firm has the software's knowledge, its output is not altered by changes in the software's market value, even if its market price goes to zero. If firm j's production function is $Q_j = A_j F(K_j, L_j)$, then the software's *knowledge* (any knowledge) changes A_j or F but the *market value* of that knowledge is neither in L_j nor in K_j.

Finally, consider R&D expenses. Monopoly power, due to innovations, is temporary and subject to erosion by competing ideas. Therefore, firms with surplus wealth engage in intense technological competition over the knowledge that gave them monopoly power in the first place. Some R&D cost protect a firm's market position by improving products, demonstrating safety of new products, etc. More generally, R&D aims to bolster existing market monopoly power either by updating existing technology or by developing and broadening the reach of a technology to new applications. In either case R&D cover cost of securing added propriety knowledge whose value to the firm is exactly the market value of being able to prevent others from using that knowledge. This value is surplus wealth not invested capital. The act of investing in R&D to develop a patent is the same as purchasing the patent from another firm!

These are not new ideas. Grossman and Stiglitz (1980) show the production of knowledge cannot take place in a competitive economy. To appropriate returns from the cost of producing any knowledge, a firm must have a monopoly power over it, and the market value of that knowledge reflects its monopoly power. In short, standard competitive analysis implies intangible assets would have zero market value under pure competition and their positive value reflects a market power of the owners of such knowledge. Most intangible assets arise when firms acquire other firms with surplus wealth. We later demonstrate this fact with examples in Table 1.

The empirical success of the studies cited above actually support the main idea of this paper. Appendix A shows *the value of intangibles is about a quarter of total surplus wealth*, and the two are highly correlated. Hence, the results of those empirical studies would improve if they use surplus wealth in a non-competitive context instead of intangibles ("knowledge capital") in a competitive context. Similarly, all results of this paper remain valid even if intangible assets are recorded as capital, the difference being quantitative. Appendix A provides the relevant data.

1.1c Other data adjustments and errors

A. Asset Revaluation. Compustat asset values are stated in *historical* terms and need to be adjusted to current prices. We do it by using Table B.103 of Z.1 lines 1 and 45, where current and historical total asset values are provided, and the ratio between them for 1950-2015 is used to adjust Compustat asset values from historical to current values. Since most of the change in prices was due to changed value of real estate holdings, this adjustment ensures that surplus wealth does not contain any land value. This is so since market price of equity reflects the value of land owned while *current value* of assets contains those same values, hence by (1) the two cancel each other in the surplus.

B. Redundant Assets. If capital is an efficient input, a reduced amount of capital assets reduces the productive capacity of the firm. An asset is, therefore, said to be a *redundant asset* if a reduction in its quantity *does not* reduce the firm's productive capacity. This does not mean holding a redundant asset is irrational. It does mean redundant assets are excluded from capital needed for productive capacity and from the replacement value of the firm's assets; hence they are part of surplus wealth. Since reasons for holding redundant assets are not easily observable, the normal practice is to assume current valued assets are needed by the firm and are, therefore, the replacement value of the firm's capital. However, some redundant assets can sometimes be identified. By December 2015 the holdings of liquid assets by foreign subsidiaries rose to $2.4 Trillion (see Whalen and McCoy (2016)), while domestic holdings of liquid assets rose since 2008 by about $1.9 Trillion. These foreign assets increased due to a legal provision that allows Indefinitely Reinvested Foreign Earnings to be free of US income tax. Hence, $2.4 Trillion are kept abroad not out of productive needs but as a device to save income tax, hence not necessary for productive capacity. It is a part of the firm's value but not in as capital employed but rather as a surplus wealth. The reasoning that applies to recent abnormal domestic hoarding of liquid asset is more complex and appears as an outgrowth of the 2008-2009 financial crisis and the low interest rate since then. That part of these liquid assets which is not needed for normal operations of a firm or for its desired investment program, is surplus value. Management could distribute it as dividends or purchase their own shares to benefit shareholders, but they prefer to keep it under their control since they view it as costless and, possibly, useful for unknown future opportunities. Such motives are difficult to measure, and only little data is available about it; hence, we ignore it. As for the foreign held assets, we have data only for eight recent years and *whenever we use it we shall explicitly state so.* Most tables and figures that apply to 1950-2015 do not include foreign held assets. To help the reader assess the effect of including intangible and redundant assets in the surplus, we include in the basic data file of Appendix A the sample aggregates of intangibles. We also report in the text, whenever used, the amount of foreign held liquid assets. One can then recompute both total assets and surplus values to test the implication of excluding these items from the surplus.

C. Data errors. There are two data errors which we note. In aggregating capital employed and wealth created by firms, we add variables that we would have liked to control. First, when aggregating private debt, inter-firm holdings would be cancelled by indebtedness of firms that issued the debt. However, since most debt of firms is owned either by households or by financial institutions, and these are excluded from our aggregation, the effect of ignoring such inter-firm holdings is small. Since surplus wealth is computed by subtracting aggregate debts from aggregate assets, our inability to account for inter-firm holdings of debt *has no effect on surplus wealth*. The only effect is a small upward bias in the size of aggregate wealth generated by non-financial firms in our Compustat data. Second, we are unable to estimate the inter-firm holdings of equity within the non-financial Compustat universe, and this component causes an upward bias in the estimated size of capital employed. If firms own securities in firms outside this universe, their values are correctly recorded. Again, this data error *has no effect on the surplus* since any asset added to the balance sheet alters the market value of a firm and is hence cancelled in the estimated surplus. No doubt some measurement errors remain. Since the same procedure is used in all years 1950-2015, and since we mostly focus on ratios like (surplus)/(market value), the behavior of proportions over time is a reasonably accurate measure.

1.2 Surplus wealth in 2015

Table 1 explains our approach[3]and offers a first demonstration of the association of IT with

[3] In examining Table 1 recall that according to the Data Adjustment procedure in (A) above, the values of tangible and intangible assets in Table 1 equal their book value multiplied by 1.2456 (from Table B.103 of the Z.1) in order to adjust for their historical value. This increases capital employed and reduces the surplus. Since for rapidly growing high tech firms most assets are recently acquired, this procedure causes a downward bias in their estimated surplus wealth. For example, the book value of Facebook Inc. assets are only $49.407 Billion and most were acquired in recent years, yet Table 1 records them at $61.541 Billion. Also, as we explain later, Facebook's intangibles were acquired in 2014 and valued at $21.272 Billion, yet they are valued in Table 1 by the adjusted value of $26.496 Billion.

surplus wealth. It contains four groups of firms. Those in the first are in decline or slow growing, resulting in negative surplus wealth. One may view negative surplus as reflecting too high a value of capital but the surplus is market dependent. From December 2015 to December 2016 prices of Marathon Oil and US steel shares rose sharply, resulting in positive surpluses in 2016. We thus find that the first group, defined by $S \equiv \frac{\text{Surplus Wealth}}{\text{Total Wealth}} \leq 0$, constitutes 21.2% of our universe of 4,200 firms in 2015. The second group, defined by $0 \leq S \leq 0.30$, consists of relatively low tech firms selling standard goods or services with close substitutes and only small market advantage. It constitutes 13.7% of our universe in 2015. The third group, which constitutes 12.1% of the firms, is defined by $0.30 \leq S \leq 0.70$. Firms in this group have solid technological base and major market advantage.

Table 1: Selected Statistics for Some US Firms, Fiscal 2015

(Values in million of 2015 dollars)

Sample Firm by Four Groups	Total Assets at Current Prices	Intangible Assets at Current Prices	Total Debt	Market Value	Capital Employed	Foreign Liquid Assets	Surplus Wealth	$\frac{\text{Surplus}}{\text{Total Wealth}}$	$\frac{\text{Surplus}}{\text{Market Value}}$
US Steel	11,447	244	6,754	1,167	11,203	na	- 3,282	-0.41	-2.81
Marathon Oil	40,247	143	13,758	8,523	40,104	na	-17,823	-0.80	-2.09
General Motors	242,294	7,408	154,197	51,015	234,887	na	-29,675	-0.14	-0.58
Chevron Corp.	331,458	5,715	112,217	169,378	280,343	45,400	1,252	0.00	0.01
Berkshire Hathaway	687,891	94,004	293,630	325,196	583,487	10,400	35,339	0.06	0.11
Northfolk Inc.	42,674	0	22,072	25,190	42,674	na	4,588	0.10	0.18
Caterpiller Inc.	97,776	11,753	63,612	39,575	69,022	17,000	34,165	0.33	0.86
General Electric	613,697	102,476	389,582	292,164	407,222	104,000	274,525	0.40	0.94
Southwest Airline	26,546	1,786	13,954	27,886	24,760	na	17,080	0.41	0.61
Microsoft	361,821	27,122	96,140	354,392	226,399	108,300	224,133	0.50	0.63
Honeywell International	61,428	25,500	6,284	55,428	19,328	16,600	42,384	0.69	0.76
Dow Chemicals	84,733	19,644	41,843	61,500	46,316	18,773	57,027	0.55	0.93
Apple Inc.	361,821	11,222	171,124	615,336	259,099	91,500	527,361	0.67	0.86
Alphabet (Google) Inc.	219,503	24,558	27,130	528,168	136,645	58,300	418,653	0.75	0.79
3M Corp	40,754	14,760	20,971	91,789	13,994	12,000	98,767	0.88	1.08
Pepsico Inc.	86,777	32,919	57,637	144,684	13,658	40,200	188,663	0.93	1.30
Amazon.Com	81,517	5,631	52,060	318,344	75,886	na	294,518	0.80	0.93
Amgen, Inc.	89,155	32,919	43,493	122,397	23,636	32,600	142,254	0.86	1.16
Celgene Corp	33,697	19,602	21,134	94,203	14,095	na	101,242	0.88	1.07
Facebook	61,541	26,496	5,189	297,758	35,045	na	267,902	0.88	0.90
Aggregate Compustat (N=4200)								**0.44**	**0.71**
Including Financials								**na**	**0.79**

Source: WRDS Compustat files for 2015 (see Data Appendix C)

The fourth group, defined by $S \geq 0.70$ constitutes 53% of the 2015 firms and reflects the advanced US sector transformed by IT where most innovations take place[4]. We stress that IT is not restricted to traditional sectors such as semiconductors and computers, but applies to all firms in

[4] In December of 2015 Apple Inc. and Microsoft's equity prices were relatively low. Between 12/31/2015 and 5/1/2017 Apple Inc. price rose by 36.25% and Microsoft's by 46.76%. Both firms moved from group 3 to group 4.

diverse economic sectors that have advanced technological base transformed by the IT revolution. Technologically advanced firms have surplus wealth that, in most cases, exceeds 80% of total wealth created. The aggregates at the bottom are ratios of the totals over the 4,200 Compustat firms in 2015. Hence, when capital *includes* assets held abroad, we find that surplus wealth is 44% of all wealth created and 71% of total market value of non financial firms. If we add aggregate data for *financial* firms, the ratio of surplus wealth to total market value rises to 79%. Finally, when we adjust capital and surplus wealth fully for foreign held assets, we find that *total surplus wealth equals 82% of total stock market value and 78% of capital employed*! This shows that surplus wealth is so large that 82% of all value that changed hands on stock exchanges in 2015 was trades of surplus wealth. In 2015 US wealth ownership was in a state where capital invested is approximately financed by bondholders, while stockholders own and trade surplus wealth.

The intangibles in Table 1 offer examples for our earlier argument, and Facebook is one. Facebook was started in 2003 as a social website at Harvard and incorporated in 2004. As a corporation, it began with initial investment of less than $50 Million but raised $16 Billion in its initial public offering in 2012. During 2012-2014 it acquired Instagram, Whatsapp, Pryte and LiveRail- with negligible capital on their balance sheet- for about $20 Billion, accounting for most of its $21 Billion[5] intangibles in 2015. In that year its gross profit margin was 84%; in December 2015 capital employed was $35 Billion and total created wealth was $303 Billion. By May 2017 its surplus wealth exceeded $450 Billion, a capitalization that was due to the fact that the firm is growing fast and has no effective competitors. Competitors like LinkedIn can, at best, establish a sub-network with narrow focus. In effect, the firm controls a world public utility with strong externalities. Facebook Inc. is an extreme case, but its monopoly power is typical.

Facebook shows why intangibles *are associated with rapid acquisitions*. In Table 1 Amgen, Celgene, Pepsico, Alphabet, Honeywell, General Electric and Berkshire Hathaway also have large fractions of intangibles due to active acquisition record. Apple, Amazon.com, Chevron and Southwest Airlines do not have such history, hence a smaller fractions of intangibles. We also note that (4a) and (5) imply that if (surplus)/(market value) > 1, debt exceeds capital and there are many such examples (e.g. Pepsico Inc.). These occur when an acquired firm is liquid on its own and is used as a collateral

[5] Intangibles of Facebook Inc. in Table 1 are recorded as $(21,272)×(1.2456) = $26,496

for bondholders to finance the acquisition. In such a case bondholders own more than a firm's capital.

Empirical evidence points to a very large surplus wealth in 2015. We now study its growth over the last half century. Is it a recent phenomenon? Have the surplus ratios changed over time?

1.3 Surplus wealth 1950-2015

1.3a The general tendency.

Appendix A reports aggregate Compustat data and in Figure 1 we draw two curves for 1950-2015. One is surplus\(market value) for Compustat samples combined *with the financial corporate sector* and the second is this same ratio for the Compustat samples alone. In both cases the surplus is computed without excluding foreign liquid assets from capital.

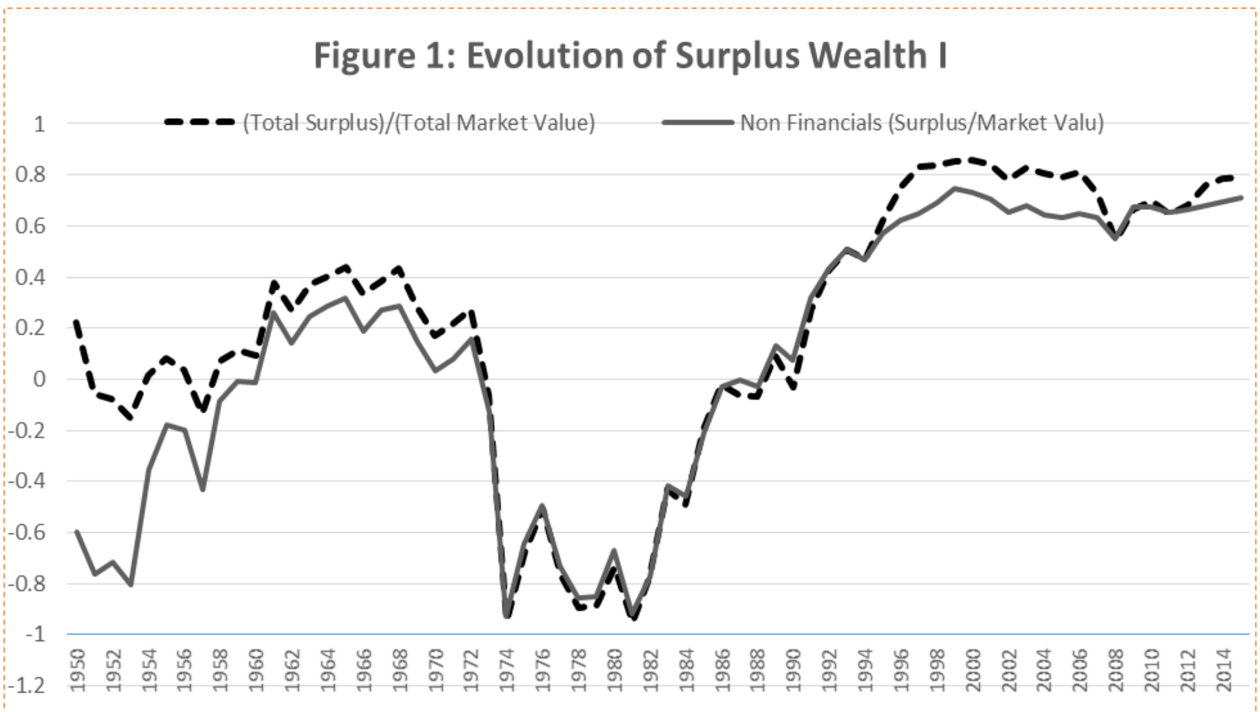


Figure 1: Evolution of Surplus Wealth I

Although Compustat samples are not a panel, aggregate ratios are reliable and consistent over time. Figure 1 shows the large 2015 surplus in Table 1 is the culmination of growth that began in the 1970's. In the mid 1950s there is virtually no aggregate surplus wealth up to about 1958, after which a significant surplus developed as a result of the hardware innovation phase of the IT revolution in the 1960's. This surplus did not last. Most discussions of early 1970's focus on productivity slowdown and stagflation but the figure shows the effect on corporate profits and private wealth was catastrophic:

total surplus fell from $372 Billion and 43% of total market value in 1968 to –$590 Billion in 1974.

Conditions changed, and a new era began in 1974-1982 that has continued until today, in 2017. This is the span of time that corresponds exactly to the second, software phase, of the IT revolution. The surplus rose from the low in 1974 to a temporary peak of $14.025 Trillion and 86% of total market value in 2000. During 2000-2015 the surplus and total wealth continued to rise, but the ratio of surplus\(market value) remained in the 70%-80% range except for 2008-2012. The peak was in the dotcom boom and the decline in 2008-2012 was due to the Great Recession. To isolate a trend one may interpolate and conclude that the rising surplus\(market value) ratio continued into 2015 when, adjusting capital and surplus for foreign holdings, it reached 82% of the stock market value. It is hard to find any evidence the process of rising surplus wealth has come to and end.

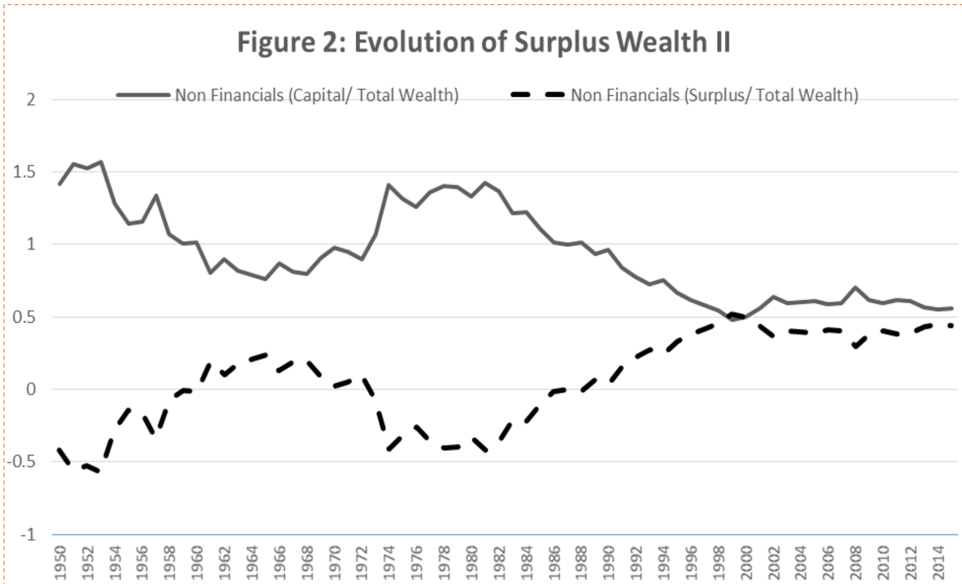
Figure 1 reveals two more facts. First, surplus ratios were negative in the 1970's; hence, the rise after 1974 was, partly, a recovery from the 1968-1974 collapse. Actual recovery began in 1981-1986 and we show later that *this is exactly the time the software phase of the IT revolution went into high gear*. Second, comparing the surplus of non-financial firms with the surplus of the combined sectors reveals they are the same, with two minor differences in early 1950s and in 1996-2006. Therefore, we study several questions using only the non-financial firms' data in the Compustat universe, but such conclusions also apply to financial firms.

1.3b Growth rates of capital and wealth.

In Figure 2 we plot two aggregate ratios for the non-financial samples (without adjusting for foreign assets): capital/wealth and surplus/wealth. Since wealth consists of the ownership values of stockholders and bondholders, Figure 2 shows that over 1980-2015, capital/wealth declined from 1.33 to 0.56, and surplus/wealth rose from -0.33 to +0.44; hence, capital invested grew much slower than wealth. We compare these two growth rates by using the GNP deflator to restate both non-financial values in millions of 2015 dollars:

	1980 Value	2015 Value	Mean Growth Rate 1974-2015
Total Non-Financial Wealth:	5,523,338	32,364,579	4.91%
Total Non-Financial Capital:	7,365,166	18,017,771	2.48%

The difference of 2.43% reflects (i) a 5.54% growth rate of real market value, and (ii) the change in the leverage rate which we examine later. Such large differences in growth rates between total wealth and capital employed cannot continue indefinitely, but it is not evident where the process is heading.



1.3c *The Real size of surplus wealth 1974 - 2015.*

How large is the surplus and what is its composition? We present in Table 3 real values for selected years in *billions of 2015 prices* (using GNP deflator). The table shows that *between 1974 and 2015 real surplus wealth increased by $ 25.9 Trillion* with ownership which is heavily concentrated. The sheer size of this surplus calls for rethinking of standard views about the relation between innovations and wealth distribution.

Table 3: Size and Composition of Surplus Wealth

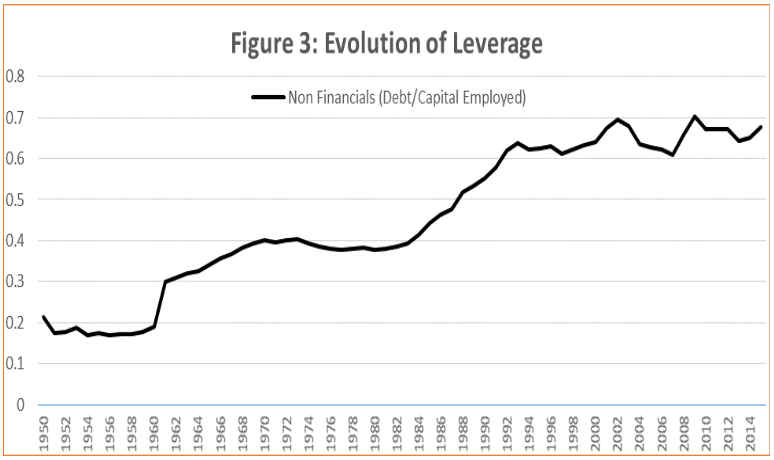
(Billion of 2015 Dollars)

Year	Non-financials Excess Market Value	Non-financials Intangible Assets	Untaxed Foreign Asset Holdings	Non-financials Surplus Wealth*	Financial Sector Surplus Wealth	Total Surplus Wealth
1974	-1,882.85	82.60	na	- 1,800.25	-252.70	-2,052.85
1980	-1,918.22	76.39	na	- 1,841.83	-393.03	-2,234.86
1986	- 357.00	242.47	na	- 114.53	19.18	-95.31
1992	1,775.53	466.15	na	2,241.68	434.63	2,676.31
2000	10,232.61	2,149.65	na	12,382.26	5,588.41	17,970.68
2010	5,744.77	3,625.87	1,363.00	10,733.64	3,392.93	14,126.56
2014	9,660.70	4,752.54	2,299.00	16,712.24	7,270.44	23,982.67
2015	8,805.44	5,541.37	2,434.00	16,780.81	7,067.44	23,848.25

Source: Compustat files and Z.1 (see Appendix C). (*) Non-financials surplus is the sum of the first three components

1.3d Dynamics of corporate leverage.

Figure 3 plots debt/capital ratio of non-financial firms for 1950-2015 (no adjustment for foreign holdings). It shows high leverage in 2015 is the culmination of a sequence that began in the 1950s where US businesses increased leverage from 22% of capital employed to 68%. If we adjust capital for foreign holdings this percentage rises to 78%. Indeed, a large number of advanced technology firms exhibit debt/capital > 1; hence, lenders are willing to accept intangible assets as collateral.



These changes lead to a state where the financial structure of the non-financial corporate sector may be approximated by a leverage ratio of 1, when bondholders finance the capital stock and receive a stipulated return, while stockholders own and trade surplus wealth, bearing all profit risks. Such division is possible if the surplus is large enough to provide bondholders with a safe collateral. From this perspective, most value and risk traded on the stock market is of surplus wealth, while ownership of the firm's capital employed is mostly traded on the bond market. Figure 3 shows these conclusions did not hold in 1950, and the growth of a large surplus wealth made this development possible.

Having shown surplus wealth is very large and has risen sharply, we turn to explain why IT is *the cause* for the rise in monopoly power, an increased surplus wealth, and therefore for the rise in both functional and personal inequality.

2. Demonstrating Why IT is the Cause of Rising Surplus Profits and Surplus Wealth

What caused surplus wealth to rise over 1974-2015? Some firms have large surplus wealth due to well known American brands with recognized pricing power (e.g. Coca Cola), but Table 1 points to a more widespread surplus. To explain it textbooks appeal to advantages a firm has, such as skilled labor force, superior management, location, control of a resource, patents' protection, customer's loyalty or similar reasons. Superior labor force and outstanding management are appropriately compensated in competitive markets, hence all these amount to saying the firm has some monopoly or oligopoly pricing power. Other causes invoked are capital adjustment cost, liquidity services of a firm's assets, and taxes. These are valid reasons that reflect market friction. However, the *magnitude* of surplus wealth exhibited in Section 1 is incompatible with friction. It is so large that monopoly power is the only plausible explanation. Note that we use the term "monopoly power" in the broadest sense of a power to impact a firm's profitability by monopoly, oligopoly, monopolistic competition or by monopsony power over the firm's suppliers. It then follows that to demonstrate that IT has caused the observed surplus wealth we need to show that IT has caused the rising monopoly power.

2.1 All innovation waves cause rising monopoly power

As noted earlier, this paper is an application of the general theoretic view that rising innovation waves cause rising monopoly power and therefore technological advance impact income and wealth inequality. Therefore, to explain the rising monopoly power we shall demonstrate, in the next section, that the *timing* of IT development match exactly the growth pattern of surplus wealth.

To briefly explain the conjectured general principle, note that the term *monopoly wealth* may elicit a wrong impression that US firms are engaged in illegal acts since during the Robber Barons' era large surplus wealth was attained by collusion, intimidation, corrupt legislators and other illegal means. In comparison, most surplus wealth of the 20th and early 21th centuries is legal and actively supported by public policy. To encourage innovations, our laws protect patents and intellectual property rights, granting innovators monopoly power over the results of their innovations. But, once an initial monopoly is established, advantages of first mover together with a mix of updated patents, intellectual property rights and trade secrets, make it very hard for potential competitors to enter the market. In addition, firms with market power employ diverse strategies to choke off competing innovations, including the purchase of competitors.

It follows that increased rates of technical progress increase the economy's average monopoly power and move markets further away from competitive behavior. Legally protected monopoly power creates a conflict between competitive institutions and innovative creativity. Therefore, economic growth with technical change cannot be fully described by the competitive equilibrium of an economy, most results of competitive growth theory with technical change are internally inconsistent, and most of their applications, such as Solow's (1957) total factor productivity estimates, are flawed. Even the case of Cobb-Douglas production function with neutral technological change does not imply constant relative shares when monopoly power changes over time.

But reality is even more complex. First, patents and trade secrets wear off with time, hence legally protected pricing power has limited duration. Second, high profitability attracts competing innovations; therefore, under rapid innovations the real competition is among innovators, leading to patent races. Given long enough time, the power that brings down an innovator's monopoly is a competing innovation, which, if successful, replaces one innovator's pricing power with another, who offers a superior product. This is what Schumpeterian "creative destruction" is all about. Hence, during long periods of rapid technical progress, consumers may face a *sequence* of protected monopolies, each replaced by a subsequent market power of a new innovator and therefore there is a permanent monopoly power in the economy. Third, if innovations stop, legal protection and economic advantages of monopoly dissipate, and markets converge back to competitive conditions.

Pricing power then results from two opposing forces: declining technologies cause monopoly power to decline, while rising new technologies cause rising pricing power. This effect can be seen in Figure 1. A powerful *hardware innovation phase of IT* took place in the 1960s, and the rise of surplus wealth, reaching 43% of total market value in 1968, is no accident. Mainframe computers gained wide use during the 1950s, and the minicomputer was introduced in the 1960s. These developments stalled after 1968, leading to the "productivity slowdown" when a slower innovation rate caused surplus wealth to collapse and vanish by the early 1970s. These were replaced by the PC and Internet, leading to the *software innovation phase of IT*, that took hold in the 1980s, and which is in place today.

But all of this is, indirectly, anticipated in the literature. It motivated Schumpeter's (1942) view on creative destruction and his opposition to neo-classical theory. Arrow (1962) stresses that innovations require monopoly patent protection to enable innovators to appropriate benefits. Grossman and Stiglitz (1980) demonstrate that equilibrium with production of information cannot exist without monopoly power of producers. Although addressing specific problems, Aghion and Howitt (1992) and Barro and Sala-I-Martin (1992) study growth models with monopoly power. Finally, all Industrial Organization work on innovations, R&D, patent races etc. assume monopoly power of innovators (e.g. Tirole (1989) Chapter 10). In Section 4 we return to this issue as we study economic growth with a monopolistic competition model.

The above applies to all innovations. We turn now to study properties of IT that further explain why it caused the rising monopoly power as seen in the data of Section 1.

2.2 *Timing of IT innovations matches exactly the growth pattern of surplus wealth*

Figure 1 shows that surplus wealth stopped falling in 1974, fluctuated until 1981 when it began to rise. This timing matches exactly the dawn of the software innovation phase of the IT revolution and two events mark it: Apple 1 was released in 1976 and IBM's PC was released in 1981. The figure also shows actual long term recovery of surplus wealth began around 1981-1986, and this is exactly when the new software innovation phase of IT went into high gear. IBM adopted Microsoft's DOS as the PC operating system in 1981, the military communication network (ARPANET) adopted in 1983 the protocol TCP/IP which expedited development of what we call today "the internet," and Microsoft went public in 1986. Celgene was founded in 1986 and Gilead Sciences was founded in 1987.

The rise of surplus wealth was accelerated during the 1990s, and this timing corresponds to the fact that in 1993, Marc Andreesen developed Mosaic, the first web browser, which changed name in 1994 to Netscape Navigator. It lead to a battle over dominance of search engines, which resulted in the temporary dominance of Microsoft's Internet Explorer, released in August 1995. Other milestones which accompany the rise of surplus wealth are:

- Amazon.com was founded in 1994;
- Expedia was founded in 1996
- Netflix and Priceline.com were founded in 1997;
- Google was founded in 1998 and its algorithm came to dominate internet search;
- Many other innovations sharply accelerated usage of the internet and inaugurated the sharp rise of capital spending and economic expansion in 1995-1999. It lead to the dot com boom;
- Facebook was founded in 2004;
- Uber was founded in 2009.

The IT revolution not only transformed many older firms but it spawned a very large number of new firms. We show later many of the firms with the largest surplus wealth did not even exist before 1974.

2.3 *Statistical evidence of an association of IT with surplus wealth*

Table 1 points to our conclusion that high surplus wealth of firms are associated with sectors with higher degrees of IT transformation. Being a General Purpose Technology (GPT as in Bresnahan and Trajtenberg (1995)) IT transforms firms in *diverse sectors* into becoming advanced technology firms, and it will ultimately transform the entire economy. Our basic hypothesis is that IT is the cause of rising monopoly power and surplus wealth and our statistical hypothesis is that *surplus wealth is associated with the degree of IT transformation*. The problem is that IT lead to the creation of diverse new sectors and it transformed other sectors with diverse business practices and diverse elasticities of demand or supply which impact the magnitudes of surplus wealth. Hence, fully transformed firms and those firms that did not even exist before the IT revolution, will all exhibit different magnitudes of monopoly rent and surplus wealth that vary with the factors noted. In other words, there does not exist one "index of IT transformation" with which to exhibit a single valued *quantitative structural relation* between IT and surplus wealth. Some measures were experimented with by Bresnahan et. al. (2002) who measured it by specific IT equipment used and by Bessen (2017) who defined it by the proportion of hours worked by IT personnel (i.e. computer analysts, computer scientists, etc.). These are not convincing measures for several conceptual reasons, and I use Bessen's measure as an example.

(i) *Differences in business models.* Consider Apple, Amazon and Celgene, all products of IT and *100% IT transformed*. They have drastically different business models with very different proportions of IT personnel. Apple purchases all components from other firms and outsources all manufacturing. Therefore, the proportion of its IT personal is much higher than Amazon, who has a large retailing operation which only increased after adding the 91,000 employees acquired with Whole Food stores. Celgene is in-between the other two. Although it does all of its own manufacturing, it is on a relatively small scale. These three firms have very *different* Bessen's (2017) proportions of IT personnel, but the *same degree* of IT transformation.

(ii) Difference in source of monopoly power. Apples' surplus wealth results from monopoly ownership of superior consumer products, Amazon's surplus wealth arises from retailing monopsony power over suppliers, while Celgene surplus results from its monopoly over biotechnology drugs it owns. These depend upon three different elasticities which can hardly be explained by the simple measure of IT personnel.

(iii) Differences in tasks of IT personnel. Even within the same industry with the same demand or supply functions, IT personnel may perform different tasks and therefore mean different things. Firm A may have large IT personnel who *operate* a successfully IT transformed firm (with surplus) while firm B, in the same industry, may have large IT personnel engaged in an effort to IT transform the firm (hence without a surplus wealth).

In short, theory shows that a simple head count such as Bessen's (2017) or number of IT pieces of equipment cannot explain differences in surplus wealth among firms. A low R^2 of a regression with dubious interpretation is not a convincing test of our hypothesis that IT is the cause of surplus wealth.

Instead of using an observed firm structural variable to predict surplus wealth, we formulate a *statistical test* of the hypothesis that IT transformation is associated with surplus wealth. To that end we use prior public information on those sectors/activities *which are fully IT transformed*. These are sectors, or activities, known publically to use business models which are fully IT-dependent, and would not exist in their present form without IT. The list of "fully IT transformed sectors" is as follows: Computer and semiconductors, online retailing and home delivery; online taxi reservations, on-line travel and leisure reservation services; telecommunication and mobile telephone with sectors dependent upon it, from payment technologies to electronic home management; film production and movie streaming; artificial intelligence and cloud computing; defense industries; Biotechnology drugs and genetic seed alteration, and social media. This is not a subjectively selected list of sectors. Most of them did not even exist before 1974, and those like ATT and Verizon, are included since their current business model would not exist without IT. Belonging to this list is an incomplete record of the full effect of IT on the economy, since the list does not contain many partially transformed firms in sectors such as automobiles or banks. Computers and robots have dramatically changed these sectors but further innovations are needed to complete their transformation.

For each of the 4,200 firms in our 2015 Compustat sample we thus define the following index:

$$\chi_i = \begin{cases} 1 & \text{if} \quad \{\text{firm } i\} \in \{\text{fully IT transformed sectors}\} \\ 0 & \text{if} \quad \{\text{firm } i\} \notin \{\text{fully IT transformed sectors}\}. \end{cases}$$

Consider two equal sized samples of firms out the 4,200 firms, one consisting of firms with $\chi_i = 1$ and a second with $\chi_i = 0$. If IT is not associated with surplus wealth we would expect total wealth of the two samples to be the same. Indeed, consider a sequence of such equal sized random samples, and compute, for each sample, total surplus wealth and $\bar{\chi}$ - the proportion of IT transformed firms in the sample. Then, a positive correlation, across samples, between total sample surplus wealth and $\bar{\chi}$ would support the hypothesis that IT is positively associated with surplus wealth. That is, this hypothesis implies that the larger is $\bar{\chi}$, the larger we expect the surplus of the sample to be.

The above sampling program is time consuming. We used a simpler approach by computing χ_i values for only 500 firms whose surplus wealth was controlled as follows. Sorting by *the size of* *surplus wealth*, we selected (i) the 200 firms with largest surplus wealth; (ii) the 200 firms with smallest surplus wealth; (iii) 100 firms around the mean value of surplus wealth. For each firm we also computed Tobin q $= \frac{\text{wealth}}{\text{capital}}$ where intangibles were excluded from capital but liquid assets held abroad were not (most are unknown). 50 firms with the largest surplus wealth account for 50.4% of aggregate surplus wealth of non-financial US business in 2015, and the top 200 account for 74.4% of the total, hence our coverage is rather extensive. A large number of small firms have positive or negative surplus and some large firms with large absolute value of negative surplus wealth are in the bottom group. Details are available in Appendix C and the record of the 500 firms is in Appendix B.

To illustrate, Table 2 records 20 firms from each of the three groups. Note two facts. First, 9 out of the top 10 firms belong to the IT transformed sector. Second, the three groups have mean values $\overline{\chi} = 0.75$, $\overline{\chi} = 0.45$ and $\overline{\chi} = 0.05$, showing that *surplus wealth rises sharply with the value of* $\overline{\chi}$, thus supporting the conclusion of a strong association of IT transformed firms with surplus wealth.

Table 2: 60 US Firms with Largest, Middle and Smallest Surplus Wealth in 2015

(Values in Million of 2015 dollars, data without foreign liquid holdings)

20 Firms with Largest Surplus Values			20 Firms with Surplus Values Around the Mean			20 Firms with Smallest Surplus Values		
Firm Name	χ Value	Surplus Wealth	Firm Name	χ Value	Surplus Wealth	Firm Name	χ Value	Surplus Wealth
APPLE INC	1	435861	LIBERTY VENTURES	0	3552	YAHOO INC	1	-7283
ALPHABET INC	1	396179	FRONTIER COMMUN.	1	3539	WILLIAMS PARTNERS LP	0	-7496
AMAZON.COM INC	1	294519	BLUE BUFFALO PET PRODU	0	3536	ENTERGY CORP	0	-7558
AT&T INC	1	269517	BLACKBAUD INC	1	3517	ICAHN ENTERPRISES LP	0	-7670
FACEBOOK INC	1	267902	FMC TECHNOLOGIES INC	0	3490	AES CORP	0	-7670
VERIZON COMM.	1	260112	TREEHOUSE FOODS INC	0	3480	PLAINS GP HOLDINGS LP	0	-9648
MICROSOFT CORP	1	258150	WILLIAMS COS INC	0	3462	ENERGY TRANSFER EQUITY	0	-10672
JOHNSON & JOHNSON	1	238127	OUTFRONT MEDIA INC	0	3431	NEWMONT MINING	0	-10759
PROCTER & GAMBLE CO	0	209646	AMERICAN WATER WORKS	0	3423	LEUCADIA NATIONAL	0	-12449
PFIZER INC	1	203586	PRA HEALTH SCIENCES INC	1	3406	ENERGY TRANSFER PARTN.	0	-13729
COMCAST CORP	1	177803	BRINKER INTL INC	0	3404	HESS CORP	0	-14465
GENERAL ELECTRIC CO	1	170531	BIO-TECHNE CORP	1	3401	FREEPORT-MCMORAN INC	0	-15417
COCA-COLA CO	0	167927	ACADIA PHARMACEUTICAL	1	3380	AGNC INVESTMENT CORP	0	-15787
ORACLE CORP	1	162979	CHARLES RIVER LABS INTL	1	3377	MARATHON OIL CORP	0	-17822
WAL-MART STORES INC	0	160896	CAVIUM INC	1	3370	STARWOOD PROPERTY	0	-19919
ALLERGAN PLC	1	160859	COMMUNICATIONS SAL& LS	0	3356	ANNALY CAPITAL MANAG.	0	-20543
PHILIP MORRIS	0	151843	WEX INC	1	3354	EXELON CORP	0	-21681
PEPSICO INC	0	149538	EPAM SYSTEMS INC	1	3342	FORD MOTOR CO	0	-27908
DISNEY (WALT) CO	1	147021	SONOCO PRODUCTS CO	0	3331	GENERAL MOTORS CO	0	-29675
IBM	1	135571	B&G FOODS INC	0	3327	CHEVRON CORP	0	-44148
Mean χ Value	**0.75**			**0.45**			**0.05**	

As for Tobin q, recall Wright's (2004) result that Tobin q fluctuates, reaching a random value of 1.80 in 1999, which is the highest ever. Tobin q can be very large for firms with small capital employed hence this measure is very volatile over small firms. However, in 2015, mean Tobin q for the 100 firms with largest surplus wealth was 3.73, while 1,223 firms out of the 4,200 had Tobin q higher than 3.00. Mean Tobin q for the 200 firms with the smallest surplus wealth was 0.75.

Examining, in Appendix B, the 50 firms with the largest surplus wealth shows that the surplus is found mostly in two categories of firms. Either firms with market power due to well established brand names such as Coca-Cola, Pepsico, McDonald's, Philip Morris, Atria and Reynolds American or in firms transformed by IT, and there are 36 of them out of the 50. Most of these 36 firms did not even exist the 1970s, when the software phase of the IT revolution starts.

Finally, Table 3 reports values of $\bar{\chi}$ for the specified groups of firms, listed in rising order of their surplus wealth. The values of $\bar{\chi}$ rise sharply, showing again that high values of surplus wealth are strongly associated with the degree at which firms have been transformed by IT.

Table 3:Values $\bar{\chi}$ for Groups with Falling Surplus Wealth

Group of Firms	$\bar{\chi}$ Percent of Firms in Group Transformed by IT
10 Firms with the smallest surplus wealth	0
100 Firms with the smallest surplus wealth	1
Second 100 Firms with smallest surplus wealth	5
100 Firms with surplus wealth around the mean	35
Second 100 Firms with the largest surplus wealth	45
100 Firms with the largest surplus wealth	73
10 Firms with the largest surplus wealth	95

We targeted the relation of IT with *size* of surplus wealth in a group, not surplus normalized by firm size, measured by wealth, capital or market value. Our file contains many small firms and measures like $\frac{\text{surplus}}{\text{wealth}}, \frac{\text{surplus}}{\text{capital}}$ or $\frac{\text{surplus}}{\text{market value}}$ lead to *artificially high correlation* between surplus wealth and IT transformation since a large number of small high tech firms dominate $\chi_i = 1$ and many failing oil and natural resource firms dominate $\chi_i = 0$. Also, giving equal weight to Apple and a small firm with negligible surplus is unsatisfactory. Firms with varying sizes are scattered over the file and many large firms are found among the bottom 20 firms in Table 2.

2.4 Economic theory explains why IT would cause rising monopoly power and surplus wealth

Proof that IT causes a rising monopoly power follows from the economic theoretic observation that every innovation wave causes rising monopoly power and the 1974-2015 rise of monopoly power corresponds exactly to the rising tide of IT innovations. This fact also motivates us to explore, in Section 5, a growth model with monopoly power. However, to amplify this point we explore some unique IT properties that further facilitate the erection of barriers to entry which, given the advantage of an initial monopoly power, enable IT innovators to consolidate and enhance their market power.

(i) *The kernel of monopoly power: private ownership of knowledge.* Innovators are sole owners of information they can prevent others from using, which is the kernel of their monopoly power, and this is how barriers to competition begin. To consolidate market power innovators build added barriers to entry that take the form of multiple layers of related innovations which constitute a protective "moat." These innovations were facilitated by the drastic decline in the cost of processing and storing information and by the growing computer chip miniaturization, which enables ever growing range of applications. These IT properties have facilitated the maintenance of leadership position of innovators' firms by the use of many layers of new patents, intellectual property rights or simple trade secrets. Such firms protect market power by on-going upgrades of their technology, making it harder for competitors to catch up. A weapon often used is to buy out potential competitors. A purchasing firm may enhance such new technology but sometimes it uses its ownership to suppress it.

(ii) IT enables network externality on platforms. As noted, IT enables vast amount of information to be communicated and shared, at electronic speed and with steeply declining cost, by a large number of agents. This is a unique coordination property of IT in human history. For this reason, IT transformed many firms into "platforms" which consist of public users, buyers, ap developers, suppliers, business partners etc. all coordinated on a single set of activities. These facts create network externalities among participants at virtually zero marginal cost to the platform firm and replicating such externalities is very difficult and constitute an additional barrier to entry. In addition, using IT tools, such a firm extracts large amount of hitherto private information of the public, which becomes valuable property of the platform firm and further expands its monopoly power.

(iii) IT Platforms: increasing returns and rising optimal firm size. Apart from declining cost over time, IT entails increasing returns to scale and declining marginal user cost of platform firms, over a wide and rising range. Scale economies, coordination externalities and falling computing cost facilitate firm management and increase optimal firms' size. In many cases they lead to a "winner takes all" outcome documented by Autor et. al. (2017) and rising economic concentration (e.g. Bessen (2016), (2017), Azar et. al. (2016a), Azar et. al. (2016b), Grullon et. al. (2016), Gonzalez and Trivín (2016), Gutiérrez and Phillipon (2016) and Peters and Taylor (2017)). This literature provides strong empirical and conceptual support for our perspective.

(iv) IT enables communication to increase customer loyalty. A growing number of "customer loyalty programs" allow firms to communicate directly with their customers, to offer added benefits to active customers. Some programs do not charge any fees (e.g. retail stores or hotel chains), but others charge fixed fees which are major sources of income (e.g. Costco, Amazon Prime, credit cards of airline miles programs). Operating such programs is enhanced by the Internet's emergence as a business tool and falling computing cost. Apart from being a source of income, loyalty programs enable firms to discriminate among its customers, as any monopoly would.

3. Explaining the Rise of Functional and Personal Inequality

Since rising monopoly power results in rising share of monopoly profits, a rise in monopoly power alters the functional distribution of income by reducing the shares of labor and of normal capital input. Since we have shown in Section 1 that the US is close to a state where bondholders finance all invested capital, rising monopoly power has caused a rise in the relative share of monopoly profits by the approximately the same percentage points by which it has lowered the relative shares of labor and interest incomes of the private corporate sector. Consequently, we first estimate the relative share of monopoly profits in total income created by the US corporate sector. We actually provide *three independent estimates* of this magnitude, one presented next, which is deduced from the surplus wealth observed in Section 1. The other two are developed in Section 4.

3.1 Test I: an asset based "back of the envelope" estimate of the share of monopoly profits

Estimates of surplus wealth offer a first estimate of the share of monopoly profits in private sector output. This output is divided into three: labor share, capital share and share of monopoly profits. Figure 1 shows that in the early 1980s, there was no surplus wealth and therefore, the share of monopoly profits was zero. Table 1 shows that in 2015 non-financial corporate business exhibited $\frac{\text{surplus}}{\text{wealth}} = 44\%$. Later in Table 4 we show that adjusted for self-employed and management income, relative labor share was 0.52 in 2015; hence, the shares of competitive capital income plus share of monopoly profits in output was 0.48. Assuming, for simplicity, that the rate of return on capital equals the rate on surplus wealth, we have two equations: $R(K+S) = 0.48Y$ and $S = 0.44(K+S)$ which imply share of monopoly profits in value added was (0.48)×(0.44) = 0.211 which is an *approximate* measure of income share deduced from the surplus. We thus conclude that the share of monopoly profits rose from 0% in the early 1980s to 21.1% in 2015. Being important, we estimate it again in Sections 4.3a-4.3b using two different, *independent*, methods that use only flow data (income and expenditures) to discover these two alternate sources also imply similar estimates of 0.21 - 0.23 share of surplus monopoly profits in net output!

3.2 IT has also caused rising personal income and wealth inequality

We turn to explain why IT has also caused an increased wealth concentration in fewer *individual* hands hence increased personal inequality.

(i) *IT increases speed of development and decreases required capital for initial value recognition.* Consider a major innovation in heavy industries such as railroads, steel, automobiles etc. that were the drivers of growth in the 19th or early in the 20th century. Such innovation was more than just an idea since it typically required substantial investment in the form of a plant and equipment. The innovator had to demonstrate technical feasibility of product or process, reasonable production costs and demand that would lead to a profitable price. Hence, translating an idea into a prototype and then to mass production typically required significant capital investments, and to raise it, the innovator had to give up a substantial ownership share. Also, since *profits arrived after investments* and after marketing development, the innovator realized most value only after the idea proved successful, by which time the wealth created would be widely distributed. With a conservative public attitude, the time taken for an innovation's adoption could be long. Therefore, one often finds in the literature a discussion of the rate of innovation "adoption," and of why economic development revolves around the adoption rate of an innovation by other firms (e.g. Schumpeter (1934)).

These features remained in place even in the early stages of the IT revolution in 1950-1970, which was mostly *hardware based*. An innovation in computers or semiconductors required an innovator to do the design and build a plant for most components needed for the final product, and that required heavy capital investments. It should, thus, come as no surprise that during these initial stages IBM was a very large manufacturer of semiconductors!

In contrast, innovations in the recent stage of IT are more *software based* and typically purely informational increments to knowledge. For example: computer program, drug formulation, smart phone app, genetically engineered seed or a video game, are all purely informational changes. They do require some hardware adaptation, but their key characteristic is that once an innovator has the idea, it typically requires only a modest venture capital, which, in Silicon Valley, is in the range of $20-$50 million, to conduct a feasibility study. This initial investment enables a "proof of concept," which reduces the innovation's risk at modest cost. The important result is that *the wealth created ends up being concentrated in a small number of hands*.

The assumption of small initial investment is not always valid. In cases such as new drugs, FDA approval imposes restrictions on a drug's public suitability. A drug company must therefore conduct several complex clinical trials in order to prove feasibility as well as safety. Such studies are very costly, making drug development one of the most expensive areas of feasibility studies. However, surplus wealth developed by drug companies is also among the highest.

Outsourcing is an additional factor that has lowered the capital required for developing a new IT iea, and contribute to the concentration of wealth created. It is the result of growing specialization within IT and by the fact that most systems can be decomposed into standard components, which are developed on their own and assembled at the end. We also note the important impact of government research that also contributed to lower the capital cost of IT innovations (see Wright (2017)).

(ii) The impact of finance and investment banking. With proof of concept established, the innovating group needs capital to proceed with its investment plans. To that end it needs a market to realize the value of its innovation by selling securities *at a sharply increased market value*. The innovating group, in fact, offers its valuable liquid "currency," without yielding too much equity ownership. For a public sale of its securities, the firm needs investment bankers. First, since most innovations entail technical details whose appreciation requires expert knowledge, the firm needs a public introduction. By taking the firm public, the bankers provide a signal to the market that the valuation of the firm is justified. Second, by selling the securities through their own financial brokers, investment bankers make available to the firm their own network externality, which is very valuable and results in a significant transfer of value *to the banking sector*.

An initial public offering (IPO) completes the creation of liquid surplus wealth, often by a firm with relatively small sales and invested capital. In recent years, an active private market developed in securities of successful firms which allows a new firm to delay the IPO and raise as much capital as it needs from private venture capital sources, at a valuation which is commensurate with a potential IPO value. In either case, *the result is a high concentration of equity ownership by the innovator*. Since most IT wealth was gained by stockholders, and since stock ownership is heavily concentrated in a small fraction of the population, it follows IT caused more wealth to flow into a few hands, increasing wealth and income inequality. This conclusion is not entirely sufficient since many IT entrepreneurs were young at the start, without much wealth or stock ownership.

To address this last point recall that since the 1980s IT innovations were mostly *software based,* requiring technical knowledge of computer software. This gave young innovators with computer science training an advantage. Hence, *successful* IT innovations result in young innovators retaining much of their shares and the wealth created by IT being heavily concentrated in few, often young, hands. As noted earlier, this was not true earlier in the 20th century; a major innovation in the growth industries of the time required heavy investments before commercial success was established. This required more investors to join, and the wealth created was therefore spread among more people.

The importance of finance and investment banking for the development of innovations also explains the high surplus wealth we find in the financial sector. However, it appears that some of this surplus wealth is, actually, a capitalization of the public's risk sharing rent since surplus wealth in that sector is rather persistent; it remained positive *even at the depth of the Great Recession*.

The impact of (i) - (ii) is the *increased speed of business development* and wealth creation, a conclusion supported by results of others (e.g. Greenwood and Jovanovic (1999)). Another index for this speed is the length of time it takes a new firm, from the date of its incorporation to the date of its IPO. A recent IPO of *Snap Inc*. was completed on Marc 2, 2017 whereas the firm was founded on September 16, 2011. It then took Snap Inc. 5.5 years from start to the IPO, whereas Facebook took 8 years and Microsoft 10 years to do it. In sum, compared to innovations in the past, new ideas in IT typically require less time and less invested capital before the market recognizes the value of an innovation. Consequently, wealth creation has been accelerated to enable an innovator to end up with a larger ownership share, resulting in the ownership of new wealth being more concentrated.

We next demonstrate that the conclusion of sharply rising monopoly power also explain other observed macroeconomic facts stated in the introduction: slow growth of wages and capital invested, and a declining relative shares of labor and interest income. To that end we study the macroeconomic implications of rising monopoly power in an equilibrium growth model. It *assumes that IT causes rising monopoly power* and the manner in which IT changes monopoly power is not essential. We take monopoly power to be exogenous and study how rising monopoly power changes the economy.

4. Growth with Monopoly Power: Macroeconomic Implications of Rising Monopoly Power

We formulate a standard Dixit-Stiglitz monopolistic competition growth model in which firms have pricing power. In Sections 4.1-4.3 we specify only part of the model as we focus on distribution questions and income and wealth inequality can be studied without a complete General Equilibrium specification (e.g. Solow (1960)). In Sections 4.4 -4.5 we complete the specifications and deduce wide macroeconomic implications of rising monopoly power. We work with the *simplest* assumptions but explain why the results remain valid even under more general conditions.

Our Dixit-Stiglitz monopolistic competition growth model is standard, used by others to address diverse problems. Hornstein (1993) and Cooper (1993) used it (with increasing returns) to assess the propagation of productivity shocks. Karabarbounis and Neiman (2014) use it to explain the decline of labor share by capital/labor substitution motivated by the decline in capital cost. The model is close to the one used by Barkai (2016a) who used imputed "required" interest rate to deduce the mark up and aggregate profits. We comment on this method later in Section 3.4.

4.1 A model of growth when firms have pricing power

There is a large number of identical consumer-households with utility over consumption and labor, who optimize dynamically over time with a utility function

$$U_t = \sum_{\tau=t}^{\infty} \beta^{(\tau-t)} u(C_\tau, L_\tau). \tag{6}$$

Consumption follows a Dixit and Stiglitz (1977) framework with M firms, each producing a different intermediate good. These are used by households and firms to produce final consumption or investment goods, which are CES composites of the intermediate goods in accord with

$$C_t = \left[\sum_{j=1}^{M} (Y_{it}^{C})^{\frac{\theta_t - 1}{\theta_t}} \right]^{\frac{\theta_t}{\theta_t - 1}} \qquad I_t = \left[\sum_{j=1}^{M} (Y_{jt}^{I})^{\frac{\theta_t - 1}{\theta_t}} \right]^{\frac{\theta_t}{\theta_t - 1}}. \tag{7}$$

(C, I) are consumption and investment, (Y_{it}^{C}, Y_{it}^{I}) are amounts of intermediate good i used to produce, consumption C_t and investment I_t. θ_t is elasticity of substitution; it varies with time and we consider only $\infty > \theta_t > 1$, that permits profit maximization. The model does not nest a competitive economy with finite θ_t, and its error rises for large θ_t. The number of firms *is fixed since there is no free entry*.

Consider a variant of (7), that introduces a compositional effect that distinguished consumption from investment goods. It also permits the prices of consumption and investment goods to exhibit different growth rates, in accord with Gordon's (1990) demonstration that investment goods prices have declined (see also Greenwood et. al. (1997)). To that end we can replaces (7) with

$$\text{(7a)} \qquad C_t = [\sum_{j=1}^{M} \vartheta_j^C (Y_{it}^C)^{\frac{\theta_t - 1}{\theta_t}}]^{\frac{\theta_t}{\theta_t - 1}} \qquad I_t = [\sum_{j=1}^{M} \psi_t \vartheta_j^I (Y_{jt}^I)^{\frac{\theta_t - 1}{\theta_t}}]^{\frac{\theta_t}{\theta_t - 1}}.$$

ψ_t measures higher capital efficiency or lower cost of producing capital goods. We do not study this case but examine it only to show that all our distributional conclusions remain valid under (7a).

The Dixit-Stiglitz demand gives rise to monopolistic competitive pricing by producers of intermediate goods. To simplify the analysis we assume that capital and labor are freely mobile, hired in free markets and paid the competitive wage rate and rental rates (W_t, R_t). Hence, the supply of capital and labor are symmetric, and households own capital they rent to firms. Aggregate capital growth follows $K_t = (1-\delta)K_{t-1} + I_t$ (δ is a depreciation rate), and aggregate labor supply is exogenous. Regardless of who owns capital, in profit calculations firms consider the alternative cost of renting capital they may own and maximize profits at any date by allocating capital and labor optimally, given market prices. Our key assumption is then that stockholders benefit from any pricing power the firm has, and consumers, households or capital owners do not form coalitions to break pricing power of firms. Under such assumptions *capital owners and stock holders perform different functions.* Firms' ownership shares are traded in open markets, and profits are distributed as dividends only after capital and labor are paid their incomes in accord with the prices at which they are hired. An alternative model could have a class of entrepreneurs who own all the shares but who do not work, while households own no shares. Entrepreneurs may own capital therefore their consumption and savings are financed by dividends paid by their shares and rental from capital ownership, if they own any.

To derive demand functions for consumption and investments, we first address the issue of measurement units. Starting with Dixit and Stiglitz (1977), it is common to use labor as a numéraire. Since we integrate the model with a neoclassical production structure, we prefer to use consumption as a reference. To that end we first introduce an abstract unit of account, with which to write the budget constraints of the two uses, and later show how to adjust them to consumption as a numéraire.

Since the utility function is increasing in consumption, one can derive the implied demand functions for intermediate goods with prices p_{jt} from the following optimization procedure:

$$\text{(8a)} \quad \text{Maximize } C_t = [\sum_{j=1}^{M} (Y_{jt}^C)^{\frac{\theta_t - 1}{\theta_t}}]^{\frac{\theta_t}{\theta_t - 1}} \text{ subject to consumption expense } \hat{P}_t^C C_t = \sum_{j=1}^{M} P_{jt} Y_{jt}^C$$

$$\text{(8b)} \quad \text{Maximize } I_t = [\sum_{j=1}^{M} (Y_{it}^I)^{\frac{\theta_t - 1}{\theta_t}}]^{\frac{\theta_t}{\theta_t - 1}} \text{ subject to investment expense } \hat{P}_t^I I_t = \sum_{j=1}^{M} P_{jt} Y_{jt}^I.$$

The implied demands are functions of expenditures $(\hat{P}_t^C C_t, \hat{P}_t^I I_t)$, and we define them later in terms of (C_t, I_t), measured in units of the consumption good. The optimization is standard; the price and implied demand functions are defined by

(9a) $$P_t^C = P_t^I = [\sum_{j=1}^{M} (P_{jt})^{1-\theta_t}]^{\frac{1}{1-\theta_t}} = P_t$$

and

(9b) $$Y_{jt}^C = (\frac{P_{jt}}{P_t})^{-\theta}(\frac{\hat{P}_t^C}{P_t})C_t \quad , \qquad Y_{jt}^I = (\frac{P_{jt}}{P_t})^{-\theta}(\frac{\hat{P}_t^I}{P_t})I_t .$$

It is well known P_t is cost of a unit of consumption or investment at the optimal mix of intermediate goods (see Brakman and Heijdra (2004), Ch. 1). Next, insert (9b) into (8a)-(8b) to find

(10) $$v_t = [\sum_{j=1}^{M} [(\frac{P_{jt}}{P_t})^{-\theta} \frac{\hat{P}_t^v}{P_t} v_t]^{\frac{\theta_t - 1}{\theta_t}}]^{\frac{\theta_t}{\theta_t - 1}} = [\sum_{j=1}^{M} (P_{jt})^{1-\theta_t}]^{\frac{\theta_t}{\theta_t - 1}} \frac{1}{(P_t)^{-\theta_t}} \frac{\hat{P}_t}{P_t} v_t \quad , \quad v = C, I .$$

(9a) and (10) imply $\hat{P}_t^C = \hat{P}_t^I \equiv P_t$ hence the final demand functions are

(11a) $$Y_{jt}^C = (\frac{P_{jt}}{P_t})^{-\theta_t} C_t \quad , \quad Y_{jt}^I = (\frac{P_{jt}}{P_t^I})^{-\theta_t} I_t \quad , \quad Y_{jt} = (\frac{P_{jt}}{P_t})^{-\theta_t}(C_t + I_t)$$

and price

(11c) $$P_t = [\sum_{j=1}^{M} (P_{jt})^{1-\theta_t}]^{\frac{1}{1-\theta_t}} .$$

Aggregate output is then

(11b) $$\sum_{j=1}^{M} \frac{P_{jt}}{P_t} Y_{jt} = C_t + I_t = Y_t .$$

We later assume production functions for intermediate goods therefore

(12) $$Y_t = \sum_{j=1}^{M} (\frac{P_{jt}}{P_t}) Y_{jt} \equiv \sum_{j=1}^{M} (\frac{P_{jt}}{P_t}) A_{jt}(K_{jt})^{\alpha}(N_{jt})^{(1-\alpha)} .$$

Considering (7a), with an effect of changed efficiency of capital goods, the solutions are

(13a) $$P_t^C = [\sum_{j=1}^{M} \vartheta_j^C (\frac{P_{jt}}{\vartheta_j^C})^{1-\theta_t}]^{\frac{1}{1-\theta_t}} = P_t \qquad , \qquad P_t^I = [\sum_{j=1}^{M} \vartheta_j^C \psi_t (\frac{P_{jt}}{\vartheta_j^C \psi_t})^{1-\theta_t}]^{\frac{1}{1-\theta_t}}$$

(13b) $$Y_{jt}^C = (\frac{P_{jt}}{\vartheta_j^C P_t})^{-\theta_t} C_t \ , \ Y_{jt}^I = (\frac{P_{jt}}{\vartheta_j^I P_t^I})^{-\theta} \psi_t^{\frac{\theta_t}{\theta_t - 1}} I_t \ , \ Y_{jt} = (\frac{P_{jt}}{\vartheta_j^C P_t})^{-\theta_t} C_t + (\frac{P_{jt}}{\vartheta_j^I P_t^I})^{-\theta_t} \psi_t^{\frac{\theta_t}{\theta_t - 1}} I_t .$$

(13c) $$\sum_{j=1}^{M} \frac{P_{jt}}{P_t} Y_{jt} = C_t + \psi_t^{\frac{\theta_t}{\theta_t - 1}} (\frac{P_t^I}{P_t}) I_t = Y_t$$

Since equilibrium prices of intermediate goods and consumption are bounded and since $\theta > 1$ and ψ_t rises, (13a) implies that the price of a unit of capital goods *declines*. As noted, these assumptions do not alter our main distributional results, shortly to be developed for the simpler symmetric case. For our immediate purposes, this is all we need in order to proceed. In the rest of the paper we set $P_t = 1$.

Before proceeding we comment on the assumption of fixed number of firms. Innovations entail risks and obsolescence, resulting in a birth and death of firms. A fixed number of firms is interpreted as a model of "sectors" or "dynasties." To illustrate, firms developing computer technology started in the 1940's-1950's with mainframe computers (e.g. Univac, IBM). By late 1960's smaller computers took over (e.g. DEC, Data General), and these gave rise to the PC and then to mobile technology. Firms rose and fell, but decline of one resulted from innovations of successors. Knowledge and technology were merged into the surviving firms, and wealth created was invested in the next generation of firms. We are not concerned here with firm survival; although each faces private risk of obsolescence, the dynasty-firm incorporates new innovations that counter obsolescence faced by each individual firm.

4.2 Optimization by intermediate goods' producers

Each firm j has a production function of the form

(14a) $$Y_{jt} = (\Psi_t \Psi_{jt})(K_{jt})^{\alpha}(N_{jt})^{(1-\alpha)} \quad , \quad A_{jt} = \Psi_t \Psi_{jt}$$

where Ψ_t is a common component, and Ψ_{jt} is a firm specific random technological level. The Ψ_{jt} are drawn from a distribution with mean 1. Date t profit function is

$$\Pi_t^j = P_{jt}Y_{jt} - W_t N_{jt} - R_t K_{jt}.$$

We study monopolistic competitive Nash Equilibrium, hence, producers take aggregate income and price P_t=1 as given, select their own prices and allocate labor and capital to maximize profits at each t:

(14b) $$\text{Max}_{P_{jt},N_{jt},K_{jt}}\left[P_{jt}Y_{jt} - W_t N_{jt} - R_t K_{jt}] + \lambda_{jt}[\Psi_t \Psi_{jt} K_{jt}^{\alpha} N_{jt}^{1-\alpha} - Y_{jt}]\right] \quad , \quad Y_{jt} = P_{jt}^{-\theta}(C_t + I_t)$$

The first order conditions (where (W_t, R_t) are the real rates) are

(14c) $$(\theta - 1)P_{jt}^{-\theta}(C_t + I_t) = \lambda_{jt}\theta P_{jt}^{-\theta}(C_t + I_t)P_{jt}^{-1} \Rightarrow \lambda_{jt} = P_{jt}\frac{(\theta - 1)}{\theta} \text{ all } j$$

(14d) $$W_t = P_{jt}\frac{\theta_t - 1}{\theta_t}(1-\alpha)[\Psi_t \Psi_{jt}](K_{jt})^{\alpha} N_{jt}^{-\alpha} = P_{jt}\frac{\theta_t - 1}{\theta_t}\frac{\partial Y_{jt}}{\partial N_{jt}}.$$

(14e) $$R_t = P_{jt}\frac{\theta_t - 1}{\theta_t}\alpha[\Psi_t \Psi_{jt}](K_{jt})^{\alpha - 1} N_{jt}^{1-\alpha} = P_{jt}\frac{\theta_t - 1}{\theta_t}\frac{\partial Y_{jt}}{\partial K_{jt}}.$$

Conditions (14d)-(14e) do not depend upon the symmetry assumption and (7a) impacts only (14c). Since all income distribution results depend upon (14d)-(14e), they are invariant to the heterogeneity assumptions. Using the above, we turn to resolve the question of *aggregation*:

Proposition 1: In an equilibrium

(i) $P_{jt}\Psi_{jt} = p_t^\star$ for all j where

(15) $$p_t^\star = [\sum_{j=1}^{M} \Psi_{jt}^{(\theta-1)}]^{\frac{1}{\theta-1}} \equiv \vartheta_t^\star ;$$

(ii) equilibrium quantities act in accord with an aggregate production function and

(16) $$Y_t = A_t(K_t)^\alpha (N_t)^{(1-\alpha)} \quad , \quad A_t = \vartheta_t^\star \Psi_t$$

(iii) if $\Psi_{jt} = 1$ for all j, then for all j we have $P_{jt} = p_t^\star = \vartheta_t^\star = 1$.

Proof: (i) From (14d)-(14e) we deduce

(17) $$\frac{W_t}{R_t} = \frac{(1-\alpha)}{\alpha}\left(\frac{K_{jt}}{N_{jt}}\right) \quad \text{for all j}$$

hence (K_{jt}/N_{jt}) is independent of j. By (14d)

(18) $$\Psi_{jt}P_{jt} = p_t^\star = W_t \Big/ \left[\left(\frac{\theta-1}{\theta}\right)(1-\alpha)\Psi_t(K_{jt}/N_{jt})^\alpha\right]$$ is also independent of j.

Insert (18) into (11a) to deduce

(19) $$1 = p_t^\star [\sum_{j=1}^{M} \Psi_{jt}^{(\theta-1)}]^{\frac{1}{1-\theta}} \Rightarrow p_t^\star = [\sum_{j=1}^{M} \Psi_{jt}^{(\theta-1)}]^{\frac{1}{\theta-1}} \equiv \vartheta_t^\star .$$

(iii) By (11c) and (19)

$$Y_t = \sum_{j=1}^{M} \frac{p_t^\star}{P_t} \Psi_t (K_{jt})^\alpha (N_{jt})^{(1-\alpha)} \equiv A_t \sum_{j=1}^{M} (K_{jt})^\alpha (N_{jt})^{(1-\alpha)} \quad , \quad A_t = \vartheta_t^\star \Psi_t .$$

Since all K_{jt}/N_{jt} are the same, there is a natural aggregation:

$$Y_t = \sum_{j=1}^{M} A_t (K_{jt})^\alpha (N_{jt})^{(1-\alpha)} = A_t\left(\frac{K_{jt}}{N_{jt}}\right)^\alpha \sum_{j=1}^{M} N_{jt} = A_t\left(\frac{K_{jt}}{N_{jt}}\right)^{\alpha-1} \sum_{j=1}^{M} K_{jt} = A_t K_t^\alpha N_t^{1-\alpha}$$

where $$K_t = \sum_{j=1}^{M} K_{jt} \quad , \quad N_t = \sum_{j=1}^{M} N_{jt}$$ ■

Proposition 2 (without proof): The results hold under (7a), with the following modifications:

(i) $P_{jt}\Psi_{jt} = p_t^\star$ for all j where

(19a) $$\frac{p_t^\star}{P_t^C} = [\sum_{j=1}^{M} (\vartheta_j^C)^\theta \Psi_{jt}^{(\theta-1)}]^{\frac{1}{\theta-1}} \equiv \vartheta_t^\star$$

(19b) $$\frac{p_t^\star}{P_t^I} = [\sum_{j=1}^{M} (\vartheta_j^I)^\theta \Psi_{jt}^{(\theta-1)}]^{\frac{1}{\theta-1}} \equiv (\vartheta^I)^\star \psi_t^{-\frac{\theta}{1-\theta}}$$

(ii) equilibrium quantities act in accord with an aggregate production function and

(19c) $$Y_t = A_t(K_t)^\alpha (N_t)^{(1-\alpha)} .$$ ■

With aggregation questions resolved, all further developments are made in aggregate terms. To explain our next step note that (14b)-(14e) and Proposition 1 are sufficient to permit a study of the functional distribution of income. We do that in the next section but keep in mind two important facts.

- First, rising surplus wealth in Section 1 revealed rising monopoly power during 1970-2015 and we now have the tools to quantify it and expand on the asset based estimates in Section 3.1.
- Second, (14d)-(14e) say, as a first order response, that a rising monopoly power (i.e. declining θ_t) *cause* a fall in the wage and interest rate. We address this question with a full general equilibrium study only in Section 3.4, after resolving the functional distribution question.

4.3 Time evolution of monopoly power and its effects on the functional distribution of income

We turn to implications of the symmetric model (7) to income distributions. This expands the results of the *asset based approach* (Section 3.1) with which we estimated the share of monopoly profits in non financial business to be 0.211 in 2015, versus a 0 in the early years of 1984-1986.

4.3a Distribution of income I: the labor share approach

The problem of declining relative share of labor has occupied researchers for some time with multiple hypotheses of explaining it. For a sample of recent work, see Elsby et. al. (2013), Fleck et. al. (2011), Jacobson and Occhino (2012), Karabarbounis and Neiman (2014) and Krusell et. al. (2000). Since we focus on the effect of monopoly power, detailed reviews of their diverse approaches and focus would not help clarify our results. We thus start by noting that by (14d)-(14e)

$$Y_t = \frac{\theta_t}{\theta_t - 1}[R_t \sum_{j=1}^{M} K_{jt} + W_t \sum_{j=1}^{M} N_{jt}] = \frac{\theta_t}{\theta_t - 1}[R_t K_t + W_t N_t].$$

Proposition 1 then implies that the distribution of income is

$$\text{(20)}\qquad \begin{aligned} &\text{Labor income} && W_t N_t = (1-\alpha)\frac{\theta_t - 1}{\theta_t} Y_t \\ &\text{Capital Rent Income} && R_t K_t = \alpha \frac{\theta_t - 1}{\theta_t} Y_t \\ &\text{Monopoly Surplus income} && = \frac{1}{\theta_t} Y_t . \end{aligned}$$

Labor share is $\frac{\theta_t - 1}{\theta_t}(1-\alpha)$, and monopoly surplus income share is $\frac{1}{\theta_t}$. These results also hold for (7a) since they depend only on conditions (14d)-(14e) and on (ii) of Proposition 2. Competitive conditions hold if $\theta_t \Rightarrow \infty$, $\frac{\theta_t - 1}{\theta_t} \Rightarrow 1$, hence the model at hand cannot approximate well a competitive economy. Since Figure 1 shows that monopoly wealth is negative prior to 1986 and we know corporate profits are also low, the accuracy of the model is low prior to 1986. Since we use corporate profits in computing Table 5 and we want Tables 4 and 5 to be comparable, our results cover only 1986-2015.

Before exploring use of (20) we comment on the treatment of *management compensation*. We know that monopoly power, due to innovations, is temporary and is subject to erosion by competing ideas. Therefore, firms with surplus wealth compete over technological advantage. Hence, the vital issues management is concerned with are not only making sure production and marketing schedules are on track, but mostly, that an optimal strategy is employed to preserve a firm's market edge. This is the firm's battle for survival, and the strategy employed seeks organic improvements and/or acquisitions aimed to consolidate the firm's market power. This suggests that a model of output, as a function of labor and capital, must question the labor designation of management since it benefits the firm as a guardian of its market position. It is thus more appropriate to consider management *as partners* in the innovating process and their compensation as profit sharing with the firm's owners, all of whom benefit from surplus income generated after wage and capital interest cost. This view is supported by the fact that base wage is a small component of officers' compensation; most of it takes the form of profits from granted equity at prices below market and from granted stock options, all of whose realization depends upon the size of surplus wealth. We, therefore, treat officers' compensation as profit-sharing, which is part of a firm's surplus income. This point out even further a fact, which is recognized by others (e.g. Elsby et. al. (2013)), that true labor share is actually lower than the BLS published numbers.

To use (20), note that with knowledge of α, a given labor share imply a value of θ_t. We assume $\alpha = 0.33$ based on established econometric studies, but the relevant relative labor share requires some explanation. Since we focus on corporate business, self employed wages present a problem due to BLS' imputing their wage as equal to non self employed wage, a practice criticized by Elsby et. al. (2013). Therefore we use the "payroll labor share" with two adjustments. Denote published labor share by sh_w and published payroll share sh_w^{pr}, then the self employed relative share is $sh_w - sh_w^{pr}$ and our first natural change defines adjusted payroll share by

$$\text{(21a)} \qquad \text{Adjusted payroll share excluding self employed} = (sh_w^{pr})/[1-(sh_w - sh_w^{pr})].$$

A second problem is that payroll share contains *management compensation* which we need to address. We know that monopoly power, due to innovations, is temporary and is subject to erosion by competing ideas. Therefore, firms with surplus wealth compete over technological advantage. Hence, the vital issues management is concerned with are not only making sure production and marketing schedules are on track, but mostly, that an optimal strategy is employed to preserve a firm's market edge. This is the firm's battle for survival, and the strategy employed seeks organic improvements and/or acquisitions aimed to consolidate the firm's market power. This suggests that a model of output, as a function of labor and capital, must question the labor designation of management since it benefits the firm as a guardian of its market position. It is thus more appropriate to consider management *as partners* in the innovating process and their compensation as profit sharing with the firm's owners, all of whom benefit from surplus income generated after wage and capital interest cost. This view is supported by the fact that base wage is only a small fraction of their income that includes the value of exercised granted stock and options (see Moylan (2008) and Elsby et. al. (2013)). Indeed, rising management compensation and large profits from exercised stock options have slowed down the decline of labor share and this also explains the *rise of payroll labor* share during the dotcom years 1998-2002, a conclusion confirmed by Elsby et. al. (2013). This points out even further a fact, which is recognized by others (e.g. Elsby et. al. (2013)), that true labor share is actually lower than the BLS published numbers. In short, officers' compensation should be treated as profit sharing rather than wages and this our second adjustment. To that end we use IRS data on Officers' Compensation (*"Returns of Active Corporations"* Table 2) to compute the share of Officers' Compensation in total published wages (in Appendix A) which is denoted s_W^{of}, and exclude it from payroll share to deduce the definition of payroll share used in the computations of Table 4

$$\text{(21b)} \qquad \textbf{Final adjusted payroll share} = (sh_w^{pr} - s_W^{of} sh_w)/[1-(sh_w - sh_w^{pr})] .$$

Inclusion of officers' compensation in surplus income may not be sufficient. In private communication Solow[6] argues surplus income is often distributed to workers in the form of higher wages, from janitors to managers, paid by firms with large surplus. At this time we do not have adequate data, apart from officers' compensation, to account for such differences.

Table 4 reports our computed payroll labor share 1986-2015 and the implied θ_t in accord with (20), by assuming that $\alpha = 0.33$ and all changes in labor share *are caused by changes in pricing power of firms*. Table 4 shows that as the IT revolution progressed, the pricing power of firms increased from

[6] In a note by Robert Solow, entitled "Monopoly Rent and the Functional Distribution of Income," April 15, 2017

θ_t=5.21 in 1986 to θ_t= 4.36 in 2015. The removal of officers' compensation from payroll does smooth somewhat the effect of stock market fluctuations but does not remove it, suggesting some firms may use bonuses and stock options to compensate other employees besides officers.

Table 4: Dynamics of Labor Share and Firms' Monopoly Power, Excluding the Self -Employed, 1990-2015

Year	Adjusted Payroll Share	Implied θ_t	Implied Share of Surplus Income	Year	Adjusted Payroll Share	Implied θ_t	Implied Share of Surplus Income
1986	0.54	5.21	0.192	2001	0.55	5.76	0.174
1987	0.55	5.46	0.183	2002	0.55	5.66	0.177
1988	0.55	5.73	0.175	2003	0.55	5.50	0.182
1989	0.55	5.49	0.182	2004	0.54	5.13	0.195
1990	0.56	5.88	0.170	2005	0.53	4.86	0.206
1991	0.55	5.76	0.174	2006	0.53	4.71	0.212
1992	0.55	5.68	0.176	2007	0.53	4.74	0.211
1993	0.55	5.52	0.181	2008	0.53	4.84	0.207
1994	0.53	4.94	0.202	2009	0.53	4.69	0.213
1995	0.53	4.80	0.208	2010	0.52	4.62	0.216
1996	0.53	4.74	0.211	2011	0.52	4.44	0.225
1997	0.53	4.80	0.208	2012	0.51	4.24	0.236
1998	0.54	4.97	0.201	2013	0.51	4.26	0.235
1999	0.54	4.99	0.200	2014	0.51	4.23	0.236
2000	0.55	5.55	0.180	2015	0.52	4.36	0.229

Two results stand out. First, we have a second quantitative description of the key conclusions: pricing power of firms increased from 1986 to 2015, demonstrated by the rising proportion of surplus wealth in Figures 1-3 and by falling labor share in Table 4. This table reports that in 2015 the share of monopoly profits in output of non-financial corporations (about half of GNP) is 23% which is the percentage by which the wage rate and capital rent are below their competitive levels. This is consistent with the independent, asset based, estimate of 21% for 2015, reported in Section 3.1.

Second, results in Table 4 appear disappointing, showing share of monopoly profits of 0.192 in 1986 versus zero *actual* surplus wealth, which implies a share of zero in 1986. Also, Appendix A has θ_t=6.35 in 1980 deduced from labor share, which is in conflict with no surplus wealth in 1980 seen in Figure 1. This means that as early as 1980-1986 actual labor share is lower than predicted by the model, which means that *if the only factor that lowered the wage was the rising monopoly power, then in 1980-1986 labor share is already far too low.* We later return to this model inconsistency for further study and comparison with results in Table 5. With this in mind we introduce, in the next section, a third method to estimate monopoly surplus income via the "profit share approach."

4.3b Distribution of income II: the profits share approach

The implication of (20) is that $\frac{1}{\theta_t}Y_t + fk_t \alpha \frac{\theta_t - 1}{\theta_t} Y_t$ is gross profits of the firm after labor and capital expenses, where fk_t is fraction of capital not financed by debt and hence owned by the firm.

Define output value by Y_t= (Value added at current prices-Taxes on production and imports). The firm has an accounting identity which defines the disposition of these gross profits. There are two direct deductions which are the compensation to officers and expenses for R&D which, as explained in Section 1, are the amounts the firm uses to protect its market power. We, thus, define

(22a) $$(\text{Net Profits})_t = \frac{1}{\theta_t} Y_t + fk_t \alpha \frac{\theta_t - 1}{\theta_t} Y_t \text{ - (Officers salaries)}_t \text{ - (R\&D cost)}_t.$$

Net profits are then disposed by

(22b) Net Profits = Dividends + Corporate taxes and transfers +Foreign earning retained + Savings.

Equating (22a) with (22b) is an identity where all quantities are known; hence, it is an equation in θ_t.

To estimate θ_t as precisely as possible, and since surplus wealth data are not used, we limit the study to "Non Financial Corporate Business," as defined by the Z.1 publication Table S.5.a with three added sources: (1) for R&D spending we use the Z.1 series FA105013043.A; (2) proportion of officers compensation in BLS wages, reported by the IRS, was used above and reported in Appendix A. We deduce the proportion of officers compensation in net value added with published labor share; (3) the fk_t data in Appendix A is computed from our Compustat samples, *adjusting capital for foreign holdings*. All other data is in the Z.1 publication Table S.5.a.[7] The results are reported in Table 5.

Table 5: Dynamics of the Profits Share and Firms' Pricing Power 1986-2015

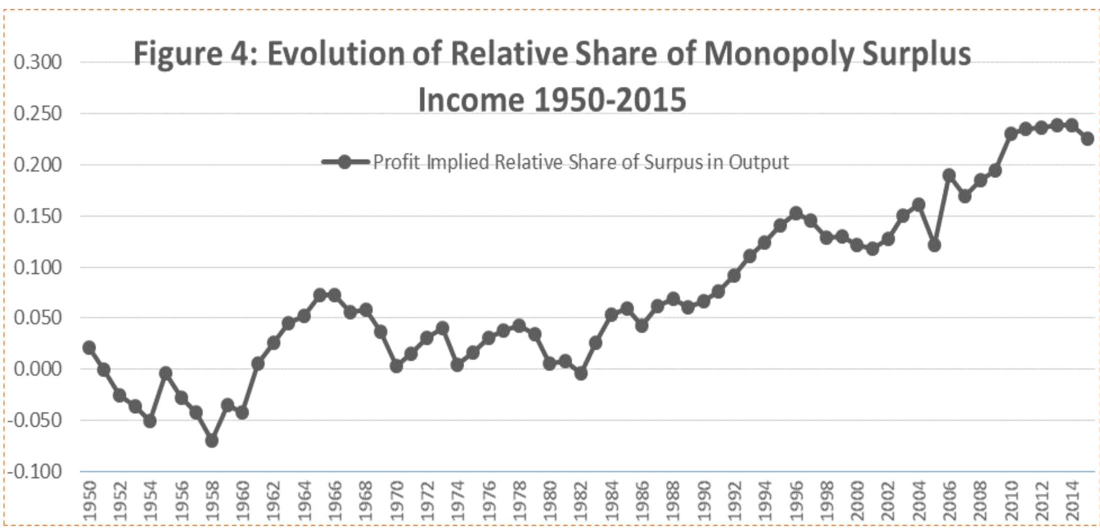
Year	Computed θ_t	Implied Share of Surplus Income	Year	Computed θ_t	Implied Share of Surplus Income
1986	23.675	0.042	2001	8.484	0.118
1987	16.179	0.062	2002	7.806	0.128
1988	14.591	0.069	2003	6.626	0.151
1989	16.610	0.060	2004	6.207	0.161
1990	15.005	0.067	2005	8.262	0.121
1991	13.074	0.076	2006	5.254	0.190
1992	10.859	0.092	2007	5.896	0.170
1993	8.980	0.111	2008	5.412	0.185
1994	8.077	0.124	2009	5.137	0.195
1995	7.127	0.140	2010	4.332	0.231
1996	6.536	0.153	2011	4.243	0.236
1997	6.884	0.145	2012	4.241	0.236
1998	7.795	0.128	2013	4.196	0.238
1999	7.681	0.130	2014	4.188	0.239
2000	8.205	0.122	2015	4.424	0.226

Table 5 reveals a sharp rise in monopoly pricing power from 23.675 in 1986 to 4.424 in 2015 with a corresponding rise of monopoly profit share from 4.2% in 1986 to 22.6% in 2015. We then have *three* estimates of the share of monopoly profit: one deduced from surplus wealth in 3.1, the second from relative labor share in 4.3a and the third used the profit share approach in this section. Although

[7] Series used in the computations are then: Gross value added-FA106902501.A; Taxes on production and imports - FA106240101.A; Dividends paid - FA106121001.A; Corporate income Tax paid - FA106220001.A; Other transfers paid - FA 106403001.A; Foreign earnings retained - FA106006065.A; Corporate Savings (excluding foreign earnings retained abroad) - FA106012095.A.

these used different approaches and different data sources, all three estimates for 2015 are in the narrow range of 21%-23%. This same value is also close to Solow's (2017) estimate in the cited note. It is also close to estimates of Barkai (2016a) who use a similar model but arrives at them by imputing a "required interest rate" to distinguish between interest income and profits. Since the interest rate is an endogenous variable, we prefer our three methods which do not rely upon such imputations.

The profit share approach is our most accurate aggregate method. It is based on an accounting identity; it requires no added assumptions or approximations and, apart from the three series noted above, the data used is consistent and from a single source. With this in mind, we present in Figure 4 the relative share of monopoly profits in value added of non-financial corporations, 1950-2015. It shows this share was zero during 1970-1982 and rose to a high of 23.9% in 2014. It also shows this share was practically zero during 1950-1962 and rose to a peak of 7.3% in 1965 during the early phase of the IT revolution, before falling back to zero in 1970. These results, based on entirely independent sources, are consistent with results in Figure 1 that show a sustained rise of $\frac{\text{surplus wealth}}{\text{market value}}$ after 1986, reaching 79% in 2015, but also a positive surplus wealth in 1962-1970 when this ratio reached a high of 32% in 1965 for non-financial corporations. Although results based on asset prices exhibit high volatility, the consistency between Figure 1 and Figure 4 is very encouraging.



We now return to the dynamics of labor share in the earlier years. Although Table 4 shows labor share is below its competitive level in 2015, it also shows it is too low even in 1986, when surplus wealth is actually close to zero. Table 5 confirms this last fact and shows that share of monopoly profits is indeed very small in 1986. Therefore, the results in Table 5, deduced from profit share, are consistent with all surplus wealth results in Figures 1-3. The actual labor share in the 1980's is *then out of line with the rest of our results*. However, it is compatible with the fact that wage growth and labor share *started to fall early in the 1970's*, caused by factors not present in our study. Political factors such as laws to weaken unions, automation, outsourcing, and globalization were operative before the rise of monopoly power in the 1980's. Hence, by the time monopoly power came into play, wages and labor share were already low. What we do find remarkable is the fact that by 2015 the high monopoly power seems to have become the dominant factor.

4.4 Other Macroeconomic effects of rising monopoly power

4.4a *Effects on the interest rate, wage rate and economic aggregates*

We now complete the model developed earlier and, to study *analytically* the effects of rising monopoly power, we simplify the model and assume (i) $\Psi_{jt} = 1$ all j, (ii) $\frac{A_{t+1}}{A_t} = a = \text{constant}$, (ii) labor supply is $N_t = 1$ and is supplied inelastically. The first removes the randomness assumed earlier and is actually a steady state condition. The second is standard in the literature and, we explain later, the third has no effect on our conclusions; any labor supply that permits a steady state leads to the same results.

The agent dynamic optimization takes the form of

(23a) $$\text{Max}\sum_{\tau=0}^{\infty} \beta^{\tau}\frac{1}{1-\gamma}C_{\tau}^{1-\gamma}$$

subject to the budget

(23b) $$C_t + K_{t+1} = W_t + K_t(R_t + (1-\delta)) + \Pi_t$$

The optimum satisfies

(23c) $$1 = \beta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}[R_{t+1} + (1-\delta)].$$ [8]

To study the effect of a declining θ_t on equilibrium wage rates and interest rates we write the aggregate production function in the standard form of

$$Y_t = A_t(K_t)^{\alpha}(N_t)^{(1-\alpha)} = N_tA_t^{1/(1-\alpha)}[K_t / (N_tA_t^{1/(1-\alpha)})]^{\alpha} = N_tA_t^{1/(1-\alpha)}(k_t)^{\alpha} \quad , \quad k_t = \left(\frac{K_t}{N_tA_t^{1/(1-\alpha)}}\right)$$

and equilibrium conditions can now be scaled. Define first

$$c_t = \left(\frac{C_t}{N_tA_t^{1/(1-\alpha)}}\right) \;,\; w_t = \left(\frac{W_t}{N_tA_t^{1/(1-\alpha)}}\right) \;,\; \pi_t = \left(\frac{\Pi_t}{N_tA_t^{1/(1-\alpha)}}\right) \;,\; N_t = 1$$

[8] If additive utility function was introduced and flexible labor supply allowed, we would add the static condition $(u_N/u_c) = W_t$ but we shall see later that it has no impact on the results.

then the conditions are

(24a) $$c_t + a^{1/(1-\alpha)}k_{t+1} = k_t^\alpha + k_t(1-\delta)$$

(24b) $$1 = \beta(a^{1/(1-\alpha)}\frac{c_{t+1}}{c_t})^{-\gamma}[R_{t+1} + (1-\delta)]$$

(24c) $$w_t = \frac{(\theta_t - 1)}{\theta_t}(1-\alpha)(k_t)^\alpha$$

(24d) $$R_t = \frac{(\theta_t - 1)}{\theta_t}\alpha(k_t)^{\alpha-1}.$$

Since labor supply is constant, the asymptotic growth factor is $a^{1/(1-\alpha)}$, analogous to the continuous time growth rate of $\lambda_a/(1-\alpha)$, which is independent of θ_t. It follows that for any fixed $\theta_t = \theta$ the steady state of the economy, which is a function of θ, is defined by

(25a) $$(k^\star)^\alpha = c^\star + [a^{1/(1-\alpha)}k^\star - k^\star(1-\delta)]$$

(25b) $$1 = \beta(a^{1/(1-\alpha)})^{-\gamma}[R^\star + (1-\delta)]$$

(25c) $$w^\star = \frac{(\theta - 1)}{\theta}(1-\alpha)(k^\star)^\alpha.$$

(25d) $$R^\star = \frac{(\theta - 1)}{\theta}\alpha(k^\star)^{\alpha-1}.$$

Proposition 3: As θ_t declines over time, at any date, the wage rate and the interest rate initially decline at that date. However, the capital stock adjusts and, in the long run, the interest rate tends to return to the same steady state, which is independent of θ_t.

Proof: It follows from (25b) that the steady state interest rate $r^\star = R^\star - \delta$ is independent of θ_t. On the other hand, Since

$$\frac{d[(\theta_t - 1)/\theta_t]}{dt} = \frac{1}{\theta_t^2} > 0$$

and since at date t the capital stock is given, the value of k_t is also given. By (24a) the capital stock at t+1 is also determined at date t and therefore, by (24c)-(24d), any decrease of θ_t causes the wage rate and the interest rate to decline *initially*. This decline follows an adjustment of the capital stock so as to adjust k_t over time and allow the interest rate to return to its steady state. ■

Proposition 3 shows that a continuous rise of monopoly power exerts continuous pressure to lower interest rates *at each date* but the process is neutralized by subsequent adjustments of the capital stock which alters k_t. The next proposition shows this is a *downward* adjustment of the capital stock with *lower* investment and permanently lower wage rate path for each θ.

Proposition 4: As θ_t declines over time, equilibrium paths of output, consumption, the wage rate, capital stock and the rate of investment, *all decline permanently*.

Proof: The proof follows from a demonstration that a decline from θ_{t-1} to θ_t causes a decline in the steady state value of $k^\star(\theta)$ relative to $\theta_{t-1} = \theta$. To prove this consider (25b)-(25d). Since by (25b) the rental $R^\star$ does not change with θ, it requires that $\frac{(\theta-1)}{\theta}(k^\star)^{\alpha-1} = \text{constant}$. This means that differentiation of this expression implies

$$(\alpha-1)(k^\star)^{(\alpha-2)}\frac{(\theta-1)}{\theta}\frac{dk^\star}{d\theta} + (k^\star)^{\alpha-1}\frac{1}{\theta^2} = 0$$

therefore

$$\frac{dk^\star}{d\theta} = \frac{1}{\theta(\theta-1)}(1-\alpha)k^\star\left(\frac{1}{\theta^2}\right) > 0.$$

But then output = $(k^\star)^\alpha$; investment = $k^\star[a^{1/(1-\alpha)} - (1-\delta)]$; consumption = $(k^\star)^\alpha - k^\star[a^{1/(1-\alpha)} - (1-\delta)]$ decline. To see why the wage rate declines rewrite (25c) as $w^\star = [\frac{(\theta-1)}{\theta}(1-\alpha)(k^\star)^{\alpha-1}]k^\star$. By Proposition 3 the expression $[\frac{(\theta-1)}{\theta}(1-\alpha)(k^\star)^{\alpha-1}]$ is a positive constant, independent of θ, therefore

$$\frac{dw^\star}{d\theta} = [\frac{(\theta-1)}{\theta}(1-\alpha)(k^\star)^{\alpha-1}]\frac{dk^\star}{d\theta} > 0. \qquad \blacksquare$$

The conclusion of Proposition 4 is that a rise in monopoly power causes a *decline* in the level of investment and a *fall* in the level of the capital stock and, with unchanged steady state value of capital rental rate, they cause a decline in the macroeconomic variables and in the relative share of capital . The decline in labor share is then due only to the lower wages. The argument remains the same if optimum labor supply is introduced to satisfy $u_N/u_C = W$, an equation which determines N. In such a case a lower wage would also lead to a decline in labor market participation.

Some Important Qualificatios

We offer two qualification. First, Barkai (2016b) studies a similar problem with an OLG model where agents have a log utility. These lead the young to save a fixed fraction of income, and since a rise in monopoly power increases their income relative to the old, it also increases their savings. The result is an *increase* in the equilibrium capital/labor ratio and a *lower* natural interest rate. We then note

(24b) and (25b) show an OLG economy and log utility lead to results which are difficult to replicate in a more realistic economic set-up where the natural rate is determined by the growth rate.

A second qualification relates to vintage capital. Extensive research has demonstrated the rate of investment alters the growth rate significantly when technical progress is embodied (e.g. Greenwood et. al. (1997), Boucekkine et. al. (2011)). Since rising monopoly power lowers the investment rate and the level of capital in our model, if we introduce vintage capital to embody technology, the equilibrium growth rate will decline and will lower the natural interest rate as well. Since these are second order to the primary effect of θ_t on the variables in Proposition 4, the conclusions of the proposition continue to hold in such an expanded model. The formal argument of this case is lengthy, therefore it cannot be included here. We sum it up with the following statement, without proof:

Corollary to Proposition 4: If technical progress is embodied in new capital vintages, rising monopoly power lowers the equilibrium growth rate of the economy and hence it lowers the natural interest rate. However, the results of Proposition 4 continue to hold.

4.4b Effects on the gap between wages and output per hour

Turning to the relation between the real wage W_t/P_t and output per hour Y_t/N_t, we note first that under pure competition labor share is $(1-\alpha)$, equilibrium real wage is $[(1-\alpha)Y_t]/N_t$ and output per man-hour is Y_t/N_t; hence, their ratio is a constant $(1-\alpha)$. Hence, if we set up two index numbers series, one for the real wage and a second for output per man-hour, with a common base at some date, *the two series would be equal* without any gap between the two variables.

With pricing power of firms the two variables under consideration take different forms

$$\frac{Y_t}{N_t} = A_t\left(\frac{K_t}{N_t}\right)^{\alpha} \quad , \quad W_t = \frac{(\theta_t - 1)}{\theta_t}(1-\alpha)A_t\left(\frac{K_t}{N_t}\right)^{\alpha}$$

hence, we can see that

$$\frac{W_t}{Y_t} = \frac{(\theta_t - 1)}{\theta_t}(1-\alpha).$$

Since $(\theta_t - 1)/\theta_t$ declines, the *wage declines relative to average labor productivity*, as observed in the data. If we select an earlier date t_0 when the surplus is zero and labor share is $(1-\alpha)$, then setting the two numbers $W_{t_0} = Y_{t_0}/N_{t_0} = 100$ eliminates $(1-\alpha)$. All subsequent differences between the two series would then be due to the appearance of market pricing power measured by $(\theta_t - 1)/\theta_t$ which has declined, thus explaining why the mean wage has fallen below output per man-hour.

4 .4c Effects on the error in measured total factor productivity (TFP)

The TFP problem arises because the standard way of computing it assumes no surplus and one would therefore conclude there is an error in the standard computation. To compute this error we note that since $Y_t = A_t K_t^{\alpha} N_t^{1-\alpha}$ the *true* total factor productivity is

$$\frac{\dot{A}_t}{A_t} = \frac{\dot{Y}_t}{Y_t} - \alpha\frac{\dot{K}_t}{K_t} - (1-\alpha)\frac{\dot{N}_t}{N_t}.$$

Standard method defines TFP by

$$TFP_t = \frac{\dot{Y}_t}{Y_t} - [1 - \frac{W_t N_t}{Y_t}]\frac{\dot{K}_t}{K_t} - [\frac{W_t N_t}{Y_t}]\frac{\dot{N}_t}{N_t}$$

hence, the computed TFP is actually

$$TFP_t = \frac{\dot{Y}_t}{Y_t} - [1 - \frac{\theta_t - 1}{\theta_t}(1-\alpha)]\frac{\dot{K}_t}{K_t} - [\frac{\theta_t - 1}{\theta_t}(1-\alpha)]\frac{\dot{N}_t}{N_t}.$$

Hence, the error is

$$\text{Error} = \frac{\dot{A}_t}{A_t} - TFP_t = -[\alpha\frac{\dot{K}_t}{K_t} + (1-\alpha)\frac{\dot{N}_t}{N_t}] + [1 - \frac{\theta_t - 1}{\theta_t}(1-\alpha)]\frac{\dot{K}_t}{K_t} - [\frac{\theta_t - 1}{\theta_t}(1-\alpha)]\frac{\dot{N}_t}{N_t}.$$

Since $\alpha\frac{\dot{K}_t}{K_t} + (1-\alpha)\frac{\dot{N}_t}{N_t} = \frac{\dot{Y}_t}{Y_t} - \frac{\dot{A}_t}{A_t}$ the correct productivity measure relative to computed TFP is then

(26)
$$\frac{\dot{A}_t}{A_t} = (\frac{\theta_t}{\theta_t - 1})TFP - (\frac{1}{\theta_t})[\frac{\dot{Y}_t}{Y_t} - \frac{\dot{K}_t}{K_t}].$$

Table 7: Assessing the Implied Error in Computed TFP 1990-2015
(percent)

Year	Standard TFP	Corrected TFP	TFP Error	Year	Standard TFF	Corrected TFP	TFP Error
1990	0.82	0.90	0.078	2003	2.30	2.67	0.362
1991	0.25	0.41	0.162	2004	2.57	2.80	0.233
1992	3.54	3.65	0.105	2005	1.67	1.77	0.103
1993	0.43	0.40	-0.031	2006	0.75	0.85	0.104
1994	1.45	1.40	-0.050	2007	0.89	1.10	0.208
1995	0.83	0.82	-0.010	2008	-0.79	-0.41	0.375
1996	2.31	2.39	0.077	2009	-0.39	0.49	0.876
1997	1.91	1.90	-0.010	2010	2.92	3.24	0.318
1998	2.68	2.81	0.132	2011	0.58	0.47	-0.109
1999	2.87	3.06	0.187	2012	1.32	1.29	-0.036
2000	2.41	2.74	0.326	2013	0.45	0.43	-0.012
2001	0.75	1.14	0.384	2014	1.09	1.08	-0.011
2002	2.27	2.72	0.457	2015	1.18	1.21	0.022

We illustrate the impact of this factor in Table 7 for 1990-2015 using the results in Table 5. Equation (26) shows there are two factors at work. First, a fixed bias of computed TFP relative the correct TFP by a proportional factor of $(\frac{\theta_t}{\theta_t - 1})$, which is the entire bias when output and capital grow at the same rate. Second, differences between the growth of output and capital cause further bias: in recessions or periods of slow output growth relative to the growth of capital, standard TFP can be significantly biased downward. However, in recoveries, when output grows faster than capital, standard productivity measure is biased downward**.**

In 18 of the 26 years 1990-2015, the error is positive. Standard TFP measures underestimated the true rate of productivity growth over 1990-2015 by a mean of 0.1631 percentage point but, since θ_t declined and became more important, the magnitude of, this error *increased* with time; hence, over 2000-2015 the mean error was 0.2251. The error was large during the sharp decline in 2009 when the output decline was not matched by a decline in capital, causing corrected TFP to measure 0.49%, while standard TFP was -0.39%. The error exceeded 0.20% in 9 out of the 16 years 2000-2015 when market monopoly power became more significant. We also note that our corrected measure places a heavier weight on the contribution of capital. Interestingly, the two measures are very close during 2011-2015 when the discussion of "secular stagnation" intensified.

4. A Final Note

By examining the pattern of IT this paper has demonstrated that even neutral technical progress has profound effects on distribution, not only on growth. The data for 1950-2015 reveals that, although the IT revolution has improved living standards, it has also caused rising inequality with other negative economic effects. The mechanism underlying our study arises from the economic observation that, to appropriate the gains from their innovations, society must grant innovators monopoly power over products or processes that result from their innovations. But a general rise of monopoly power changes the distribution of income. We conjecture that our results regarding IT generalize: all major innovation waves cause rising monopoly power and rising shares of monopoly profits in national income, but when waves of innovations slow down, monopoly power decline, causing a decline in inequality. The structural relation between waves of innovations and inequality depend upon other factors such as the power of organized labor, income taxes and the nature of the innovation wave itself. We hope to quantify this relation by further studying available data for wider time interval of 1900 - 2015.

Given that IT has had a sharp effect on distribution, if our conjecture is correct then we are not observing an economy in an approximate steady state or even close to steady state. What we know about the current phase of the process is that during the innovations wave of 1980-2015, *rising monopoly power caused the growth rate of wealth to exceed the growth rate of the economy by 2.43% (see section 1)* and this explains the drastic rise in inequality during this period. Our perspective conflicts with Piketty's (2014) view of wealth accumulating through a lengthy intergenerational process where the rate of return on family assets exceeds the economy's growth rate, causing wealth inequality to rise. The process of accumulation we describe here shows that wealth creation in 1950-2015 had little to do with intergenerational accumulation and mostly reflects rise of individual wealth enabled by IT based innovations together with rapid decline of wealth created in older industries such as railroads, automobiles, steel, etc. We, therefore, question the darker future forecasted by Piketty's (2014), which appears motivated by a model of agrarian society in which dynastic land (not subdivided by inheritance) is the main form of wealth. Our analysis contradicts Piketty's forecast of rising social stratification as in the 19th century since rising surplus is not associated with intergenerational wealth transfer within a fixed set of dynasties with growing wealth through high saving rate. Instead, our analysis shows the rapid movement of of wealth is technologically based. This wealth is transformed from one group of monopoly wealth owners to the next set of innovators, who may be young but not members of the same family. *This does not alter other dark and authoritarian implications of growing inequality*, but the 19th century Victorian age is not the appropriate model for it.

The darker effects of the IT revolution are only slowly beginning to be noticed by the general public. More careful legislation is needed to address problems arising from private firms trading private information of their customers and the subversive potential of Social Networks which must be regulated since they are privately held public utilities. The more fundamental question of income distribution cannot be addressed effectively by corporate taxation or wealth taxation since these two impact the incentives of firms to locate or innovate. Our preliminary analysis shows optimal taxation requires more progressive income taxation with much higher marginal rates on income from dividends and capital gains received by the stockholders, most of which are actually monopoly gains. In addition, much tighter restrictions must be applied to wealth which escapes taxation via non profit institutions.

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Appendix A: File of the Aggregates

The next two pages report the results of aggregating each of the 66 files of Compustat firms’ financial reports which have been edited in accord with the following criteria:

1. firms with headquarters in the US.
2. non-financial firms: exclude firms with Industrial Classification Code from 6000 to 6499.
3. firms with positive assets
4. firms for which market value can be constructed.

Year	Number of firms	Assets - Total	Intangible Assets - Total	Liabilities - Total	Market Value of Stock	Z.1 Factor to adjust for historical asset values	Current Price Assets	Current Price Intangib.	Total Wealth Compustat	Total Capital Compustat	Surplus in Compustat Samples	Net Worth Financials	Market Value Financial	Total Market Value of Stock	Non Financials (Surplus/Ma rket Valu)	Non Financials (Surplus/ Total Wealth)	Z.1 Current Value of Assets	Z.1 Historical Value of Assets	Non Financials (Debt/Capital Employed)	Surplus in Financials	Total Surplus of Both Sectors	(Total Surplus)/(Total Market Value)
1950	522	86564.9	344.2	27354.4	63081.3	1.4881	128817.99	512.20	90435.64	128305.79	-37870.15	-13169	49672	112753.3	-0.600339	-0.42	452351	303977	0.213196641	62841	24970.85	0.221464506
1951	687	129519.8	340.4	33720.4	90594.5	1.4969	193874.75	509.53	124314.90	193365.22	-69050.32	-11023	50063	140657.5	-0.7621909	-0.56	500818	334576	0.174386934	61086	-7964.32	-0.056622087
1952	690	139782.8	358.8	36445.0	98934.1	1.4808	206993.85	531.38	135379.12	206462.47	-71083.36	-8789	50591	149525.1	-0.7184921	-0.53	524443	354156	0.176521367	59380	-11703.36	-0.078270183
1953	704	152158.5	395.6	41591.1	99684.7	1.4603	222203.97	577.78	141275.87	221626.19	-80350.32	-6952	50992	150676.7	-0.8060446	-0.57	545661	373652	0.187663507	57944	-22406.32	-0.148704624
1954	718	163466.2	431.7	39543.6	143409.6	1.4358	234697.94	619.88	182953.16	234078.06	-51124.90	-2482	51649	195058.6	-0.3564957	-0.28	560184	390166	0.168933346	54131	3006.10	0.015411282
1955	729	180035.0	463.6	45254.2	179627.3	1.4312	257671.84	663.48	224881.50	257008.36	-32126.86	1423	52012	231639.3	-0.1788529	-0.14	615620	430133	0.176080641	50589	18462.14	0.079702101
1956	754	197659.2	522.8	48536.6	198290.4	1.4521	287024.23	759.12	246827.01	286265.11	-39438.11	4907	52620	250910.4	-0.1988906	-0.16	672577	463170	0.169551114	47713	8274.89	0.032979473
1957	776	219301.7	596.7	54385.5	182381.8	1.4453	316965.27	862.49	236767.35	316102.78	-79335.43	6212	53395	235776.8	-0.4349963	-0.34	709225	490698	0.172050054	47183	-32152.43	-0.136368066
1958	850	239706.3	667.8	57968.0	258883.0	1.4160	339429.98	945.55	316850.97	338484.43	-21633.46	10466	54286	313169.0	-0.0835646	-0.07	733083	517705	0.17125742	43820	22186.54	0.070845255
1959	865	259250.2	876.9	64089.0	292734.7	1.3881	359855.33	1217.15	356823.69	358638.18	-1814.49	13175	54974	347708.7	-0.0061984	-0.01	772959	556862	0.17870093	41799	39984.51	0.114994269
1960	1286	284354.8	1035.1	73485.8	306145.5	1.3564	385697.12	1404.06	379631.28	384293.07	-4661.79	17639	55908	362053.5	-0.0152274	-0.01	790406	582726	0.191223297	38269	33607.21	0.09282389
1961	1241	307555.7	1433.6	121557.2	384100.7	1.3273	408212.07	1902.75	505657.95	406309.31	99348.64	2562	78518	462618.7	0.25865259	0.20	819941	617761	0.299174164	75956	175304.64	0.378939804
1962	1637	337059.8	1630.1	135502.4	351810.7	1.3038	439451.63	2125.32	487313.04	437326.30	49986.74	9256	74795	426605.7	0.1420842	0.10	854759	655601	0.309842733	65539	115525.74	0.270802163
1963	1775	363876.2	1993.9	148108.7	416933.0	1.2795	465577.09	2551.18	565041.70	463025.91	102015.79	1881	87551	504484.0	0.24468152	0.18	893607	698407	0.31987137	85670	187685.79	0.372035194
1964	2128	406282.7	2439.0	167792.7	484090.7	1.2709	516325.78	3099.55	651883.44	513226.23	138657.21	45	96021	580111.7	0.28642814	0.21	945102	743675	0.32693711	95976	234633.21	0.404462098
1965	1998	449242.1	3099.1	190168.0	541756.8	1.2530	562906.97	3883.19	731924.77	559023.78	172900.99	-4406	106063	647819.8	0.31914871	0.24	1024000	817229	0.340178648	110469	283369.99	0.437420994
1966	2138	510210.6	3781.1	225490.4	501379.9	1.2509	638222.56	4729.81	726870.22	633492.76	93377.47	-2949	108209	609588.9	0.18624097	0.13	1109880	887265	0.355947831	111158	204535.47	0.335530197
1967	2222	573148.1	4790.6	260988.3	618346.8	1.2521	717647.74	5998.44	879335.15	711649.30	167685.84	4780	117648	735994.8	0.27118412	0.19	1193305	953031	0.366737246	112868	280553.84	0.381189957
1968	2658	660106.3	7004.7	313986.0	713849.7	1.2587	830877.83	8816.80	1027835.74	822061.03	205774.72	-19934	146483	860332.7	0.28826055	0.20	1308179	1039307	0.381949763	166417	372191.72	0.432613691
1969	2968	747310.5	9999.1	367886.8	663362.0	1.2665	946484.27	12664.08	1031248.87	933820.19	97428.67	1711	128581	791943.0	0.14687104	0.09	1445940	1141663	0.393958956	126870	224298.67	0.283225765
1970	3075	818394.4	12348.2	417985.9	643117.1	1.2905	1056174.45	15935.94	1061103.04	1040238.51	20864.53	14890	122471	765588.1	0.03244281	0.02	1566503	1213831	0.401817376	107581	128445.53	0.167773665
1971	3202	884495.0	13306.7	453564.6	749888.1	1.3130	1161319.91	17471.43	1203452.65	1143848.48	59604.17	10226	143477	893365.1	0.07948409	0.05	1713766	1305254	0.396525054	133251	192855.17	0.215874983
1972	3450	969584.8	14555.2	499151.8	886280.0	1.3071	1267318.92	19024.73	1385431.78	1248294.19	137137.59	12613	160080	1046360.0	0.15473393	0.10	1897040	1451364	0.399867106	147467	284604.59	0.271994908
1973	3535	1098044.1	16057.4	578073.1	759372.8	1.3271	1457193.12	21309.44	1337445.87	1435883.68	-98437.81	77826	118935	878307.8	-0.1296304	-0.07	2168207	1633817	0.40259045	41109	-57328.81	-0.065271886
1974	3711	1266100.3	16774.9	694134.7	556911.9	1.4156	1792310.60	23746.78	1251046.56	1768563.82	-517517.26	138548	65900	622811.9	-0.9292624	-0.41	2559238	1807863	0.392484944	-72648	-590165.26	-0.947581886
1975	3663	1342145.9	16652.4	729888.3	708643.4	1.4311	1920716.56	23831.25	1438531.66	1896885.31	-458353.65	149871	74976	783619.4	-0.6468044	-0.32	2906076	2030689	0.384782513	-74895	-533248.65	-0.680494484
1976	3684	1466129.5	16568.4	793262.1	870591.9	1.4433	2116086.57	23913.40	1663854.02	2092173.17	-428319.15	158643	97475	968066.9	-0.4919861	-0.26	3218357	2229837	0.379156996	-61168	-489487.15	-0.505633582
1977	3658	1589029.7	17449.0	861611.1	817609.8	1.4506	2305117.72	25312.26	1679220.90	2279805.46	-600584.57	190414	93415	911024.8	-0.7345614	-0.36	3583483	2470269	0.377931872	-96999	-697583.57	-0.765713081
1978	3714	1765458.9	19864.2	972762.3	850799.5	1.4630	2582847.50	29061.06	1823561.83	2553786.43	-730224.60	223085	102170	952969.5	-0.8582804	-0.40	4078823	2788006	0.380909806	-120915	-851139.60	-0.89314461
1979	3974	2004237.2	22256.4	1126166.0	978189.0	1.4814	2969032.02	32970.17	2104355.02	2936061.85	-831706.83	257147	117825	1096014.0	-0.8502517	-0.40	4718660	3185319	0.38356346	-139322	-971028.83	-0.885963904
1980	4093	2222815.4	22819.0	1252677.8	1241164.9	1.5116	3359939.23	34492.51	2493842.71	3325446.72	-831604.01	307120	129662	1370826.9	-0.670019	-0.33	5371491	3553586	0.376694603	-177458	-1009062.01	-0.736097332
1981	4771	2494743.2	26079.0	1419884.3	1200700.3	1.5087	3763783.81	39344.99	2620584.62	3724438.82	-1103854.19	315890	140116	1340816.3	-0.919342	-0.42	6043687	4005928	0.381234437	-175774	-1279628.19	-0.954365041
1982	4804	2558525.8	29593.3	1451549.3	1306792.0	1.4909	3814383.00	44119.30	2758341.29	3770263.71	-1011922.41	286932	158774	1465566.0	-0.7743562	-0.37	6389338	4285696	0.384999418	-128158	-1140080.41	-0.777911363
1983	5007	2743223.7	33035.0	1537424.2	1684104.8	1.4464	3967729.94	47781.05	3221528.96	3919948.90	-698419.93	306387	199615	1883719.8	-0.4147129	-0.22	6721378	4647051	0.392205155	-106772	-805191.93	-0.427447824
1984	5145	2933572.7	41274.5	1680921.3	1638599.7	1.4067	4126587.57	58059.84	3319521.01	4068527.73	-749006.70	373383	209891	1848490.7	-0.4571017	-0.23	7298303	5188331	0.413152232	-163492	-912498.70	-0.493645271
1985	5080	3085259.1	72848.6	1817621.2	1899329.6	1.3661	4214743.77	99517.73	3716950.86	4115226.04	-398275.17	344535	309114	2208443.6	-0.2096925	-0.11	7802957	5711888	0.44168199	-35421	-433696.17	-0.19638091
1986	5266	3230143.7	105169.1	1947351.6	2198199.5	1.3480	4354257.42	141768.73	4145551.12	4212488.69	-66937.57	357752	368965	2567164.5	-0.0304511	-0.02	8153537	6048585	0.462280552	11213	-55724.57	-0.021706659
1987	5394	3426199.1	133793.0	2096270.5	2293468.8	1.3357	4576384.66	178707.76	4389739.28	4397676.90	-7937.62	487148	328947	2622415.8	-0.003461	0.00	8675752	6495270	0.476676783	-158201	-166138.62	-0.063353272
1988	5227	3975555.9	178054.4	2612066.7	2360356.9	1.3282	5280389.22	236494.36	4972423.58	5043894.86	-71471.28	511078	388881	2749237.9	-0.0302799	-0.01	9432664	7101765	0.517866996	-122197	-193668.28	-0.070444351
1989	4978	4192306.2	222920.8	2801851.5	2812792.7	1.3221	5542804.16	294731.95	5614644.22	5248072.21	366572.02	533015	477010	3289802.7	0.13032315	0.07	9975893	7545278	0.533882047	-56005	310567.02	0.094402931
1990	4875	4399062.8	224075.2	2960276.8	2603135.5	1.2864	5658994.33	288252.32	5563412.30	5370742.01	192670.29	658286	377896	2981031.5	0.0740147	0.03	10238063	7958637	0.551185804	-280390	-87719.71	-0.02942596
1991	4953	4577619.4	254773.7	3091026.5	3294373.2	1.2371	5662892.12	315176.00	6385399.65	5347716.11	1037683.54	545371	570316	3864689.2	0.31498664	0.16	10208881	8252386	0.578008705	24945	1062628.54	0.274958344
1992	5105	4742023.6	271163.4	3279356.3	3566448.2	1.1854	5621424.93	321450.27	6845804.56	5299974.66	1545829.90	446810	746524	4312972.2	0.4334368	0.23	10219945	8621163	0.618749436	299714	1845543.90	0.427905353
1993	5494	5123732.5	306828.8	3562136.0	4159949.0	1.1617	5952438.30	356454.84	7722084.92	5595983.46	2126101.46	474463	910666	5070615.0	0.51108835	0.28	10700200	9210505	0.636552268	436203	2562304.46	0.505324203
1994	5780	5395550.2	354338.0	3648125.4	4159165.7	1.1648	6284894.04	412743.20	7807291.14	5872150.84	1935140.30	445326	893902	5053067.7	0.46527127	0.25	11371614	9762474	0.621258805	448576	2383716.30	0.471736464
1995	6391	5761708.1	421148.3	3857499.1	5440310.3	1.1585	6674674.32	487880.95	9297809.47	6186793.36	3111016.11	184031	1283957	6724267.3	0.57184534	0.33	12226547	10554192	0.62350541	1099926	4210942.11	0.62623062
1996	6978	6351548.0	535005.2	4169133.9	6511681.4	1.1382	7229270.94	608937.80	10680815.33	6620333.14	4060482.19	-401116	1807976	8319657.4	0.62356893	0.38	12959470	11386030	0.629746851	2209092	6269574.19	0.753585622
1997	7057	6960989.9	628818.9	4568323.0	8259258.4	1.1815	8224256.52	742935.65	12827581.37	7481320.87	5346260.50	-1076011	2534883	10794141.4	0.64730515	0.42	14289732	12094793	0.610630533	3610894	8957154.50	0.8298163
1998	6853	7640730.8	786433.3	5057485.4	9957711.3	1.1869	9068884.08	933428.06	15015196.66	8135456.03	6879740.63	-1034693	2771362	12729073.3	0.69089577	0.46	16003554	13483340	0.621659729	3806055	10685795.63	0.839479466
1999	6978	8683833.8	1035335.8	5677079.3	12920681.2	1.1712	10170272.71	1212557.41	18597760.50	8957715.30	9640045.20	-983239	2794112	15714793.2	0.74609419	0.52	17774625	15176770	0.633764206	3777351	13417396.20	0.853806732
2000	6777	9730070.3	1423353.5	6268292.9	13186661.5	1.1787	11468854.93	1677709.79	19454954.38	9791145.13	9663809.25	-1233263	3128245	16314906.5	0.7328473	0.50	20433475	17335571	0.640200179	4361508	14025317.25	0.85966274
2001	6300	10000214.8	1670830.6	6486553.9	10656097.2	1.1568	11568080.90	1932788.81	17142651.11	9635292.09	7507359.02	-974535	3005495	13661592.2	0.704513	0.44	20518703	17737725	0.673207812	3980030	11487389.02	0.840852871
2002	5881	9948791.9	1583109.2	6775801.3	8566552.6	1.1649	11589800.94	1844236.09	15342353.87	9745564.85	5596789.02	-470500	2714981	11281533.6	0.65333038	0.36	20981033	18010312	0.69527025	3185481	8782270.02	0.778464202
2003	5530	10620624.1	1771723.5	7013364.6	10268548.0	1.1671	12395204.80	2067757.56	17281912.63	10327447.24	6954465.40	-956294	3516371	13784919.0	0.67725889	0.40	21491483	18414618	0.679099535	4472665	11427130.40	0.828958834
2004	5417	11387418.2	1865490.6	7375770.4	11819530.2	1.2182	13872154.43	2272540.88	19195300.57	11599613.55	7595687.02	-1125963	4037620	15857150.2	0.64263866	0.40	23864012	19589566	0.635863456	5163583	12759270.02	0.804638277
2005	5220	11811704.8	2004118.2	7640639.9	12245325.3	1.2397	14642876.46	2484489.32	19885965.22	12158387.10	7727578.12	-1009016	4341759	16587084.3	0.63106352	0.39	26064581	21025045	0.628425454	5350775	13078353.12	0.788466068
2006	5099	12606812.4	2486197.3	7959988.1	13659107.8	1.2631	15923398.90	3140263.34	21619095.94	12783135.56	8835960.38	-1335971	5038190	18697297.8	0.64689147	0.41	28193086	22320922	0.622694491	6374161	15210121.38	0.813493025
2007	4932	13276875.4	2720787.2	8377850.1	14665284.0	1.3011	17274270.40	3539960.49	23043134.12	13734309.91	9308824.21	-168356	4248838	18914122.0	0.6347524	0.40	31166627	23954437	0.609994254	4417194	13726018.21	0.725702108
2008	4727	13037936.1	2594136.4	8613257.0	9932506.7	1.2538	16347164.90	3252568.07	18545763.72	13094596.82	5451166.90	1276593	2664680	12597186.7	0.54882086	0.29	29508174	23534704	0.657771839	1388087	6839253.90	0.542919151
2009	4374	13163221.9	2726665.1	8300146.8	10913269.6	1.1334	14919234.21	3090410.15	19213416.40	11828824.06	7384592.34	1202421	3351158	14264427.6	0.67666177	0.38	27177463	23978642	0.701688243	2148737	9533329.34	0.668328908
2010	4280	13937813.3	2896995.7	8574645.7	12876812.9	1.1578	16137204.61	3354142.52	21451458.60	12783062.08	8668396.52	903939	4042602	16919414.9	0.67317873	0.40	28952082	25006110	0.670781824	3138663	11807059.52	0.697840888
2011	4216	15032713.3	3124471.5	9392200.2	13243342.0	1.1751	17664375.11	3671448.71	22635542.20	13992926.40	8642615.80	1472905	3781304	17024646.0	0.65260082	0.38	30501745	25957555	0.67121058	2308399	10951014.80	0.643244789
2012	4234	16189537.3	3367049.0	10175392.9	14728558.3	1.1807	19114489.21	3975371.30	24903951.19	15139117.92	9764833.28	1151186	4627500	19356058.3	0.66298636	0.39	31941287	27053543	0.672125879	3476314	13241147.28	0.684082839
2013	4343	17477533.5	3654351.1	10786884.4	18645782.8	1.2124	21190244.31	4430636.22	29432757.26	16759608.09	12673149.17	17049	6052386	24698258.8	0.67967583	0.43	34829105	28726750	0.643623906	6035337	18708486.17	0.757481986
2014	4381	18324135.9	3827676.3	11601706.7	20501898.3	1.2298	22534943.49	4707259.80	32103605.02	17827683.69	14275921.33	-340120	6861058	27362956.3	0.69632193	0.44	37310517	30338793	0.650769158	7201178	21477099.33	0.784896891
2015	4199	18914415.0	4448878.6	12184470.9	20180108.4	1.2456	23559141.00	5541369.29	32364579.26	18017771.71	14346807.55	-236911	6830527	27010635.4	0.71093808	0.44	39568387	31767410	0.67624738	7067438	21414245.55	0.792807917

Non Financials (Capital/ Total Wealth)	GNP Deflator 2015 = 1	Non Financial Capital in 2015 prices	Non Financial Wealth in 2015 prices	non financial equity value at 2015 prices	Non Financials Exess Market Value	Total Surplus/ Total Market Value Formula	Total Surplus/ Total Market Value in numbers	Payroll Labor Share	Relative Labor Share (published)	Officers' share in wage income	Non Financials Surplus/wealth	Cash Holdings Abroad	Non Financials Surplus Plus Foreign Holdings	Non Financials Adjusted Surplus/ wealth	Growth Rate of Real Non Financials Wealth	Non Financials Wealth in 2015 prices	Our Adjusted Payroll Share	Profit Implied Relative Share of Surpus in Output	Profit based Theta	Labor Based Theta
1.4187525	0.14664688	874930.2555	616689.8421	430157.7	-38382.35	0.221465	0.2214645	54.57	63.1	5.17	-0.4187525	0	-37870.15	-0.42	0.00	616689.84	0.56	0.022	46.166	6.14
1.555446885	0.15631097	1237054.682	795304.9985	579578.8	-69559.85	-0.05662	-0.0566221	54.95	62.8	4.73	-0.55544688	0	-69050.32	-0.56	28.96	795305.00	0.56	-0.001	-1826.813	6.32
1.525068834	0.15954455	1294074.11	848534.8866	620103.2	-71614.74	-0.07827	-0.0782702	56.19	63.7	4.54	-0.52506883	0	-71083.36	-0.53	6.69	848534.89	0.58	-0.025	-39.546	7.15
1.568747708	0.1626224	1362826.917	868735.5588	612982.7	-80928.10	-0.1487	-0.1487046	56.92	64.4	4.41	-0.56874771	0	-80350.32	-0.57	2.38	868735.56	0.58	-0.037	-27.336	7.84
1.279442544	0.16409721	1426459.729	1114907.219	873930.6	-51744.77	0.015411	0.0154113	56.67	64.6	4.62	-0.27944254	0	-51124.90	-0.28	28.34	1114907.22	0.58	-0.051	-19.664	7.71
1.142861289	0.16701018	1538878.441	1346513.751	1075547	-32790.34	0.079702	0.0797021	55.6	63.1	4.94	-0.14286129	0	-32126.86	-0.14	20.77	1346513.75	0.57	-0.004	-229.843	6.53
1.159780351	0.17292772	1655403.307	1427342.087	1146667	-40197.22	0.032979	0.0329795	57.41	65.0	4.82	-0.15978035	0	-39438.11	-0.16	6.00	1427342.09	0.59	-0.028	-36.304	8.10
1.335077593	0.17846052	1771275.639	1326721.12	1021973	-80197.92	-0.13637	-0.1363681	57.26	65.0	4.93	-0.33507759	0	-79335.43	-0.34	-7.05	1326721.12	0.59	-0.042	-23.911	7.97
1.068276461	0.18099792	1870101.202	1750577.936	1430309	-22579.02	0.070845	0.0708453	57.01	65.1	5.14	-0.06827646	0	-21633.46	-0.07	31.95	1750577.94	0.58	-0.070	-14.366	7.78
1.005085119	0.18388341	1950356.38	1940488.762	1591958	-3031.64	0.114994	0.1149943	56.55	64.3	5.16	-0.00508512	0	-1814.49	-0.01	10.85	1940488.76	0.58	-0.035	-28.900	7.21
1.012279775	0.18606355	2065386.031	2040331.223	1645381	-6065.84	0.092824	0.0928239	57.58	65.5	5.32	-0.01227977	0	-4661.79	-0.01	5.15	2040331.22	0.59	-0.042	-23.946	8.12
0.803525999	0.1875292	2166645.604	2696422.527	2048218	97445.89	0.37894	0.3789398	57.16	65.0	5.48	0.196474	0	99348.64	0.20	32.16	2696422.53	0.58	0.006	166.173	7.57
0.897423767	0.18918721	2311606.089	2575824.459	1859590	47861.41	0.270802	0.2708022	56.74	64.1	5.67	0.10257623	0	49986.74	0.10	-4.47	2575824.46	0.57	0.027	37.587	6.93
0.819454402	0.19065285	2428633.537	2963720.165	2186870	99464.61	0.372035	0.3720352	56.63	63.6	5.74	0.1805456	0	102015.79	0.18	15.06	2963720.17	0.57	0.045	22.230	6.67
0.787297541	0.19312613	2657466.553	3375428.495	2506604	135557.66	0.404462	0.4044621	56.13	62.9	5.70	0.21270246	0	138657.21	0.21	13.89	3375428.50	0.56	0.052	19.222	6.30
0.763772187	0.1956452	2857334.464	3741082.11	2769078	169017.80	0.437421	0.437421	55.79	62.2	5.78	0.23622781	0	172900.99	0.24	10.83	3741082.11	0.56	0.072	13.818	5.97
0.871534884	0.2000971	3165926.746	3632587.522	2505683	88647.66	0.33553	0.3355302	56.23	62.2	5.70	0.12846512	0	93377.47	0.13	-2.90	3632587.52	0.56	0.073	13.725	6.11
0.809303833	0.20631693	3449301.583	4262060.108	2997073	161687.40	0.38119	0.38119	56.95	62.6	5.71	0.19069617	0	167685.84	0.19	17.33	4262060.11	0.57	0.056	17.787	6.42
0.799798053	0.21429553	3836109.087	4796347.119	3331146	196957.92	0.432614	0.4326137	57.22	62.6	5.62	0.20020195	0	205774.72	0.20	12.54	4796347.12	0.57	0.058	17.275	6.54
0.905523608	0.2239413	4169932.882	4604996.321	2962214	84764.60	0.283226	0.2832258	58.51	63.9	5.85	0.09447639	0	97428.67	0.09	-3.99	4604996.32	0.58	0.037	26.974	7.35
0.980336946	0.23380692	4449134.838	4538373.113	2750633	4928.59	0.167774	0.1677737	59.25	64.6	5.96	0.01966305	0	20864.53	0.02	-1.45	4538373.11	0.59	0.004	277.726	7.91
0.95047236	0.2438191	4691381.728	4935842.353	3075592	42132.74	0.215875	0.215875	57.92	63.2	6.23	0.04952764	0	59604.17	0.05	8.76	4935842.35	0.57	0.015	66.225	6.70
0.901014549	0.25131221	4967105.228	5512791.37	3526609	118112.86	0.271995	0.2719949	58.09	63.1	6.47	0.09898545	0	137137.59	0.10	11.69	5512791.37	0.57	0.031	32.406	6.60
1.073601339	0.2603534	5515133.112	5137040.082	2916700	-119747.25	-0.06527	-0.0652719	58.95	63.6	6.65	-0.07360134	0	-98437.81	-0.07	-6.82	5137040.08	0.57	0.041	24.683	6.97
1.413667468	0.28748615	6151822.78	4351675.991	1937178	-541264.05	-0.94758	-0.9475819	59.58	64.2	6.87	-0.41366747	0	-517517.26	-0.41	-15.29	4351675.99	0.58	0.005	195.868	7.32
1.318626045	0.31799903	5965066.364	4523698.275	2228445	-482184.90	-0.68049	-0.6804945	57.47	62.4	7.10	-0.31862604	0	-458353.65	-0.32	3.95	4523698.27	0.56	0.017	60.449	5.98
1.257425918	0.33545852	6236756.733	4959939.704	2595230	-452232.55	-0.50563	-0.5056336	57.24	61.6	7.11	-0.25742592	0	-428319.15	-0.26	9.64	4959939.70	0.55	0.031	32.331	5.71
1.357656678	0.35640807	6396615.686	4711511.966	2294027	-625896.82	-0.76571	-0.7657131	57.24	61.7	7.42	-0.35765668	0	-600584.57	-0.36	-5.01	4711511.97	0.55	0.037	26.752	5.64
1.400438632	0.37991334	6722023.524	4799941.513	2239457	-759285.67	-0.89314	-0.8931446	57.63	62.0	7.59	-0.40043863	0	-730224.60	-0.40	1.88	4799941.51	0.55	0.043	23.339	5.75
1.395231231	0.4120934	7124748.572	5106500.208	2373707	-864676.99	-0.88596	-0.8859639	58.24	62.8	7.74	-0.39523123	0	-831706.83	-0.40	6.39	5106500.21	0.56	0.035	28.736	6.05
1.333462894	0.45151007	7365166.197	5523337.94	2748920	-866096.52	-0.7361	-0.7360973	58.86	63.5	7.91	-0.33346289	0	-831604.01	-0.33	8.16	5523337.94	0.56	0.005	181.983	6.35
1.421224403	0.49451757	7531458.966	5299275.014	2428023	-1143199.19	-0.95437	-0.954365	58.12	62.6	7.93	-0.4212244	0	-1103854.19	-0.42	-4.06	5299275.01	0.56	0.008	130.858	5.90
1.366859031	0.52561672	7173028.551	5247818.822	2486207	-1056041.71	-0.77791	-0.7779114	59.07	63.8	8.13	-0.36685903	0	-1011922.41	-0.37	-0.97	5247818.82	0.57	-0.003	-288.797	6.42
1.216797657	0.54243498	7226578.308	5939013.991	3104713	-746200.98	-0.42745	-0.4274478	56.87	61.9	8.38	-0.21679766	0	-698419.93	-0.22	13.17	5939013.99	0.54	0.026	38.408	5.33
1.22563698	0.55798914	7291410.289	5949078.239	2936616	-807066.54	-0.49365	-0.4936453	56.49	61.4	8.47	-0.22563698	0	-749006.70	-0.23	0.17	5949078.24	0.54	0.053	18.817	5.13
1.107151046	0.57645626	7138834.907	6447932.225	3294837	-497792.90	-0.19638	-0.1963809	56.47	61.4	8.56	-0.10715105	0	-398275.17	-0.11	8.39	6447932.23	0.54	0.060	16.762	5.10
1.016146844	0.58469134	7204636.651	7090153.059	3759590	-208706.30	-0.02171	-0.0217067	56.6	62.1	8.77	-0.01614684	0	-66937.57	-0.02	9.96	7090153.06	0.54	0.042	23.675	5.21
1.001808222	0.59624245	7375652.089	7362339.349	3846537	-186645.38	-0.06335	-0.0633533	57.09	62.9	8.81	-0.00180822	0	-7937.62	0.00	3.84	7362339.35	0.55	0.062	16.179	5.46
1.01437353	0.61430652	8210713.517	8094368.864	3842311	-307965.64	-0.07044	-0.0704444	57.24	63.2	8.29	-0.01437353	0	-71471.28	-0.01	9.94	8094368.86	0.55	0.069	14.591	5.73
0.934711443	0.63650187	8245179.513	8821096.149	4419143	71840.06	0.094403	0.0944029	56.31	62.2	7.62	0.06528856	0	366572.02	0.07	8.98	8821096.15	0.55	0.060	16.610	5.49
0.965368325	0.65812929	8160618.451	8453372.914	3955356	-95582.04	-0.02943	-0.029426	57.24	62.7	7.46	0.03463167	0	192670.29	0.03	-4.17	8453372.91	0.56	0.067	15.005	5.88
0.837491215	0.67836434	7883250.622	9412935.3	4856348	722507.53	0.274958	0.2749583	56.31	62.7	7.13	0.16250878	0	1037683.54	0.16	11.35	9412935.30	0.55	0.076	13.074	5.76
0.7741931	0.68958568	7685737.692	9927416.931	5171871	1224379.63	0.427905	0.4279054	56.49	62.6	7.45	0.2258069	0	1545829.90	0.23	5.47	9927416.93	0.55	0.092	10.859	5.68
0.724672613	0.70559785	7930839.782	10944031.32	5895637	1769646.63	0.505324	0.5053242	56.34	61.9	7.31	0.27532739	0	2126101.46	0.28	10.24	10944031.32	0.55	0.111	8.980	5.52
0.752136782	0.71859628	8171696.697	10864641.76	5787903	1522397.11	0.471736	0.4717365	56.23	60.9	8.66	0.24786322	0	1935140.30	0.25	-0.73	10864641.76	0.53	0.124	8.077	4.94
0.665403328	0.73120082	8461141.165	12715808.31	7440241	2623135.16	0.626231	0.6262306	55.79	60.7	8.82	0.33459667	0	3111016.11	0.33	17.04	12715808.31	0.53	0.140	7.127	4.80
0.619834061	0.7411672	8932307.205	14410804.06	8785712	3451544.39	0.753586	0.7535856	55.41	60.7	8.79	0.38016594	0	4060482.19	0.38	13.33	14410804.06	0.53	0.153	6.536	4.74
0.583221471	0.75385419	9924095.409	17015998.05	10956042	4603324.85	0.829816	0.8298163	55.56	60.7	8.64	0.41677853	0	5346260.50	0.42	18.08	17015998.05	0.53	0.145	6.884	4.80
0.541814817	0.75845265	10726386.24	19797144.54	13128982	5946312.58	0.839479	0.8394795	55.14	62.0	8.54	0.45818518	0	6879740.63	0.46	16.34	19797144.54	0.54	0.128	7.795	4.97
0.48165559	0.76537782	11703651.61	24298797.43	16881442	8427487.79	0.853807	0.8538067	55.12	61.9	8.37	0.51834441	0	9640045.20	0.52	22.74	24298797.43	0.54	0.130	7.681	4.99
0.503272583	0.78045563	12545421.84	24927687.85	16896107	7986099.45	0.859663	0.8596627	56.52	63.2	8.31	0.49672742	0	9663809.25	0.50	2.59	24927687.85	0.55	0.122	8.205	5.55
0.56206546	0.79350903	12142637.01	21603599.35	13429081	5574570.21	0.840853	0.8408529	56.69	63.1	7.73	0.43793454	0	7507359.02	0.44	-13.33	21603599.35	0.55	0.118	8.484	5.76
0.635206627	0.79997618	12182318.74	19178513.3	10708509	3752552.93	0.778464	0.7784642	57.95	61.4	7.63	0.36479337	0	5596789.02	0.36	-11.23	19178513.30	0.55	0.128	7.806	5.66
0.597587053	0.81018073	12747090.65	21330935.12	12674392	4886707.83	0.828959	0.8289588	57.90	60.6	7.54	0.40241295	0	6954465.40	0.40	11.22	21330935.12	0.55	0.151	6.626	5.50
0.604294447	0.82723717	14022113.6	23204107.96	14287958	5323146.14	0.804638	0.8046383	56.65	60.2	7.70	0.39570555	0	7595687.02	0.40	8.78	23204107.96	0.54	0.161	6.207	5.13
0.611405429	0.85521266	14216799.78	23252655.45	14318457	5243088.80	0.788466	0.7884661	56.27	59.2	7.80	0.38859457	0	7727578.12	0.39	0.21	23252655.45	0.53	0.121	8.262	4.86
0.59128909	0.87945991	14535211.23	24582241.54	15531246	5695697.04	0.813493	0.813493	55.35	59.2	7.80	0.40871091	0	8835960.38	0.41	5.72	24582241.54	0.53	0.190	5.254	4.71
0.596026124	0.89709344	15309787.4	25686436.87	16347555	5768863.72	0.725702	0.7257021	54.75	59.6	7.47	0.40397388	0	9308824.21	0.40	4.49	25686436.87	0.53	0.170	5.896	4.74
0.70606943	0.91101707	14373602.12	20357207.81	10902657	2198598.82	0.542919	0.5429192	54.70	59.8	7.13	0.29393057	1,098,000.00	6549166.90	0.35	-20.75	20357207.81	0.53	0.185	5.412	4.84
0.615654385	0.91602774	12913172.36	20974710.28	11913689	4294182.19	0.668329	0.6683289	54.92	58.3	6.82	0.38434561	1,188,000.00	8572592.34	0.45	3.03	20974710.28	0.53	0.195	5.137	4.69
0.595906429	0.92505977	13818633.66	23189267.63	13919979	5314254.00	0.697841	0.6978409	55.66	57.0	6.80	0.40409357	1,363,000	10031396.52	0.47	10.56	23189267.63	0.52	0.231	4.332	4.62
0.61818384	0.94157575	14861179.66	24040064.94	14065084	4971167.08	0.643245	0.6432448	54.43	57.1	6.86	0.38181616	1,630,000.00	10272615.80	0.45	3.67	24040064.94	0.52	0.236	4.243	4.44
0.60790024	0.95935585	15780503.06	25959034.09	15352550	5789461.98	0.684083	0.6840828	53.18	57.0	6.91	0.39209976	1,885,000.00	11649833.28	0.47	7.98	25959034.09	0.51	0.236	4.241	4.24
0.569420253	0.97380161	17210495.42	30224593.04	19147507	8242512.95	0.757482	0.757482	53.41	56.7	6.73	0.43057975	2,119,000.00	14792149.17	0.50	16.43	30224593.04	0.51	0.238	4.196	4.26
0.555317189	0.99047331	17999156.04	32412387.74	20699092	9568661.53	0.784897	0.7848969	53.09	56.8	6.75	0.44468281	2,299,000.00	16574921.33	0.52	7.24	32412387.74	0.51	0.239	4.188	4.23
0.556712682	1	18017771.71	32364579.26	20180108	8805438.26	0.792808	0.7928079	53.46	57.4	6.75	0.44328732	2,434,000.00	16780807.55	0.52	-0.15	32364579.26	0.52	0.226	4.424	4.36

Appendix B: File of the 500 firms

The next two pages report the results of assigning the values of to 500 firms as follows:

(i) 200 firms with largest surplus wealth;
(ii) 200 firms with smallest surplus wealth;
(iii) 100 firms around the mean value of surplus wealth.

Sruplus Analysis: Top 200

Company Name	Chi Value for IT Tranformed Sectors	Surplus Wealth at Current Prices	Tobin Q
APPLE INC	1	435861.42	2.24
ALPHABET INC	1	396179.26	3.49
AMAZON.COM INC	1	294518.50	4.88
AT&T INC	1	269517.42	2.22
FACEBOOK INC	1	267901.74	8.64
VERIZON COMMUNICATIONS INC	1	260112.49	2.68
MICROSOFT CORP	1	258150.38	2.34
JOHNSON & JOHNSON	1	238127.22	3.22
PROCTER & GAMBLE CO	0	209646.08	4.04
PFIZER INC	1	203586.49	3.07
COMCAST CORP	1	177802.97	3.49
GENERAL ELECTRIC CO	1	170531.18	1.33
COCA-COLA CO	0	167927.02	3.04
ORACLE CORP	1	162979.37	2.86
WAL-MART STORES INC	1	160896.10	1.70
ALLERGAN PLC	0	160859.45	7.05
PHILIP MORRIS INTERNATIONAL	0	151842.57	6.10
PEPSICO INC	0	149537.51	3.83
DISNEY (WALT) CO	1	147021.01	3.22
INTL BUSINESS MACHINES CORP	1	135570.82	2.45
KRAFT HEINZ CO	0	131211.94	6.92
MERCK & CO	1	127364.13	2.66
GILEAD SCIENCES INC	1	126271.03	3.51
ALTRIA GROUP INC	0	124759.51	7.58
ABBVIE INC	0	119347.57	5.75
HOME DEPOT INC	0	119029.50	3.48
CVS HEALTH CORP	0	112151.88	3.16
AMGEN INC	1	109653.47	2.95
BRISTOL-MYERS SQUIBB CO	1	102927.68	4.52
CELGENE CORP	1	101242.03	8.18
INTEL CORP	1	95392.57	1.87
MCDONALD'S CORP	0	93858.01	3.13
REYNOLDS AMERICAN INC	0	91172.95	10.43
CISCO SYSTEMS INC	1	90375.90	1.84
3M CO	1	86767.29	4.34
UNITED TECHNOLOGIES CORP	1	83528.86	2.50
WALGREENS BOOTS ALLIANCE INC	0	81916.22	2.64
UNITED PARCEL SERVICE INC	1	79393.00	2.91
EXPRESS SCRIPTS HOLDING CO	1	78219.64	5.65
STARBUCKS CORP	0	78147.05	7.06
LILLY (ELI) & CO	1	76894.22	3.33
BOEING CO	1	76498.06	1.71
MONDELEZ INTERNATIONAL INC	0	76430.94	3.62
HONEYWELL INTERNATIONAL INC	1	74470.24	3.07
DANAHER CORP	1	73448.46	5.96
LOCKHEED MARTIN CORP	1	73308.52	2.90
NIKE INC	0	69632.42	3.64
TIME WARNER CABLE INC	1	68333.52	3.79
THERMO FISHER SCIENTIFIC INC	1	64638.37	6.58
EXXON MOBIL CORP	0	64442.44	1.15
BIOGEN INC	1	61209.26	4.85
COLGATE-PALMOLIVE CO	0	60877.40	6.74
TWENTY-FIRST CENTURY FOX INC	1	58442.09	2.50
PRICELINE GROUP INC	1	57082.64	4.86
TIME WARNER INC	1	56510.40	2.61
ABBOTT LABORATORIES	1	53614.24	2.65
QUALCOMM INC	1	49480.70	1.96
TEXAS INSTRUMENTS INC	1	48957.90	4.84
DU PONT (E I) DE NEMOURS	1	48411.42	2.19
SIMON PROPERTY GROUP INC	0	47781.23	2.26
LOWE'S COMPANIES INC	0	47264.89	2.19
MCKESSON CORP	0	46832.93	1.94
AMERICAN TOWER CORP	1	45126.03	3.79
NETFLIX INC	1	44218.53	4.48
KIMBERLY-CLARK CORP	0	44106.51	3.66
ALEXION PHARMACEUTICALS INC	1	43709.85	11.39
ADOBE SYSTEMS INC	1	42968.26	6.90
COSTCO WHOLESALE CORP	0	42279.31	2.02
SPRINT CORP	1	42034.62	2.10
EMC CORP/MA	1	40856.82	2.24
MONSANTO CO	1	40019.79	2.94
GENERAL DYNAMICS CORP	1	39599.22	2.61
RAYTHEON CO	1	38945.12	3.31
GENERAL MILLS INC	0	38931.17	4.72
TJX COMPANIES INC	0	38539.91	3.86
THOMSON-REUTERS CORP	1	38425.80	6.81
NORTHROP GRUMMAN CORP	1	38320.00	3.58
DOW CHEMICAL	1	38254.35	1.59
HP INC	1	37766.99	1.42
DISH NETWORK CORP	1	37581.43	5.26
SALESFORCE.COM INC	1	35807.08	5.69
ECOLAB INC	1	35497.38	4.54
DELTA AIR LINES INC	1	33831.12	1.71
HCA HOLDINGS INC	1	33354.93	2.03
T-MOBILE US INC	1	32798.75	1.73
BECTON DICKINSON & CO	1	32789.27	3.21
UNION PACIFIC CORP	0	32296.54	1.47
ILLINOIS TOOL WORKS	0	32092.36	3.65
ENTERPRISE PRODS PRTNRS -LP	0	31142.35	1.64
FIDELITY NATIONAL INFO SVCS	1	30571.11	6.13
FEDEX CORP	1	29908.11	1.73
BOSTON SCIENTIFIC CORP	1	29836.74	5.38
STRYKER CORP	1	29551.76	3.30
PRECISION CASTPARTS CORP	1	29230.39	3.55
PAYPAL HOLDINGS INC	1	28970.90	1.95
KELLOGG CO	0	28422.31	3.84
COGNIZANT TECH SOLUTIONS	1	28137.08	3.31
FIRST DATA CORP	1	28093.81	2.66
CROWN CASTLE INTL CORP	1	27929.31	2.76
LYONDELLBASELL INDUSTRIES NV	1	27550.74	2.02

Company Name	Chi Value for IT Tranformed Sectors	Surplus Wealth at Current Prices	Tobin Q
ZIMMER BIOMET HOLDINGS INC	0	27488.91	3.58
AUTOMATIC DATA PROCESSING	1	27339.60	1.71
EBAY INC	1	27248.59	2.65
PRECISION CASTPARTS CORP	1	26335.22	3.34
ACTIVISION BLIZZARD INC	1	26156.52	3.77
CBS CORP	1	25552.10	2.74
EMERSON ELECTRIC CO	1	25549.03	2.47
BERKSHIRE HATHAWAY	0	24939.69	1.04
KROGER CO	0	24493.58	1.72
HILTON WORLDWIDE HOLDINGS	1	24485.82	2.49
CONSTELLATION BRANDS	0	24432.72	4.41
PPG INDUSTRIES INC	1	24392.84	2.74
PRAXAIR INC	1	24193.33	2.32
TARGET CORP	0	23336.50	1.46
EXPEDIA INC	1	22717.37	4.87
VIACOM INC	1	22652.73	2.75
BAXALTA INC	1	22206.26	2.75
ROPER TECHNOLOGIES INC	1	21753.22	10.62
WASTE MANAGEMENT INC	0	21531.75	2.24
LAS VEGAS SANDS CORP	0	21353.91	1.82
CHARTER COMMUNICATIONS INC	1	21296.12	1.55
CARDINAL HEALTH INC	1	21274.35	1.71
OMNICOM GROUP	1	20884.82	2.28
CENTURYLINK INC	0	20596.33	1.77
ST JUDE MEDICAL INC	1	20069.78	4.11
AMERISOURCEBERGEN CORP	0	19835.14	1.74
EOG RESOURCES INC	0	19356.36	1.58
CONAGRA FOODS INC	0	19236.45	2.88
JOHNSON CONTROLS INTL PLC	0	19124.71	1.72
STANLEY BLACK & DECKER INC	0	18834.82	3.73
DOLLAR GENERAL CORP	0	18783.67	3.65
SMUCKER (JM) CO	0	18771.20	4.84
LIBERTY MEDIA SIRIUSXM GROUP	1	18698.70	4.21
LIBERTY INTERACTV CP QVC GRP	1	18044.83	4.47
AIR PRODUCTS & CHEMICALS INC	0	17853.89	1.91
IHEARTMEDIA INC	1	17839.79	3.68
VMWARE INC -CL A	1	17820.29	2.28
DAVITA INC	1	17805.40	2.90
CATERPILLAR INC	0	17164.22	1.20
DOMINION RESOURCES INC	0	17083.90	1.25
SOUTHWEST AIRLINES	1	17079.71	1.69
DISCOVERY COMMUNICATIONS INC	1	17058.14	4.48
AMERICAN AIRLINES GROUP INC	1	16824.12	1.32
OCCIDENTAL PETROLEUM CORP	0	16614.21	1.31
REPUBLIC SERVICES INC	0	16562.33	2.45
MACY'S INC	0	16387.14	1.76
LABORATORY CP OF AMER HLDGS	1	15969.56	3.75
MOLSON COORS BREWING CO	0	15631.13	3.26
ALLIANCE DATA SYSTEMS CORP	1	15402.74	1.71
JARDEN CORP	0	15399.28	3.08
TYSON FOODS INC -CL A	0	15289.79	2.10
EQUINIX INC	1	15094.09	2.34
SYMANTEC CORP	1	14861.90	2.77
LEVEL 3 COMMUNICATIONS INC	1	14372.42	1.76
SYSCO CORP	1	14369.16	1.73
CA INC	1	14022.80	3.53
APPLIED MATERIALS INC	1	13142.67	1.94
HARRIS CORP	0	13003.45	3.09
PARKER-HANNIFIN CORP	1	12919.08	2.24
EQUITY RESIDENTIAL	0	12847.06	1.45
UNITED CONTINENTAL HLDGS INC	1	12676.28	1.32
PHILLIPS 66	0	12644.34	1.23
SOUTHERN COPPER CORP	0	12067.61	1.78
BAXTER INTERNATIONAL INC	1	11903.82	1.56
CBRE GROUP INC	0	11743.22	2.45
KINDER MORGAN INC	0	11257.03	1.16
AVALONBAY COMMUNITIES INC	0	11217.33	1.53
EASTMAN CHEMICAL CO	0	11058.78	2.05
CARNIVAL CORP/PLC (USA)	0	10892.86	1.25
PVH CORP	0	10818.63	3.23
GENERAL GROWTH PPTYS INC	0	10262.32	1.35
L-3 COMMUNICATIONS HLDGS INC	1	10012.21	2.43
ARAMARK	0	9770.39	2.72
NORWEGIAN CRUISE LINE HLDGS	0	9439.28	1.76
XEROX CORP	1	9363.11	1.55
ROYAL CARIBBEAN CRUISES LTD	0	9218.82	1.36
WESTERN DIGITAL CORP	1	8948.02	1.59
INTL PAPER CO	0	8762.60	1.26
INTERPUBLIC GROUP OF COS	1	8721.37	1.79
PPL CORP	0	8695.06	1.20
CROWN HOLDINGS INC	0	8632.99	2.08
APACHE CORP	0	8063.94	1.35
WHIRLPOOL CORP	1	8046.12	1.48
ADT CORP	1	7724.97	2.53
CARMAX INC	0	7631.58	1.46
WEYERHAEUSER CO	0	7432.54	1.48
BOSTON PROPERTIES INC	0	7386.67	1.32
UNITED RENTALS INC	0	7380.60	1.75
PLATFORM SPECIALTY PRODUCTS	0	7305.98	3.06
COMPUTER SCIENCES CORP	1	7213.24	1.79
HALLIBURTON CO	0	7197.26	1.17
PIONEER NATURAL RESOURCES CO	0	6971.25	1.38
DIGITAL REALTY TRUST INC	0	6902.82	1.56
STAPLES INC	0	6840.66	1.75
CAMERON INTERNATIONAL CORP	1	6790.35	1.60
WESTROCK CO	0	6712.04	1.33
VORNADO REALTY TRUST	0	6512.89	1.25
TEXTRON INC	1	6439.19	1.43
ESSEX PROPERTY TRUST	0	6398.77	1.43
BAKER HUGHES INC	0	6158.48	1.28

Surplus Analsys: 100 Firms Around Mean

Company Name	Chi Value of IT Transford Sectors	Surplus Wealth at Current Prices	Tobin Q
WILEY (JOHN) & SONS -CL A	0	3894.21	3.78
BURLINGTON STORES INC	0	3862.73	2.50
NEWMARKET CORP	0	3858.18	3.42
SCOTTS MIRACLE-GRO CO	0	3845.62	3.16
CARTER'S INC	0	3845.08	3.03
ASPEN TECHNOLOGY INC	1	3843.34	11.40
ARRIS INTERNATIONAL PLC	0	3829.62	2.14
FMC CORP	0	3822.76	1.66
GRACO INC	0	3820.38	5.00
CORELOGIC INC	1	3811.22	3.09
DICKS SPORTING GOODS INC	0	3811.15	1.98
PILGRIM'S PRIDE CORP	0	3806.35	1.98
WENDY'S CO	0	3799.49	2.53
SQUARE INC	1	3760.65	4.72
CINEMARK HOLDINGS INC	0	3728.06	2.18
SERVICE CORP INTERNATIONAL	0	3724.85	1.31
TORO CO	0	3723.03	4.02
ULTRAGENYX PHARMACEUTICAL	1	3693.26	6.30
EMPIRE STATE REALTY OP LP	0	3692.26	2.22
LIONS GATE ENTERTAINMENT CP	1	3689.87	2.00
LEIDOS HOLDINGS INC	1	3687.91	2.38
ITC HOLDINGS CORP	0	3662.52	1.45
REGAL ENTERTAINMENT GROUP	0	3655.35	2.30
PATTERSON COMPANIES INC	0	3654.03	2.39
VERIFONE SYSTEMS INC	1	3644.46	3.82
TAUBMAN CENTERS INC	0	3635.82	1.82
EQT MIDSTREAM PARTNERS LP	0	3635.08	2.11
DONALDSON CO INC	0	3625.27	2.88
SPECTRA ENERGY CORP	0	3620.07	1.10
HCP INC	0	3613.65	1.14
CLEAR CHANNEL OUTDOOR HLDGS	1	3610.55	1.68
WAYFAIR INC	0	3606.37	5.19
MAXIMUS INC	0	3604.00	4.76
GODADDY INC	1	3598.30	3.63
WEIGHT WATCHERS INTL INC	0	3597.44	7.43
MANPOWERGROUP	0	3596.83	1.49
SPROUTS FARMERS MARKET	0	3589.60	4.35
VERINT SYSTEMS INC	1	3565.63	4.46
REXNORD CORP	0	3555.35	2.76
BEMIS CO INC	0	3554.81	2.19
LIBERTY VENTURES	0	3552.31	1.49
FRONTIER COMMUNICATIONS CORP	1	3539.35	1.15
BLUE BUFFALO PET PRODUCTS	0	3536.06	6.54
BLACKBAUD INC	1	3517.38	6.97
FMC TECHNOLOGIES INC	0	3490.33	1.50
TREEHOUSE FOODS INC	0	3479.86	2.99
WILLIAMS COS INC	0	3462.16	1.07
OUTFRONT MEDIA INC	0	3431.07	2.56
AMERICAN WATER WORKS CO INC	0	3422.89	1.19
PRA HEALTH SCIENCES INC	1	3406.30	5.02

Company Name	Chi Value of IT Transford Sectors	Surplus Wealth at Current Prices	Tobin Q
BRINKER INTL INC	0	3404.22	3.12
BIO-TECHNE CORP	1	3401.70	8.19
ACADIA PHARMACEUTICALS INC	1	3379.87	13.23
CHARLES RIVER LABS INTL INC	1	3376.84	3.01
CAVIUM INC	1	3369.53	9.27
COMMUNICATIONS SALES & LSNG	0	3356.47	2.06
WEX INC	1	3354.47	2.18
EPAM SYSTEMS INC	1	3342.47	5.36
SONOCO PRODUCTS CO	0	3331.18	2.02
B&G FOODS INC	0	3326.98	5.07
GUIDEWIRE SOFTWARE INC	1	3323.50	4.39
VAIL RESORTS INC	0	3316.08	2.44
EQT GP HOLDINGS LP	0	3311.56	2.01
DONNELLEY (R R) & SONS CO	0	3306.54	1.52
COPART INC	0	3283.55	2.75
MSC INDUSTRIAL DIRECT -CL A	0	3250.72	2.92
VEEVA SYSTEMS INC	1	3242.55	5.88
SUPERVALU INC	0	3240.52	1.73
APTARGROUP INC	0	3221.00	2.23
GENTEX CORP	1	3204.97	2.70
POOL CORP	0	3191.84	4.41
MICROSEMI CORP	1	3177.03	3.68
CHOICE HOTELS INTL INC	0	3173.44	5.07
WATSCO INC	0	3172.93	3.04
MARATHON PETROLEUM CORP	0	3164.65	1.07
ACI WORLDWIDE INC	1	3158.09	5.36
MORNINGSTAR INC	1	3142.78	5.27
ULTRA PETROLEUM CORP	0	3136.48	3.59
MEREDITH CORP	0	3134.08	3.89
APARTMENT INVST & MGMT CO	0	3133.05	1.41
GNC HOLDINGS INC	0	3125.56	3.36
CAMDEN PROPERTY TRUST	0	3113.82	1.41
IPG PHOTONICS CORP	1	3112.97	2.73
BRUKER CORP	1	3110.85	2.64
TESORO LOGISTICS LP	0	3101.97	1.66
WEST PHARMACEUTICAL SVSC INC	1	3090.81	2.60
INTREXON CORP	1	3085.26	5.35
W P CAREY INC	0	3058.29	1.37
TRIUMPH GROUP INC	1	3056.66	1.80
NATIONAL OILWELL VARCO INC	0	3049.31	1.15
VECTOR GROUP LTD	0	3049.28	3.34
PAREXEL INTERNATIONAL CORP	0	3048.02	2.79
DELUXE CORP	0	3047.05	5.20
BWX TECHNOLOGIES INC	1	3008.65	3.09
JUNO THERAPEUTICS INC	1	2994.07	2.89
EAGLE MATERIALS INC	0	2988.54	2.44
HEICO CORP	1	2986.35	4.44
FAIR ISAAC CORP	1	2978.67	7.50
INC RESEARCH HOLDINGS INC	1	2976.95	5.72
COLUMBIA PIPELINE GROUP INC	0	2974.70	1.30

SurplusAnalysis: Bottom 200

Company Name	Chi Value for IT Transformed Sectors	Surplus Wealth at Current Prices	Tobin Q
SUNCOKE ENERGY INC	0	-629.15	0.75
CIVEO CORP	0	-630.27	0.51
FORTRESS TRANS INFRASTR INVS	0	-643.07	0.65
KELLY SERVICES INC -CL A	0	-643.09	0.72
PARKER DRILLING CO	0	-657.43	0.61
EQUITY COMMONWEALTH	0	-657.61	0.90
TROPICANA ENTERTAINMENT INC	0	-658.98	0.57
FIVE OAKS INVESTMENT CORP	0	-668.60	0.78
DIAMONDROCK HOSPITALITY CO	0	-673.11	0.84
FOREST CITY REALTY TRUST INC	0	-689.93	0.94
HRG GROUP INC	0	-692.99	0.98
XENIA HOTELS & RESORTS INC	0	-694.32	0.81
8POINT3 ENERGY PARTNERS LP	0	-697.38	0.45
SANMINA CORP	0	-709.20	0.84
PHI INC	0	-720.29	0.60
BILL BARRETT CORP	0	-731.37	0.61
CABELAS INC	0	-736.85	0.93
CAI INTERNATIONAL INC	0	-741.07	0.70
TUTOR PERINI CORP	0	-742.63	0.82
SOUTHCROSS ENERGY PRTNRS LP	0	-743.80	0.55
AMKOR TECHNOLOGY INC	1	-750.01	0.85
BROOKFLD DTLA OFFICE TR INV	0	-750.73	0.78
HERCULES OFFSHORE INC	0	-759.99	0.44
MEDICAL PROPERTIES TRUST	0	-760.29	0.89
SELECT INCOME REIT	0	-773.68	0.85
EXTERRAN CORP	0	-776.03	0.66
UNITED STATES OIL FUND LP	0	-787.32	0.80
BEAZER HOMES USA INC	0	-789.70	0.74
NEWS CORP	1	-800.06	0.93
ENERGEN CORP	0	-801.27	0.86
PORTLAND GENERAL ELECTRIC CO	0	-802.08	0.91
ARCHROCK INC	0	-802.84	0.75
CBL & ASSOCIATES PPTYS INC	0	-807.02	0.90
MONOGRAM RESIDENTIAL TRUST	0	-815.36	0.80
APPROACH RESOURCES INC	0	-821.49	0.44
SL GREEN REALTY CORP	0	-836.06	0.97
INVENTRUST PROPERTIES CORP	0	-844.56	0.84
SENIOR HOUSING PPTYS TRUST	0	-847.36	0.90
TECH DATA CORP	1	-865.80	0.88
OMAGINE INC	0	-867.86	0.03
PLAINS ALL AMER PIPELNE -LP	0	-877.24	0.96
APOLLO COMMERCIAL RE FIN INC	0	-885.56	0.74
GULFMARK OFFSHORE INC	0	-914.40	0.46
AG MORTGAGE INVESTMENT TRUST	0	-919.11	0.77
WESTERN ASSET MTG CAPITAL CP	0	-921.84	0.78
HALCON RESOURCES CORP	0	-931.47	0.78
EP ENERGY CORP	0	-961.84	0.87
INGRAM MICRO INC	1	-966.48	0.93
DYNEX CAPITAL INC	0	-972.28	0.79
APOLLO INVESTMENT CORP	0	-995.18	0.78
SCANA CORP	0	-1010.04	0.95
PATTERN ENERGY GROUP INC	0	-1033.78	0.78
FS INVESTMENT CORP	0	-1044.89	0.80
FIFTH STREET FINANCE CORP	0	-1061.12	0.67
CENTURY ALUMINUM CO	0	-1063.57	0.51
ALTISOURCE RESIDENTIAL CORP	0	-1066.27	0.65
RESOURCE CAPITAL CORP	0	-1069.30	0.69
RYDER SYSTEM INC	0	-1087.46	0.92
GATX CORP	0	-1088.32	0.87
DCP MIDSTREAM PARTNERS LP	0	-1090.25	0.83
OVERSEAS SHIPHOLDING GROUP	0	-1090.78	0.73
HUNTSMAN CORP	0	-1093.58	0.91
THOMPSON CREEK METALS CO INC	0	-1114.18	0.62
GENER8 MARITIME INC	0	-1120.61	0.62
ONEOK INC	0	-1120.84	0.94
TAL INTERNATIONAL GROUP INC	0	-1132.44	0.79
MEMORIAL PRODUCTION PRTRS LP	0	-1140.33	0.68
IRIDIUM COMMUNICATIONS INC	0	-1157.64	0.71
HECLA MINING CO	0	-1169.96	0.58
SEACOR HOLDINGS INC	0	-1173.54	0.70
CLOUD PEAK ENERGY INC	0	-1200.42	0.46
ARLINGTON ASSET INVESTMENT	0	-1212.75	0.77
APOLLO RESIDENTIAL MTG INC	0	-1213.79	0.73
PENNYMAC MORTGAGE INVEST TR	0	-1228.87	0.82
PINNACLE WEST CAPITAL CORP	0	-1254.41	0.93
HELIX ENERGY SOLUTIONS GROUP	0	-1255.10	0.57
REPUBLIC AIRWAYS HLDGS INC	0	-1276.16	0.72
RICE ENERGY INC	0	-1286.76	0.73
CAESARS ENTERTAINMENT CORP	0	-1295.14	0.90
JONES ENERGY INC	0	-1296.99	0.46
UNIT CORP	0	-1310.08	0.62
EV ENERGY PARTNERS LP	0	-1333.67	0.44
PATTERSON-UTI ENERGY INC	0	-1339.87	0.76
ARCHER-DANIELS-MIDLAND CO	0	-1359.19	0.97
ALLEGHENY TECHNOLOGIES INC	0	-1372.34	0.78
ATLAS AIR WORLDWIDE HLDG INC	0	-1385.62	0.73
REDWOOD TRUST INC	0	-1405.73	0.81
GENCO SHIPPING & TRADING	0	-1420.78	0.34
ENLINK MIDSTREAM LLC	0	-1436.58	0.82
NRG YIELD INC	0	-1437.25	0.82
TALLGRASS ENERGY GROUP LP	0	-1452.36	0.55
ISTAR INC	0	-1452.60	0.79
HAWAIIAN ELECTRIC INDS	0	-1485.67	0.89
SOUTHWESTERN ENERGY CO	0	-1500.26	0.85
TRINITY INDUSTRIES	0	-1513.65	0.85
ASHFORD HOSPITALITY TRUST	0	-1533.03	0.75
RAIT FINANCIAL TRUST	0	-1537.89	0.72
ALTISOURCE ASSET MGMT CORP	0	-1549.96	0.51
MICRON TECHNOLOGY INC	1	-1559.26	0.95
HELMERICH & PAYNE	0	-1560.87	0.82

Company Name	Chi Value for IT Transformed Sectors	Surplus Wealth at Current Prices	Tobin Q
MCDERMOTT INTL INC	0	-1577.88	0.63
TRONOX LTD	0	-1599.46	0.73
MTGE INVESTMENT CORP	0	-1613.46	0.76
KB HOME	0	-1622.44	0.74
PENNEY (J C) CO	0	-1632.29	0.87
SKYWEST INC	0	-1702.83	0.71
AIRCASTLE LTD	0	-1717.04	0.79
LINN ENERGY LLC	0	-1723.47	0.86
AMEREN CORP	0	-1752.44	0.94
ANWORTH MTG ASSET CORP	0	-1821.13	0.78
HORNBECK OFFSHORE SVCS INC	0	-1821.44	0.51
KENNEDY-WILSON HOLDINGS INC	0	-1825.09	0.80
GREAT PLAINS ENERGY INC	0	-1866.62	0.86
SUNOCO LOGISTICS PARTNERS LP	0	-1878.79	0.89
DOMINION MIDSTREAM PARTNERS	0	-1884.51	0.60
SM ENERGY CO	0	-1894.70	0.73
BREITBURN ENERGY PARTNERS LP	0	-1912.41	0.68
ARCONIC INC	0	-1943.11	0.95
XCEL ENERGY INC	0	-1966.85	0.96
DENBURY RESOURCES INC	0	-1992.96	0.73
AMERICAN HOMES 4 RENT	0	-1993.64	0.76
NOBLE ENERGY INC	0	-2093.59	0.93
MOSAIC CO	0	-2128.49	0.89
LADDER CAPITAL CORP	0	-2253.52	0.69
BLACKSTONE MORTGAGE TR INC	0	-2301.15	0.80
NEW YORK MORTGAGE TRUST INC	0	-2363.18	0.79
TAYLOR MORRISON HOME CORP	0	-2396.05	0.53
PUBLIC SERVICE ENTRP GRP INC	0	-2589.25	0.94
AIR LEASE CORP	0	-2619.85	0.83
CALPINE CORP	0	-2631.49	0.89
OASIS PETROLEUM INC	0	-2681.84	0.62
DYNEGY INC	0	-2716.52	0.80
PROSPECT CAPITAL CORP	0	-2726.15	0.68
HUDSON PACIFIC PPTYS INC	0	-2745.33	0.65
TIDEWATER INC	0	-2748.69	0.54
BOARDWALK PIPELINE PRTNRS-LP	0	-2820.65	0.72
DIAMOND OFFSHRE DRILLING INC	0	-2978.41	0.67
PARAMOUNT GROUP INC	0	-2994.40	0.71
AMERICAN CAPITAL LTD	0	-3010.07	0.61
ARES CAPITAL CORP	0	-3034.79	0.74
ATWOOD OCEANICS	0	-3170.74	0.47
PROLOGIS INC	0	-3196.92	0.92
UNITED STATES STEEL CORP	0	-3273.88	0.71
NORTHSTAR REALTY FINANCE CP	0	-3282.25	0.82
FIRSTENERGY CORP	0	-3393.01	0.94
PEABODY ENERGY CORP	0	-3483.25	0.75
EQT CORP	0	-3507.95	0.80
ARMOUR RESIDENTIAL REIT INC	0	-3633.33	0.78
QEP RESOURCES INC	0	-3648.08	0.65
WPX ENERGY INC	0	-3665.96	0.65
TWO HARBORS INVESTMENT CORP	0	-3674.79	0.79
VEREIT INC	0	-3695.30	0.81
MFA FINANCIAL INC	0	-3746.27	0.77
CAPSTEAD MORTGAGE CORP	0	-3811.67	0.79
CYS INVESTMENTS INC	0	-3866.43	0.78
NEW RESIDENTIAL INV CP	0	-3915.39	0.79
CHIMERA INVESTMENT CORP	0	-4154.44	0.78
HATTERAS FINANCIAL CORP	0	-4227.85	0.79
MURPHY OIL CORP	0	-4267.42	0.70
TARGA RESOURCES PARTNERS LP	0	-4306.23	0.68
AMERICAN ELECTRIC POWER CO	0	-4372.97	0.94
EDISON INTERNATIONAL	0	-4438.87	0.93
MIDCOAST ENERGY PARTNERS LP	0	-4548.11	0.27
COLONY CAPITAL INC	0	-4564.05	0.60
INVESCO MORTGAGE CAPITAL INC	0	-4693.34	0.78
ROWAN COMPANIES PLC	0	-4706.88	0.55
ANTERO RESOURCES CORP	0	-4723.82	0.73
CONSOLIDATED EDISON INC	0	-4902.71	0.91
TARGA RESOURCES CORP	0	-5215.33	0.62
ENBRIDGE ENERGY PRTNRS -LP	0	-5264.10	0.77
INTEGRYS HOLDING INC	0	-5364.57	0.61
COLUMBIA PIPELINE PRTNRS LP	0	-5606.91	0.37
WHITING PETROLEUM CORP	0	-5628.59	0.60
NRG ENERGY INC	0	-5719.11	0.84
CONSOL ENERGY INC	0	-5730.63	0.58
PG&E CORP	0	-5961.25	0.92
ENABLE MIDSTREAM PARTNERS LP	0	-5990.22	0.56
AVANGRID INC	0	-6183.47	0.82
TALEN ENERGY CORP	0	-6266.32	0.60
CONOCOPHILLIPS	0	-6315.42	0.95
YAHOO INC	1	-7283.26	0.87
WILLIAMS PARTNERS LP	0	-7495.94	0.84
ENTERGY CORP	0	-7557.78	0.86
ICAHN ENTERPRISES LP	0	-7669.86	0.82
AES CORP	0	-7670.28	0.83
PLAINS GP HOLDINGS LP	0	-9648.42	0.64
ENERGY TRANSFER EQUITY LP	0	-10672.07	0.85
NEWMONT MINING CORP	0	-10758.96	0.65
LEUCADIA NATIONAL CORP	0	-12448.69	0.77
ENERGY TRANSFER PARTNERS -LP	0	-13729.13	0.80
HESS CORP	0	-14464.68	0.66
FREEPORT-MCMORAN INC	0	-15417.04	0.73
AGNC INVESTMENT CORP	0	-15787.11	0.78
MARATHON OIL CORP	0	-17821.91	0.56
STARWOOD PROPERTY TRUST INC	0	-19919.41	0.81
ANNALY CAPITAL MANAGEMENT	0	-20543.27	0.78
EXELON CORP	0	-21680.75	0.81
FORD MOTOR CO	0	-27907.69	0.90
GENERAL MOTORS CO	0	-29674.53	0.87
CHEVRON CORP	0	-44148.14	0.86

Appendix C: Set of 66 Yearly Electronic Files

Individual files, 1950-2015, will be available as Appendix C at http://web.stanford.edu/~mordecai/ and the number of firms in each is recorded in the first column of this Appendix A. These rise from less than 1,000 firms in the 1950's, exceeding 3,000 in 1970, and rising further afterwards.