SIEPR Discussion Paper No. 17-016

On the Formation of Capital and Wealth

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This draft June 25, 2017

Abstract

We show modern information technology (in short IT) is the cause of rising income and wealth inequality since the 1970's and has contributed to slow growth of wages and decline in the natural rate. Hence, the source of most improvements in our living standards also causes social losses and rising inequality.

We first study all US firms whose securities trade on public exchanges. Surplus wealth of a firm is the difference between wealth created (equity and debt) and its capital. We show (i) aggregate surplus wealth rose from -$0.59 Trillion in 1974 to $24 Trillion which is 79% of total market value in 2015 and reflects rising monopoly power. The added wealth was created mostly in sectors transformed by IT. Declining or slow growing firms with broadly distributed ownership have been replaced by IT based firms with highly concentrated ownership. Rising fraction of capital has been financed by debt, reaching 78% in 2015. We explain why IT innovations enable and accelerate the erection of barriers to entry and once erected, IT facilitates maintenance of restraints on competition. These innovations also explain rising size of firms.

We next develop a model where firms have monopoly power. Monopoly surplus is unobservable and we deduce it with three methods, based on surplus wealth, share of labor or share of profits. Share of monopoly surplus rose from zero in early 1980's to 23% in 2015. This last result is, remarkably, deduced by all three methods. Share of monopoly surplus was also positive during the first, hardware, phase of the IT revolution. It was zero in 1950-1962, reaching 7.3% in 1965 before falling back to zero in 1970. Standard TFP computation is shown to be biased when firms have monopoly power.

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)) and during that time real wages grew slower than productivity implies. Although widely discussed, a compelling explanation of these facts is yet to emerge. Textbooks offer many possible causes for inequality but most writers explain that rising inequality is a result of changes in government actions (e.g. Stigliz (2012)). Monopoly power is often cited as a potential cause but the typical view is that in advanced economies it arises either from government granting it to wealthy supporters of the party in power or from government failing to enforce the laws against anti-competitive behavior by the politically connected (e.g. Stiglitz (2012) Ch. 2). Monopoly rent creates a difference between *capital* and *wealth* which has important implications. Indeed, this paper aims to measure this difference and show that it is the key to understanding current inequality. In assuming that wealth equals capital Piketty (2014) focuses on a questionable difference between the growth rate of output and labor income vs. the interest rate at which intergenerational family wealth grows. Stiglitz (2016) questions Piketty and, taking land as the difference between capital and wealth, constructs dynamic models with land and studies the effects of wealth tax on wealth distribution. He concludes that wealth taxation has subtle effects ignored by Piketty's (2014) universal capital tax plan. Piketty (2014) actually explores the land question (page 198) but concludes that it does not help explain past inequality, which is not surprising. Although US land value is large, gains in its value since the 1970's are more equally distributed than other forms of wealth because of the widespread home ownership.

In this paper we estimate *surplus wealth*, which is the difference between wealth and capital.

[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 the present draft. He thanks Kenneth Judd and Maurizio Motolese for detailed comments; to 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 to 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; to Zina Shapiro who provided invaluable help with WARDS Compustat data files and to Linda Kurz for many helpful discussions and comments throughout this work.

We show it is large, its ownership is heavily concentrated, and its growth rate during the last 40 years far exceeded the growth rate of capital, explaining the rise in wealth inequality since the 1970's. We then show not only that monopoly rent is a significant component of US national income but also that monopoly power has risen sharply since the 1970's. By examining the distribution of surplus wealth across firms we show it is concentrated in firms that were transformed by modern information technology (in short IT). Since monopoly rent is caused by limited competition, we analyze the nature of IT and show it has two fundamental effects. First, it enables and facilitates the creation of technological barriers to entry and to a rising business concentration. Second, it causes an increased concentration of ownership of the wealth created by firms transformed by this revolution. We next develop a theoretical model of growth under monopoly power for studying wealth and income distribution with which we show why rising monopoly power and monopoly rent explain

(i) the rising income and wealth inequality;
(ii) the slow growth of the wage rate and the downward pressure on the natural interest rate;
(iii) the divergence of trend wages from the trend ouput/(man hour);
(iii) the existence of a bias in the measured rate of TFP.

In sum, these phenomena are all caused by modern IT through its effect on markets' performance.

1. The Evolution of Surplus Wealth 1950-2015

Estimating surplus wealth with precision is difficult with existing data and we can only hope to approximate its order of magnitude. Also, *a direct* measurement raises several conceptual issues which we address early. We thus note two issues discussed in the next section. First, surplus arises mostly from pricing power of business therefore we cannot analyze the entire economy. Government and households do not engage in pricing and for business without publicly trading securities there is no reliable market value with which to assess wealth created by such a business. Therefore we first identify a unit of analysis for which measurements are made and for that unit we must have reliable *market* values. Second, research on endogenous growth views R&D as one of the determinant of economy's growth rate and the stock of past R&D expenses as a form of capital. This raises a conceptual question of how to treat "Good Will" and "Intangible Assets." on the balance sheet of firms. We do not follow the practice of the endogenous growth literature and later explain that most intangible assets of a firm are surplus values of other firms that the firm under consideration acquired in the past. We start by discussing our methodology and explaining it with examples.

1.1 Methodology and examples for 2015

How should one compare the difference between wealth and capital? One usually thinks of a political entity like a nation as a unit of measurement and this is the way the Federal Reserve and the BEA document US wealth in Table B.1 of *"Z.1 Financial Accounts of the United States"* (in short, Z.1) which reports aggregate net wealth of *US residents*. Consequently, they must close ownership relations by including the Public and Foreign Sectors as entities with assets, liabilities and net worth. *This is not our approach*. We select an economic unit engaged in production and distribution and 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?* The natural unit for such a program is the firm whose securities trade on public exchanges with an explicit market price. Such a firm employs resources and capital which consists of assets used in production and whose value is recorded on the firm's financial reports. These activities also create a firm specific wealth, shared by stockholders and bondholders,[2] deduced from the market value of the firm's financial securities. Hence, one formal difference between wealth and capital is that they are measured differently: wealth created is measured as a market value of the firm's ownership securities while capital employed is measured as the market value of assets employed by the firm in production.

If one asks why there can be a difference between wealth created and capital employed*,* the answer is clear. Equilibrium of a fully flexible Walrasian competitive economy requires the condition of surplus wealth=zero to hold at all dates or, in a random setting, for surplus to fluctuate around zero. The fact that the market value of a firm can be different from replacement value is, obviously, well known. This difference is the basis of Tobin's q (Brainard and Tobin (1967), Tobin (1969)) which was designed to measures the *adjustment* potential in a competitive economy. It reflects the common view that such difference is only a matter of temporary dynamic adjustment and over time, the zero surplus equilibrium condition holds. Our results do not support this view and lead to a different perspective expressed formally in the model developed after we estimate the size of surplus wealth and after we study the changes in it over the period of 1950-2015.

Since we select the firm with ownership shares that trade on public exchanges as our unit of

[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.

analysis, we decided to use the WRDS Compustat data files covering 1950-2015 that provide standard financial reports on all firms with securities trading on public exchanges. The number of firms reporting and the scope of the files change from year to year for various reasons: not all firms respond, some firms provide incomplete information hence there are missing observations, new firms go public and old firms disappear either due to mergers or failure, etc. These problems are more pronounced in the earlier years 1950-1970 when the number of reporting firms is relatively smaller. After 1970 our sample sizes exceed 3,000 firms, they contain virtually all of US based corporations and the aggregates are reliable. We study only firms which are US based and for which information is available on security prices and equity values. Since the Compustat universe focuses on corporate business it may appear that it covers the sectors of "Nonfinancial Corporate Business" together with "Financial Corporate Business" in the Z.1 publication. This is not the case since the Z.1 includes *all* corporations, including private corporate firms with securities that do not trade publicly and therefore their values are imputed by Z.1.

In comparison with non-financial firms, the complex financial accounting of financial intermediaries and the multiple participants in risk bearing of such firms raise deep conceptual problems. Viewing a firm as jointly owned by stockholders and bondholders is not applicable for 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 therefore avoid Compustat individual balance sheet of financial intermediaries and exclude from our samples all firms with SIC codes 6000 - 6499 (which is far wider than just banks). Instead, we compute surplus wealth in "Financial Corporate Business" by using only the limited aggregates in Z.1 (Tables S.6.a and B.1). These deprive us of the detailed individual firm information we have for nonfinancial firms. Consequently, whenever possible we present results jointly for financial and non-financial sectors (by combining our Compustat aggregates with Z.1 aggregates). When estimated asset values and capital are needed, results are deduced only for Compustat samples of non-financial firms. We 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 values *already on the balance sheet* of firms and we now explain these data items, including the question of "Current Price" adjustment of total cost.

Discussion of data adjustments and errors

A. Treatment of Intangible Assets. Careful examination shows *most* "Good Will" and "Intangible Assets" arise when firms acquire other firms with surplus wealth which becomes intangibles for the acquiring firm. "Intangible assets" *are thus mostly surplus wealth* that changed ownership but remains surplus wealth. We later demonstrate this with examples in Table 1. This may appear in conflict with BEA's procedure of treating "intellectual property products" as a form of capital invested. From the perspective of the Endogenous Growth literature (e.g. Romer (1990), Garcia-Macia et. al. (2016), Bloom et. al. (2017)) the stock of intangibles is the accumulated cost of somebody's past R&D investments, it is a form of "Knowledge Capital" which is then the cause of economic growth. This assumes the equilibrium condition surplus=0 from which the treatment of intangibles is an implication. We disagree and the data does not support this view. In a competitive economy knowledge is shared by all firms and its capital value would be equal to zero on the balance sheet of any firm. The truth is that "Intangible Assets" reflect value of knowledge over which the *firm in question has exclusive ownership rights and the value measures the market power it has in preventing others from using it*. R&D

expenditures are very valuable for protecting the market position of a firm (further discussed later), thereby maintaining its surplus value by improving products, developing markets or marketing new products and demonstrating safety of new products. On the other hand, if a firm acquires a software package used for production needs, it is a regular durable asset subject to depreciation and it should be recorded as such. In sum, when Surplus= 0 condition does not hold we record as surplus wealth all value created or purchased by non competitive firms who invests in creation or purchase of knowledge with exclusive ownership rights to that firm but to the exclusion of all others.

B. 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.

C. 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 assets 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, redundant assets can sometimes be identified, which is the case with the increased cash and liquid asset holdings of US firms over the last twenty years. By December 2015 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 rather as a device to save income tax hence not necessary for productive capacity. It is part of the firm's value but not in the category of 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. It is surplus wealth since it is not needed for normal operations of a firm or for its desired investment program. 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 8 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 assist 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.

D. 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.

The problem's complexity ensures measurement errors remain, therefore we stress only the significance of *order of magnitude* of variables of interest. Since the same procedure is used in all years 1950 - 2015, and since we mostly focus on ratios such as (surplus)/(market value), the behavior of proportions over time provides a reasonably accurate view of changes over time and such changes are probably the most important results.

We turn to examples in Table 1 which explain our approach.[3] The table contains four groups of firms. Those in the first are relatively distressed, in decline or slow growing, resulting in negative surplus wealth. One may think a negative surplus reflects too high a value of employed capital but the prices of US steel and Marathon Oil equities were \$7.98 and \$12.38 respectively at the end of 2015 and rose to \$35.84 and \$18.24 respectively in December 15, 2016. This resulted in positive surpluses in 2016 when recorded values appeared more reasonable estimates of capital employed. Since surplus wealth is market dependent it is random and we simply note that the first group, defined by $S \equiv \frac{\text{Surplus Wealth}}{\text{Total Wealth}} \leq 0$, constitutes 21.2% of our universe of 4200 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. Their surpluses are relatively small due to some competition and only small market advantage. This group constitutes 13.7% of our universe in 2015. The third group,

[3] In examining Table 1 recall that according to the Data Adjustment procedure in (B) 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 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.

which constitutes 12.1% of the firms in 2015, is defined by the condition $0.30 \le S \le 0.70$. Each firm in this group has a solid technological base and major market advantage in it's field.

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	$\frac{\text{Surplus}}{\text{TotalWealth}}$	$\frac{\text{Surplus}}{\text{Market Value}}$
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 B)

The fourth group defined by $S \ge 0.70$ constitutes 53% of the 2015 Compustat 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 rather, it applies to all firms producing diverse products and services with an advanced technological base transformed by the IT revolution. Such firms are now found in most sectors from manufacturing through natural resources and services. Technologically advanced firms have surplus wealth that, in most cases, exceeds 80% of the total wealth created. The aggregates at the bottom are ratios of the totals for all firms. We thus find that if liquid assets held abroad are included in capital employed, for the 4,200 firms under study in 2015, surplus wealth is 44% of all wealth created and 71% of total market value of all firms. If we add aggregate data for *financial* corporate firms as reported in Z.1, the ratio of surplus wealth (excluding foreign holdings) to total market value rises to 79%. As explained earlier we avoid the question of

[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.

ownership of the financial sector and therefore do not compute total wealth created in the combined sectors. Also, Appendix A shows surplus wealth equals 68% of capital employed when foreign holdings are included in capital but if we adjust capital employed and surplus wealth for foreign liquid assets, surplus wealth in 2015 rises to 78% of capital employed.

We conclude from Table 1 and from inspecting the 2015 file in Appendix B, that surplus wealth is very large. Indeed, it is so large that about 90% of all value that changed hands on stock exchanges in 2015 did not reflect capital in the usual sense but surplus wealth. This means in 2015 US wealth ownership was in a state where capital invested is approximately financed by bondholders (who "own" it) while stockholders own and trade surplus wealth. Studying the files lead to two other important conclusions, partly related to our earlier discussion of goodwill and intangible assets, which we explain by using the example of *Facebook.*

Facebook Inc. was started in 2003 as a social website at Harvard and incorporated in 2004 with insignificant capital invested. As a corporate entity it developed with initial venture investments of less than $50 Million and raised $16 Billion in its initial public offering in 2012. In 2014 it acquired the three firms Whatsapp, Pryte and LiveRail for about $20 Billion which account for most of its $21 Billion[5] intangible assets in 2015. The firm's total revenue in 2015 was $17.9 Billion with a gross profit margin of 84%. Facebook Inc. employed capital in December 2015 was only $35 Billion, but with total wealth of $303 Billion which was created practically over night. By May 2017 its surplus wealth exceeded $450 Billion. This is a capitalization of the firm's rapidly growing profits based on the fact that it has no effective competitors since it controls a world-wide network externality with strong intellectual property rights. Potential competitors such as, LinkedIn can, at best, establish a sub-network with narrowly defined focus. In effect, Facebook Inc. controls a world public utility which it created. Although Facebook Inc. may appear an extreme case, it is actually typical. An examination of the technology used, the business practice and marketing strategy of virtually any successful modern US IT based firm reveals the same picture as Facebook Inc. and the key elements of this example will be later generalized. Here we focus on intangibles and technology.

(i) Goodwill and intangibles. Facebook's intangibles are surplus values of acquired firms that had little real assets when acquired. A study of the Compustat files shows intangible assets *are entirely*

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

associated with firms that grow through rapid acquisitions. Hence, in Table 1 Amgen, Celgene, Pepsico Inc., Alphabet, Honeywell International, General Electric and Berkshire Hathaway have large fraction of intangibles due to their long acquisition history. Apple Inc., Amazon.com, Southwest Airlines and Chevron Corp. do not have such history and relatively low intangibles. A precise study of the structure of intangible assets requires one to examine the investment history of each firm and research each acquisition in terms of timing and price paid for it compared with its real asset values, a task beyond the scope of this paper. The fact that intangible assets are excluded from capital does not diminish the value and liquidity of such assets. Indeed, by (4a) and (5) (surplus)/(market value) > 1 imply that debt exeeds capital employed and such examples are seen in Table 1 (e.g. Pepsico Inc.). This may seem like excessive leverage but if an acquired firm (who generates the intangibles) remains liquid on its own, it could be used as a collateral for bondholders to finance the acquisition. In this case bondholders may own more than the capital stock of a firm.

(ii) Surplus wealth and technology. What characterizes the firms that produced large surplus wealth in 2015? Some traditional firms (e.g. Pepsico Inc) have large surplus values due to their ownership of brands with recognized pricing power. However, Table 1 reflects a different reality: most traditional firms where standard commodities are sold by large number of competitive firms exhibit low surplus ratios. Our key finding is that firms with high surplus ratios are associated with sectors transformed by modern advances in IT. We define IT as the technology of processing, transmitting and storing information but since we study only privately owned segments of IT we go beyond the transistor, DNA or the Internet which are public goods at the foundation of present day technology. IT has been the tool used to transform firms in many sectors into becoming advanced technology firms. A partial list includes biotechnology and drugs; medical instruments and hospitals; seed alteration and agriculture productivity; on-line retailing and home delivery; travel and taxi services; film production, movie streaming and TV; telecommunication and mobile telephone with many associated sectors from payment methods to home management; artificial intelligence and cloud computing, and finally, social media and the internet. Ultimately, IT will transform the entire economy and the only question is what form it will take in each sector. This diverse list shows there is no firm's "Index of IT Transformation" which is correlated with surplus wealth to exhibit a *quantitative* association between IT and surplus wealth. Such a measure cannot even be defined by SIC codes. Lacking such an index, Table 2 records the list of 50 US firms with the largest surplus wealth in 2015, with aggregate surplus which is 50.4%

of total surplus wealth of all non-financial business in 2015.

Table 2: The 50 US Firms with Largest Surplus Wealth in 2015
(Values in million of 2015 dollars, data without foreign liquid holdings)

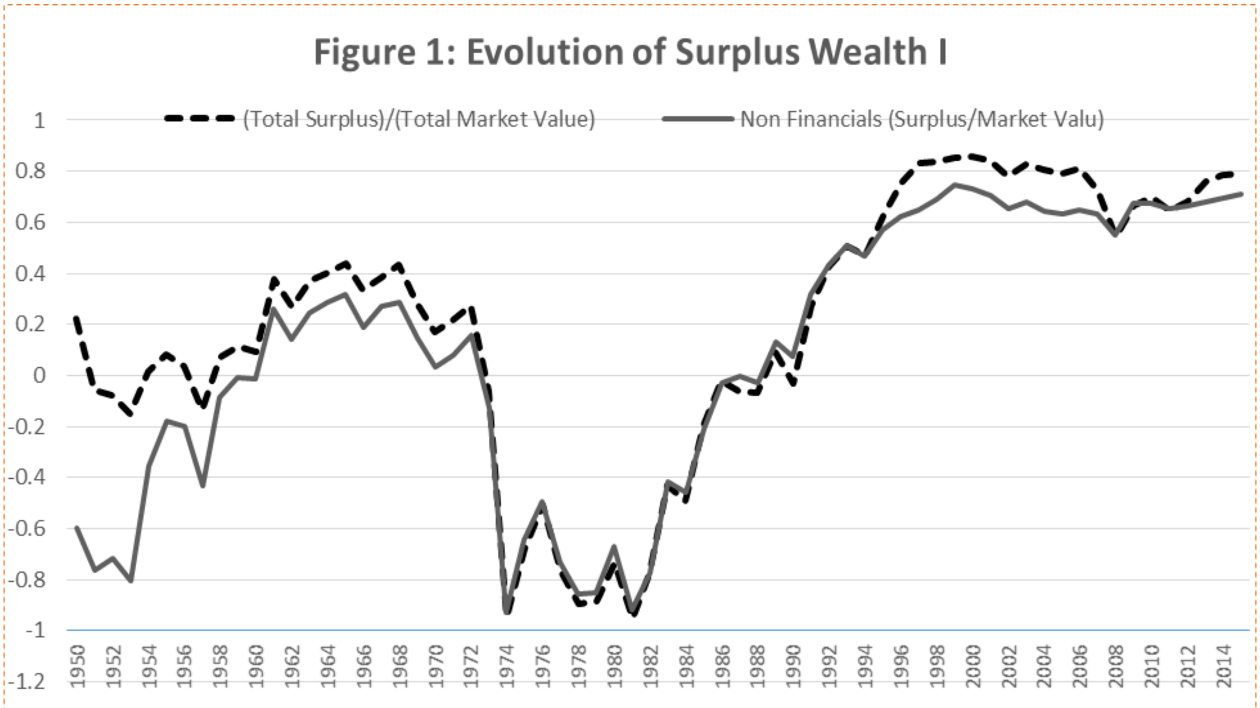
Firm	Surplus Wealth	Firm	Surplus Wealth
APPLE INC	435861.42	HOME DEPOT INC	119029.50
ALPHABET INC	396179.26	CVS HEALTH CORP	112151.88
AMAZON.COM INC	294518.50	AMGEN INC	109653.47
AT&T INC	269517.42	BRISTOL-MYERS SQUIBB CO	102927.68
FACEBOOK INC	267901.74	CELGENE CORP	101242.03
VERIZON COMMUNICATIONS INC	260112.49	INTEL CORP	95392.57
MICROSOFT CORP	258150.38	MCDONALD'S CORP	93858.01
JOHNSON & JOHNSON	238127.22	REYNOLDS AMERICAN INC	91172.95
PROCTER & GAMBLE CO	209646.08	CISCO SYSTEMS INC	90375.90
PFIZER INC	203586.49	3M CO	86767.29
COMCAST CORP	177802.97	UNITED TECHNOLOGIES CORP	83528.86
GENERAL ELECTRIC CO	170531.18	WALGREENS BOOTS ALLIANCE	81916.22
COCA-COLA CO	167927.02	UNITED PARCEL SERVICE INC	79393.00
ORACLE CORP	162979.37	EXPRESS SCRIPTS HOLDING CO	78219.64
WAL-MART STORES INC	160896.10	STARBUCKS CORP	78147.05
ALLERGAN PLC	160859.45	LILLY (ELI) & CO	76894.22
PHILIP MORRIS INTERNATIONAL	151842.57	BOEING CO	76498.06
PEPSICO INC	149537.51	MONDELEZ INTERNATIONAL	76430.94
DISNEY (WALT) CO	147021.01	HONEYWELL INTERNATIONAL	74470.24
INTL BUSINESS MACHINES CORP	135570.82	DANAHER CORP	73448.46
KRAFT HEINZ CO	131211.94	LOCKHEED MARTIN CORP	73308.52
MERCK & CO	127364.13	NIKE INC	69632.42
GILEAD SCIENCES INC	126271.03	TIME WARNER CABLE INC	68333.52
ALTRIA GROUP INC	124759.51	THERMO FISHER SCIENTIFIC	64638.37
ABBVIE INC	119347.57	EXXON	64442.44

As noted earlier, even without major capital gains Coca-Cola, Pepsico, McDonald's, Philip Morris, Atria and Reynolds American are in Table 2 due to well known brands and market power. The remarkable fact Table 2 highlights is the big changes in the US economy caused by modern IT. 43 of the 50 firms in Table 2 belong to the listed categories of firms whose business model was transformed by the IT revolution. Some, to a limited degree by altering products, materials and management methods (e.g. CVS, Home Depot, Procter & Gamble, Nike, Starbucks, Walgreen, and Walmart) but 36 are central to the IT revolution; many did not even exist in 1974. As expected, the table does not contain any firms in sectors such as energy, mining, chemicals, machinery, traditional manufacturing, automobiles or transportation. Transformation of these will take time. And then Exxon, one of history's largest wealth creator, is number 50.

The main conclusion of this paper is that, due to its unique character, the IT revolution is *the cause* of the large surplus wealth and the rise in income and wealth inequality. In addition to empirical evidence presented above we devote section 2 to make a theoretical case in support of this conclusion. Since we aim to explain why the surplus is so large, we also want to explain the circumstances that lead to the growth of such surplus. Is it a recent phenomenon? Have the surplus ratios changed over time or have they been relatively stable? To answer these questions we go beyond 2015 and turn, in the next section, to an examination of the changes over the entire period of 1950-2015.

1.2 Changes in surplus wealth 1950-2015

1.2a 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 the Compustat samples combined *with the financial corporate sector* and the second is this same ratio for the Compustat samples alone.



To assess Figure 1 we first remind the reader that the Compustat samples are not a panel survey since their composition and size vary over time as explained earlier. However, since after 1970 this universe covers more than 3000 firms (including virtually all major firm) and after 1980 over 4000 firms, the aggregates are reasonably reliable and comparable over time. In this part of the study we ignore all tax motivated foreign holdings. The figure shows that the large 2015 surplus reported in Table 1 is the culmination of growth that began in the 1970's. Starting in 1950 there was a negative non-financial and positive financial surplus wealth but no aggregate surplus wealth up to about 1958, after which a significant surplus developed during the high growth years of the 1960's. This surplus did not last. Most discussions of the early 1970's focus on unemployment, inflation and productivity slowdown. Figure 1 and Appendix A show that 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 1974-1980 that has continued until today, in 2017. The surplus rose from $-0.590 Trillion in 1974 to a temporary peak in 2000 of $14.025 Trillion and 86% of total market value. During 2000-2015 both the surplus and total wealth continued to rise but surplus\(market value) remained in the range of 70%-80% except for 2008-2012. The peak in 2000 was due to the dot com excess values of the stock market boom of 1996 - 2000 and the fall in 2008-2012 was due to the Great Recession. To isolate the trend one may disregard both extreme intervals. Interpolation leads to the conclusion that the trend of rising surplus\(market value) ratio has continues into 2015, when the high proportion of 79% is reached.

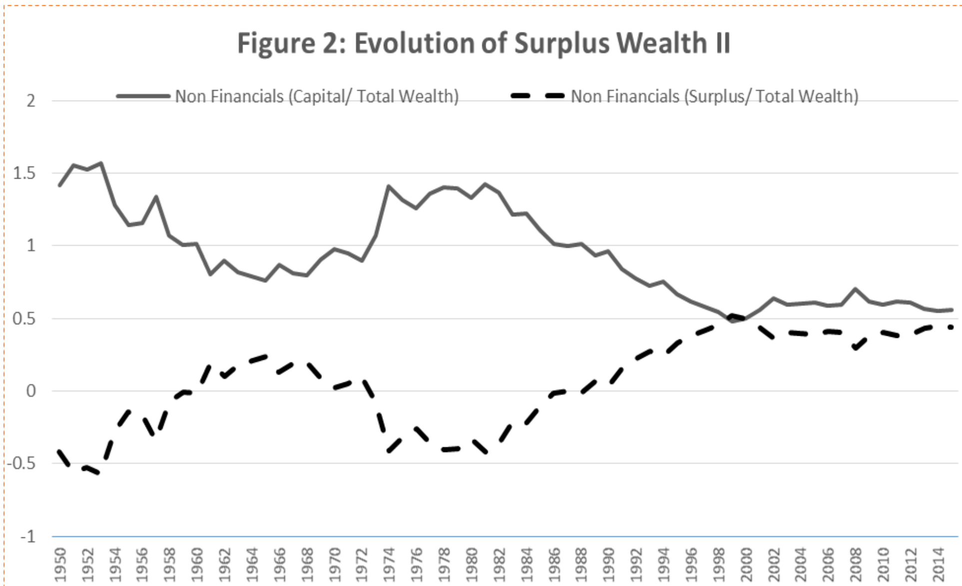
The rise of surplus wealth in 1974 - 2015 is steep. Figure 1 reveals the surplus ratio was low in early 1970's hence the sharp rise from 1974 to 2015 was in part a recovery from the surplus' collapse between 1968 and 1974. Since (surplus)/(market value) is a bounded quantity, how should we view the change in it from -95% in 1974 to +79% in 2015? Is it just a phase of a long cyclical pattern over the centuries or is it a reflection of a deep structural change during the 42 years 1974 - 2015? Since we believe the main cause for these changes is not transitory and that it is operative today and will remain in place well into the 21th century, a better understanding of the forces at hand is needed. In the rest of this paper we study different aspects and implications of the results reported in Figure 1.

Comparing in Figure 1 the surplus of non-financial firms with surplus of the combined sectors reveals they exhibit the same behavior, with two differences. First, in the 1950's financial surplus held up better than non-financial surplus and second, leading in 1996-2006 to the great recession financial surplus was exceptionally high (for well understood reasons). With this in mind we shall study several questions using only non-financial firms' data in the Compustat universe but observe that Figure 1 shows that those conclusions also apply to financial firms.

1.2b Growth rates of capital employed and wealth. In Figure 2 we plot two aggregate ratios for the non-financial samples (without adjustment due to foreign held assets): capital/wealth and surplus/wealth. Since wealth includes stockholders and bondholders ownership values, the figure 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 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 two factors. One is a 5.54% growth rate of total real market value of the non-financial firms in the Compustat samples, and the second is the change in the leverage rate of non-financial firms that we examine later. We comment again that such large differences in growth rates between total wealth and capital employed cannot continue indefinitely but it is hardly evident where the process is heading.



1.2c *The size of surplus wealth 1974 - 2015.* How large is surplus wealth in the US and what is its composition? Although we study only part of the economy, the order of magnitudes of the surplus and its components is clear. To explain it we present in Table 3 values of the surplus and its components for selected years 1974-2015 in *billions of 2015 prices* (with the GNP deflator).

As we noted, the high surplus during the dot com boom should be balanced against the lower surplus during the Great Recession. When accounting for both, the surplus is seen to have grown up to 2015 and 2016 estimates show it is continuing to rise. Given that the total market value of all domestic corporations in 2015 was $28.953 Trillion, a surplus wealth of $23.848 Trillion is significant; it takes different forms which depend upon legal restrictions, accounting practices and taxes. Table 3 shows that *between 1974 and 2015 real surplus wealth increased by $ 25.9 Trillion* with ownership which, we shall later see, is heavily concentrated. The sheer size of this surplus calls for rethinking of current accepted views about the process of economic growth, income distribution, the dynamics of capital and wealth accumulation, and the relation between innovations and wealth distribution.

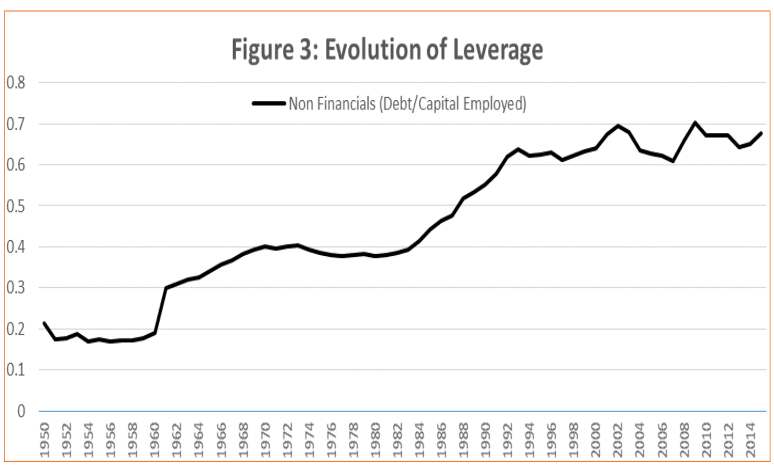
Table 3: Size and Composition of Surplus Wealth

(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 A). (*) Non-financials surplus is the sum of the first three components

1.2d Dynamics of corporate leverage. We now examine leverage directly by studying the evolution of leverage among non-financial firms in our Compustat samples. Without adjusting for foreign holdings, Figure 3 presents a plot of debt/capital ratio of non-financial firms for 1950-2015. It shows the high leverage observed in 2015 is the culmination of a long sequence that began in the 1950's where US businesses increased their leverage from 22% of capital employed to 68%. If we adjust capital for foreign holdings this percentage rises to 78%. Indeed, inspection of the 2015 file shows that a large number of advanced technology firms exhibit debt/capital > 1 hence lenders are willing to accept intangible assets as collateral.



The changes in leverage lead to a state where the financial structure of US non-financial corporate sector may be approximated by a leverage ratio of 1 when bondholders finance the capital stock employed and receive a stipulated return while stockholders own and trade surplus wealth, bearing all residual profit risks. Such a division of ownership is possible only if the surplus is large enough to provide bondholders with a safe collateral to control the default risk they must bear. 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.

Conclusions. Our empirical study enables us to arrive at the following conclusions:

(i) monopoly rent is a large component of GNP and the resulting surplus wealth, which was negative in the 1970's, rose to 79% of the market value of all firms traded on public exchanges in 2015;

(iii) surplus wealth is concentrated in the technologically advanced sectors that have been transformed by the IT revolution.

2. Information Based Technical Change Caused the Surplus and the Rising Inequality

We turn to the main thesis of this paper. Monopoly rent results from limited competition and barriers to entry and our empirical results demonstrate that rising barriers have been erected since the 1970's. Therefore, to explain the increased monopoly rent we must explain the forces that enabled the rising restrictions on competition. We argue that rising barriers to entry and limited competition are consequences of the information based technological changes that have swept modern economies since the 1970's, and of the institutions built to finance them. These resulted in rising pricing power of firms, rising proportion of surplus in total wealth and increased concentration of wealth in fewer hands. We then show that both the sharp increases in income and wealth inequality as well as the slow growth of wages since the 1970 are all primarily caused by the IT revolution. However, we add the well known but important fact that an IT innovator's monopoly power is not derived only from the technology itself and in many cases an IT technology can be copied or imitated without great difficulties. IT innovations enable and speed up the erection of barriers to entry and once erected the essential characteristics of IT facilitate the maintenance of such restraints on competition. These same characteristics also explain the growing concentration of wealth in fewer hands.

2.1 Innovations as a cause of monopoly pricing power

What causes surplus wealth of a firm? Textbooks answer by appealing to advantages the firm may have, such as superior management and labor force, superior location, control of a unique resource, patents' protection and intellectual property rights, network externality controlled by the firm, customer's loyalty or other similar reasons. Wall Street recognizes these and typically lumps them together, describing the firm as having a "moat" or a "competitive advantage" or simply "pricing power." However, all these reasons amount to saying the firm has some monopoly or oligopoly pricing power and *surplus wealth* may as well be called "*Monopoly or Oligopoly Wealth*." In some cases such term is justified as, for example, in the case of airlines.

Prior to 2005 airlines struggled under pressure of intense competition that resulted in zero surplus. A sequence of large scale mergers (e.g. 2008 - Delta and Northwest, 2010 - United and Continental in, 2015 - American and US Air) took place since regulators permitted consolidation. Although today entry is nominally free, four large firms now control most available gates at major hubs and without these an entering competitor can function only in isolated markets. Sufficient legal and institutional friction now exists to give the major airlines pricing power and the ability to function as a thriving oligopoly with rising surplus wealth. Our key point is that *the airlines are not the norm*; this oligopoly is not technologically based and its market power is derived from standard barriers to entry. We showed that for most firms with advanced information technology S > 80% and these are the firms that explain the sharp rise in surplus wealth during 1974 -2015. Moreover, to explain the data we need to *simultaneous*ly explain the expansion of the surplus and the slower growth of capital employed with the following facts:

(i) a sustained rise in income and wealth inequality;
(ii) a rapid rise in managerial compensation;
(ii) a slow growth of wages;
(iii) a decline of the natural rate;

Hence, standard barriers erected by the airlines do not explain the surplus.

The term "Monopoly Wealth" may also elicit the wrong impression that US firms are engaged in illegal acts since large surplus wealth was attained during the Robber Barons' era with ruthless methods of intimidation, corrupt legislators and other illegal means. In comparison, most surplus wealth of late 20th and early 21th centuries is entirely legal, is actively supported by policy and is encouraged in our political discourse. We provide legal protection to patents or, more generally, to intellectual property rights to encourage innovative and creative work. Our policy encourages the development of new products and processes thus enabling innovating firms to create technology platforms with which to differentiate their products, develop customer loyalty and establish economic ecosystems with pricing power. Firms like Amazon, Apple, Facebook, Google-Alphabet, Walmart and many others take legal steps to develop propriety networks with externalities which are sufficiently strong to gain their customers' loyalty in a completely open and transparent manner. As the rate of innovations increases, the size of innovating firms rises with growing pricing power and increasing surplus wealth. Also, as IT expands and transforms more sectors, a rising number of firms and products enjoy legal "moat" protection as compensation for innovations, rendering pricing power more extensive and further increasing surplus wealth.

The argument above appears paradoxical as it suggests that increased rate of technical progress increases firms' oligopoly power and move markets further away from competitive behavior. That is, there is a conflict between competitive institutions and innovative creativity since monopoly power fueled by innovations is legally protected. But reality is more complex. First, the winner among early innovators gains the reputation and strategic advantage that provides pricing power *even without legal protection*. Moreover, once established, winners consolidate market power with further developments which are kept as trade secrets. Second, trade secrets wear off with time and all legal protections are temporary, hence protected pricing power has limited duration. Third, pricing power and high profitability attracts competing innovations so that under a rapid innovation rate the real competition is among innovators. Given long enough time period, 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 provides better products that consumers prefer. Hence, during long periods of rapid technical advance consumers face a *sequence* of protected monopoly powers each replaced by a subsequent market power of a new innovator. Fourth, if the innovation rate slows down, legal protection and economic advantages dissipate and markets converge back to competitive conditions.

The four factors above imply that average pricing power is the result of two opposing forces: the decline of older technologies cause monopoly power to decline while the rise of new technologies and institutions cause pricing power to rise. The speed of these two forces can be seen in Figure 1. Mainframe computers gained wide use before the 1960's, the minicomputer was introduced in the 1960's, various personal computers were introduced in the 1970's but the mass use of the PC began with the IBM PC in 1981. This explains that although the modern stage of *software based* IT took hold only in early 1980's, powerful *hardware based* IT developments took place in the 1960's and the rise of the surplus, reaching 43% of total market value in 1968, is no accident. These developments stalled after 1968, leading to the "productivity slowdown" when a slower innovation rate caused the surplus to collapse and vanish by the early 1970's..

Most innovators prefer industrial secrecy and the advantage of being the leader of a technology instead of having legal patent protection. Such firms engage in fierce battles to protect their market positions by continuous upgrading of their technologies with new developments, making it harder for competitors to catch up. They promote customer loyalty, rendering competitors' entry harder even without patent protection. A powerful weapon that can be destructive to social progress but is often used to maintain market power is to buy out a potential competitor. Hence, large technology firms own many patents or intellectual property rights, recorded as intangible assets on their books, that once were the market value of potential competitors. A purchasing firm may enhance such new technology but sometimes use its ownership to suppress it. New innovations can thereby remain dormant.

Our society has accepted the added pricing power of innovators in exchange for more rapid technological developments because each new technology brings improvements to our life for which consumers are willing to pay the all-too-high prices that enable surplus to exist. Hence, this paper is not a welfare evaluation of existing policy towards innovators but rather, it establishes the positive result that the level of monopoly pricing and size of surplus wealth are determined by the nature and pace of innovations. Indeed, the surplus is an indirect measure of the aggregate rate of innovations.

Our reasoning up to now applies to all innovations. We next explain why IT has some unique characteristics that explain why such innovations have had the complex effects observed in the data.

2.2 Characteristics of IT that caused an increased surplus with rising wealth concentration

Rising monopoly rent does not imply an increased personal income and wealth inequality. Since both changes have taken place and since we maintain that both are caused by characteristics of IT, our analysis focuses on the two broad effects of IT: those that enable the rising barriers to entry and the limiting of competition and those that promote the rising concentration of personal income and wealth. These are distinct factors that need to be understood separately.

2.2a IT enables and facilitates rising barriers to entry and limiting competition

We defined IT as a technology of processing, transmitting and storing information and with sharply declining cost IT has the unique characteristic of enabling vast amount of information to be shared and communicated at electronic speed by a large number of economic agents. This is a unique property of IT in human history. For this reason the IT revolution has transformed many firms into "platforms" or "ecosystems" where many diverse economic agents coordinate activities by sharing information. The computer, the mobile telephone and the internet are the basic tools of the sharing and coordination platforms but a few examples will illustrate how ubiquitous they are becoming.

Social network firms are a pure form of sharing platforms but firms that provide computerized taxi services are also electronic platforms to coordinate car owners with riders; firms engaged in vacation reservations are platforms to coordinate property owners with vacationers; search engines are offered by firms that coordinate buyers with sellers; firms that provide cloud computing enable many to use the same software on a rental rather than ownership basis; firms that provide electronic payment processing are electronic platforms that coordinate buyers, sellers and banks. Distinct from traditional retailers that offer merchandise for sale on store shelves, online retailing is an electronic platform to coordinate a multitude of sellers with buyers. It is thus no surprise that Amazon.com engages in selling literally enything from food, movies to cloud computing. It is all just the power of IT that enables the many economic entities to share the platform and coordinate activities. On a larger scale, coordination due to IT arises also due to the use of common computer language or operating system that locks a multitude of users, buyers, suppliers and business partners to a single platform. Microsoft and Apple are examples of such large scale platforms. Other forms of explicit or implicit coordination are enabled by IT, but space limitation dictates we need to proceed and explain the characteristics of IT that facilitate and accelerate the rise of market monopoly power.

(i) Enabling network externality on platforms. The economic implications of ecosystems is obvious: they enable wide network externalities among interdependent participants. Such business models are based on the idea a platform will be used by multiple people at virtually zero marginal cost to the platform firm hence its profits increase with the size of its user base. The externalities are the direct consequences of IT since all that is shared is information. The size and impact of these externalities suggest that from an economic perspective these firms created *privately owned public utilities*. At the center there is the platform firm which, if a producer of its own products (e.g. Apple, Microsoft), it charges high enough prices to generate the monopoly rent. Apart from pricing its own products, most platform firms charge direct or indirect fees to the platform's users. These high fees reflect their economic power to charge a monopoly rent. However, monopoly power is often more subtle, as is the case with some platform firms (e.g. social networks, Google) who do not charge their members-

customers any direct payment. Hence, on the surface, no monopoly pricing of services provided appear to exist. But then, customers pay in two ways. First they pay in kind by turning over to the platform firm their private information which becomes a prized possession of the firm. Monopoly pricing arises when the platform firm charges other firms very high fees for advertising to its members - customers. We say "very high" fees since their financial reports reveal very high profit margins. The second payment of members-customers takes the form of higher prices charged for products advertised on the platforms by the other firms. Finally, some platform firms charge *fixed fees* for membership and these constitute a large component of their total profits. We discuss them in (iii) below in relation to strategies for improving customer loyalty.

(ii) Platforms: increasing optimal firm size. Large scale externalities, artificial intelligence and faster computing at falling cost facilitate corporate management and increase optimal firms' size. In many cases they lead to a "winner take all" phenomenon documented by Autor et. al. (2017). We noted that a "platform" arises from a dominant innovation with its unique computer software enhanced by app developers and supported by an array of suppliers and related firms. Hence, Apple Inc. is not only a firm that produces smart phones but mostly it is a platform for consumer products supported by a large number of suppliers of diverse components, accessories and apps. A platform grows into a unique "ecosystem" of rising size which increases monopoly pricing power.

(iii) Enabling rapid communication to increase customer loyalty. We finally note the growing number of "customer loyalty programs" that allow firms to communicate directly with their customers to offer them added benefits for being 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, airline miles programs etc). 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.

2.2b IT characteristics cause rising personal wealth and income inequality

Apart from facilitating the rise of monopoly power IT has a secondary effect of increasing the concentration of wealth in fewer hands due to the special manner wealth is created by IT innovations. This is our next topic.

(iv) *Increasing development speed and declining required capital for initial value recognition.* To explain this consider a major innovation in traditional industries such as shipping, railroads, steel, automobiles etc. that were the drivers of economic growth in the 19th or the first part of the 20th century. This innovation was more than just an idea since typically it required substantial investment in the form of a plant and\or a large capital equipment. The innovator had to demonstrate feasibility of the product or process, that its production cost are reasonable, and that it can be sold at a profitable price. Hence, translation of 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 substantial part of his ownership shares. Also, since *profits arrived after investments* and after marketing development, the innovator realized some value of his innovation only after the idea proved successful by which time the wealth created would be widely distributed. If a conservative public attitude prevailed, the time required for the innovation's adoption could be long and therefore one often finds in the literature a discussion of the rate of innovation "adoption" and much of the dynamics of economic development revolved around the adoption rate by other firms using similar designs (e.g. Schumpeter (1934)).

These features changed in the 20th century but remained partly 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 investment. 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 rather than improvements in hardware that require newly built physical objects. For example: computer program to perform a task, drug formulation, smart phone app, genetically engineered seed or a video game are all purely informational changes although they do require some hardware. 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 the "proof of concept" stage which reduces the innovation's risk at relatively modest cost. It expands a bit the ownership circle to a broader "innovating group" that includes this initial external capital. The important result is that the innovator or his firm does not surrender a major ownership share in exchange for finding out the true value of the innovation. The effect of the purely informational nature of the innovation is that before the firm makes heavy capital investments and even before it has a product for sale, a feasibility study can often demonstrate the approximate market value of the new idea. Hence the innovator maintains much of his ownership shares when he has a reasonable estimate of his innovation's true value.

The assumption of small initial investment is not always valid. In cases such as new drugs, the law 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, both required for approval by the FDA. Such studies are very costly and take a great deal of time, making drug development one of the most expensive areas of feasibility studies. However, surplus wealth developed by drug companies is also among the highest, reflecting pricing that constitute a major component of medical cost in the US.

Two additional key factors that further reduce the size of capital required for developing a new idea in IT and therefore contribute to the concentration of wealth created by new innovations are *outsourcing and the rapid decline of computing cost*. First, a new idea in IT requires development of software and hardware to, ultimately, operate a system such as a product or a process. The size of required investment is therefore reduced by outsourcing, made possible by growing specialization and by the fact that most systems can be decomposed into standard components which are developed on their own and assembled at the end. Second, the cost of producing a new system have been falling due to the rapid fall in the cost of information processing and storing. These two benefits are operative at all stages of an innovation development. We also note the important impact of government research that further contributed to reduce the capital cost of IT innovations (see Wright (2017)).

(v) The central role of finance and investment banking. With proof of concept established and the innovating group having a good estimate of the innovation's market value, it needs to proceed with its investment plans for which much capital is needed. To that end it needs a formal market to realize its market capitalization by selling securities at a sharply increased market value. The innovating group, in fact, offers its valuable liquid "currency" with which to engage in business without yielding too much of their equity ownership. For a public sale of its securities the firm needs investment bankers to attain two tasks. First, since most innovations entail technical details whose appreciation requires expert knowledge, the firm needs a public introduction. By taking the firm public and advancing the information about the firm's innovation, 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 advisors and 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. Wealth creation without much capital investments then results from the innovation's informational nature which enables an early and inexpensive assessment of the created value before a business is built. Most investments are made later as the firm develops its marketing. In recent years an active private market developed in securities of successful firms that postpone an IPO. That is, a private market has developed that allows a new firm to delay the IPO and raise as much capital as it needs from private 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. 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 points (iv) and (v) is that in a relatively short period an innovator with a successful idea can turn it into major personal wealth while sharing only a modest part of the gain with venture capitalists, investment bankers or the public. The Silicon Valley jargon christened this rapid change by calling a new innovation a "Unicorn" if its market value reaches $1 Billion. When investors measure success in *Billions*, it is not surprising a large number of entrepreneurs across the world have became billionaires over night during 1970-2015 via the process described here. In sum, the outcome of (iv) and (v) is the *increased speed of business development* and wealth creation, a conclusion supported by results of others (e.g. Greenwood and Jovanovic (1999)). An example may help.

The idea of *Snap Inc*. is due to three Stanford graduate students who developed computer programs for social media that allow a person to communicate with one person at a time and use a camera with self-deleting photos. The firm was started in September 16, 2011 with venture capital of $485,000 and proceeded, with a sequence of venture investments, to acquire several small firms. Its total sales in 2016 was $404 million and total non-liquid investments rose to $543 million by the end of 2016. The IPO was completed on March 2, 2017 and after the IPO the founders, with their largest venture groups, held 70% of the voting shares and 60% of the ordinary shares. It took Snap Inc. 5.5 years from start to the IPO whereas Facebook took 8 years and Microsoft 10 years to do it. This is not an unusual tale of riches but rather, it indicates that with growing speed, this process with analogous outcomes have taken place across the world since the 1970's with major effects on wealth distribution.

In sum, relative to earlier in the 20th century, new ideas in IT typically require less time and less invested capital before an innovator realizes the value of his innovation. Consequently, wealth creation has been accelerated to enable an innovator to end up with larger ownership share, resulting in the ownership of new wealth being more concentrated.

2.3 *The IT dynamics: rising monopoly power with rising wealth and income inequality*

Since the 1970's IT innovations brought about new firms or transformed old ones hence the declining or slow growing old sectors with broadly distributed wealth ownership were overtaken in importance by new, IT based, sectors with significant pricing power, large surplus wealth and highly concentrated wealth ownership. As IT innovations transformed growing number of sectors, average monopoly power rose, causing rising surplus wealth and rising wealth and income inequality. Table 3 shows that over 1974-2015 some $25.9 Trillion of surplus wealth was created, mostly in IT based sectors, with highly concentrated ownership. This explains Figures 1-3 which show sharply rising $\frac{\text{wealth}}{\text{capital}}$ ratio and wealth growth rate in 1974-2015 exceeding the growth rate of capital by 2.43%.

We then conclude that the steep rise in income and wealth inequality from 1974 to 2015 was caused by the rise in average monopoly pricing power of the new or transformed firms created by the IT revolution. This was both a result of the rising firm size and the increased market power of IT transformed sectors but also because the application of IT expanded into many other related industries. The rise of mean pricing power shows the *economy could not have been in a steady state* but rather that it has been in an adjustment to an economy with stronger monopoly power of the average firm.

Our perspective conflicts with Piketty's (2014) view of wealth accumulation as taking place through a lengthy intergenerational process where the rate of return on family assets exceeds the growth rate of the economy, causing wealth inequality to rise. The process of accumulation we describe here shows that wealth creation during 1970-2015 had little to do with intergenerational accumulation and mostly reflects rapid rise of individual wealth enabled by information based innovations together with rapid decline of wealth created in older industries such as railroads, automobiles, steel, etc. Our perspective questions the darker future forecasted by Piketty's (2014) which appears motivated by a model of agrarian society where dynastic land (not subdivided by inheritance) is the main form of wealth. Our analysis of the dynamics of the data contradicts Piketty's forecast of rising social stratification similar to the 19th century. This is so because a rising surplus is not associated with intergenerational wealth transfer within a fixed set of dynasties experiencing growing wealth but rather, wealth is transformed from one set of surplus owners to the next set who need not be members of the same family. This does not alter other dark and authoritarian implications of growing inequality, but the 19th century Victorian age may not be the appropriate model for it.

2.4 Additional implications

There are other important economic effects of a rising monopoly power that can be studied only with a formal model and this we do in Section 3 below. Here we offer only intuitive explanations why the real wage and the natural interest rates have been pressed downward by the rising pricing power and why we must reconsider our perspective about corporate officers' compensation and about measuring TFP in an economy with monopoly power.

2.4a Effects on the wage rate and on the riskless natural rate

Suppose a firm hires labor and capital inputs in free markets and pays the competitive wage and rental rates determined in open markets. This firm may also own some of its own capital but in that case it imputes its alternative cost in its profit calculations. The fraction of capital not owned by the firm is thus financed through the debt market where it pays the competitive interest rate. With pricing power the firm equates the wage or rental rate on capital to the *marginal revenues*. Hence, the firm curtails the use of labor and capital inputs and when this is done on an economy-wide scale it reduces the demand for labor and for capital, resulting in pressure to lower wages and the natural rate. Over time, rising productivity pushes for higher wage rate and for normalizing the natural rate but, as we have observed, *over 1970-2015 the pricing power of firms also has increased,* therefore these markets face conflicting factors: rising productivity pushes the wage rate higher but rising monopoly power pushes the wage rate lower, consequently *the wage rate rises slower than productivity*. We show later this same force causes a divergence of the wage from output per man-hour.

Determination of the interest rate is complex and we do not propose technology has an entirely decisive effect. However, we show the natural rate is under pressure from three important directions: rising productivity pushes it towards normalization but rising monopoly power presses the rate lower. A third factor is the rising wealth together with demand for portfolio diversification which increases the supply of wealth in search for investment with riskless returns, further lowering the natural rate.

2.4b Role of R&D and effects on management compensation and on measured relative labor share

We recall that (i) management compensation rose since the 1970's, and (ii) relative labor share declined since the 1970's. The BLS *published* labor share before the 1970's was 0.68 and it declined to 0.59 in 2015. We suggest that the IT age had important effects on these income components.

Pricing power due to innovations is temporary and is subject to erosion by competing ideas. Therefore, firms with surplus wealth engage in intense technological competition over the edge that gave them pricing power in the first place. 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. We have already explained why we treat R&D expenses of the firm as the cost of maintaining its market power and data on R&D expenditures will come into play later in Section 3 of the paper. Here we note that a model of output as a function of labor and capital must also question the labor designation of management input; it benefits the firm but not as a standard contribution of labor input to output. It is thus more appropriate to consider management *as partners* in the innovating process and their compensation as a profit sharing arrangement 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 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 make the case later on that officers' compensation is profit-sharing which is part of a firm's surplus income. This stresses 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 sum, we treat officers' compensation as part of surplus income and R&D cost as the firm's cost of preserving its surplus wealth and preventing its depreciation.

2.4c Relative share of surplus income in national income: a broad estimate

Although up to now we examined only *asset* values, these offer a simple estimate of the share of monopoly surplus in *income*. National income is divided into labor share, capital share and surplus income share. Table 1 shows that in 2015 "non-financial business with securities trading on public exchanges" exhibited (surplus)/(total wealth) = 44%. Later we show in Table 3 that, adjusted for self-employed and management income, relative labor share was 0.52 hence the shares of capital income plus share of surplus income in net value added was 0.48. Simplifying by assuming the rate of return on capital was the same as the rate on surplus wealth, it is seen the share of surplus monopoly income in value added was (0.48)×(0.44) = 0.211 which is *a measure of an income flow deduced from asset surplus*. Being an important quantity, we estimate it again in Sections 3.3a-3.3b by using two different methods and using only flow data (income and expenditures) to find out that these alternate sources also imply the same 0.21 - 0.23 share of surplus income in net value added! We thus have three independent estimates of the share of surplus income in value added which, remarkably, are the same.

2.4d Effect on measured total factor productivity (TFP)

Standard computation of TFP evaluates the contribution of each input X to total growth of output Y by $(\frac{\partial Y_t}{\partial X_t}\frac{X_t}{Y_t})\frac{\dot{X}_t}{X_t}$ and, postulating a competitive economy, assumes $(\frac{\partial Y_t}{\partial X_t}\frac{X_t}{Y_t})$ is relative share of X in Y. But if firms have pricing power, neither labor share nor capital share are measured by terms like $(\frac{\partial Y_t}{\partial X_t}\frac{X_t}{Y_t})$ which are, as explained earlier, larger than the true share of labor and capital. The distortion is further complicated by the fact that GNP is divided into three components: labor share, capital share and surplus share hence the true shares of labor and capital do not add up to 1. The standard method does not distinguish between shares of capital and monopoly surplus, thus combining them into one contribution named "capital relative share." The outcome is that the standard method distorts the weights of the two factors. When examined with a formal model we show later that in general, the standard method biases computed productivity *downward* if the difference $(\frac{\dot{Y}_t}{Y_t}-\frac{\dot{K}_t}{K_t})$ is small. If this difference is large, the effect is ambiguous.

We next formulate a model that reflects the main features of our empirical results. The model focuses on distribution questions but not on growth dynamics.

3. Theoretical Reconsideration of Income and Wealth Distribution

We formulate a growth model in which firms have pricing power and examine its impact on various distributional questions. We note two facts. First, the model leaves unspecified some non-essential dynamic components of the economy hence it is not a full General Equilibrium model since questions of income and wealth inequality or measures of technical progress can be studied without a complete specification (e.g. Solow (1960)). Second, we opt for the *simplest* and most transparent assumptions and that may appear unrealistic. We therefore also explain why the results are unaltered even under more realistic assumptions.

3.1 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

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

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

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

(C , I) are consumption and investment, (Y_{it}^C, Y_{it}^I) are the amount of intermediate good i used in producing, respectively, consumption C_t and investment I_t. With elasticity of substitution θ we consider only the case $\infty > \theta > 1$ that permits profit maximization. The model cannot be reduced to a competitive economy and its error rises for large values of θ. The number of firms *is fixed since there is no free entry*. (7) introduces a compositional effect that distinguished consumption from investment goods but it turns out to have no distribution implications therefore most analysis is done under the simplified assumption $\vartheta_j^C = \vartheta_j^I$, ensuring a consumption price of a capital good equals 1.

A variant of (7) that 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)), one can replaces (7) with

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

ψ_t measures higher capital efficiency due to improved IT or lower cost of producing a unit of capital goods. We bring this up only to show our key distributional conclusions remain valid under (7a).

The Dixit-Stiglitz demand gives rise to monopolistic competitive pricing by producers of intermediate goods, therefore *our assumptions about capital and wealth ownerships are important.* Capital and labor are assumed to be 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 may own capital they rent to firms. Aggregate capital grows in accord with $K_t = (1-\delta)K_{t-1} + I_t$ (δ is a depreciation rate) and aggregate labor available is exogenous. Regardless of who owns capital, in profit calculations firms consider the alternative cost of renting out capital they may own and maximize profits at any date by allocating capital and labor optimally in accord with 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 the pricing power of firms. Under such assumptions *capital owners and stock holders perform different functions and may also be different agents.* Firms' ownership shares are traded in open markets and profits are distributed to stock holders as dividends only after capital and labor are paid their incomes in accord with the market 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 do not own shares. Entrepreneurs may own capital hence 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

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

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

The implied demand functions depend upon 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 first order conditions are

(9a) $$P_{jt}\lambda_t^C = C_t^{\frac{1}{\theta}} \vartheta_j^C (Y_{jt}^C)^{-\frac{1}{\theta}} \Rightarrow \left(\frac{\vartheta_i^C P_{jt}}{\vartheta_j^C P_{it}}\right)^{-\theta} = \left(\frac{Y_{jt}^C}{Y_{it}^C}\right)$$

(9b) $$P_{jt}\lambda_t^I = I_t^{\frac{1}{\theta}} \vartheta_j^I (Y_{jt}^I)^{-\frac{1}{\theta}} \Rightarrow \left(\frac{\vartheta_i^I P_{jt}}{\vartheta_j^I P_{it}}\right)^{-\theta} = \left(\frac{Y_{jt}^I}{Y_{it}^I}\right) .$$

Multiply (9a)-(9b) by (Y_{jt}^C, Y_{jt}^I) and add up as in the right hand side of (8a)-(8b) to have

(10) $$\hat{P}_t Y_t^v = \sum_{j=1}^{M} P_{jt} Y_{jt}^v = Y_{it}^v (P_{it}/\vartheta_i^v)^{\theta} \sum_{j=1}^{M} (P_{jt}/\vartheta_j^v)^{1-\theta} \vartheta_j^v \Rightarrow Y_{it}^v = \frac{(P_{it}/\vartheta_i^v)^{-\theta}}{\sum_{j=1}^{M} \vartheta_j^v (P_{jt}/\vartheta_j^v)^{1-\theta}} \hat{P}_t^v Y_t^v, \; v = C, I.$$

Define the prices

(11) $$P_t^{\,C} = [\textstyle\sum_{j=1}^{M} \vartheta_j^C (\frac{P_{jt}}{\vartheta_j^C})^{1-\theta}]^{\frac{1}{1-\theta}} \quad , \quad P_t^{\,I} = [\textstyle\sum_{j=1}^{M} \vartheta_j^I (\frac{P_{jt}}{\vartheta_j^I})^{1-\theta}]^{\frac{1}{1-\theta}}$$

and demand functions

(12) $$Y_{jt}^{\,C} = \frac{(P_{jt}/\vartheta_j^C)^{-\theta}}{(P_t^{\,C})^{-\theta}} (\frac{\hat{P}_t^{\,C}}{P_t^{\,C}}) C_t \quad , \quad Y_{jt}^{\,I} = \frac{(P_{jt}/\vartheta_i^I)^{-\theta}}{(P_t^{\,I})^{-\theta}} (\frac{\hat{P}_t^{\,I}}{P_t^{\,I}}) I_t .$$

It is well known $(P_t^{\,C}, P_t^{\,I})$ are cost of a unit of consumption or investment at the optimal mix of intermediate goods (see Brakman and Heijdra (2004), Chapter 1). So far we used in (10) only the right hand side of (8a)-(8b). To explore the left side insert (12) into (8a)-(8b) we find

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

and (11) imply $\hat{P}_t^{\,C} = P_t^{\,C} \equiv P_t$, $\hat{P}_t^{\,I} = P_t^{\,I}$ hence the final demand functions are

(14a) $$Y_{jt}^{\,C} = \frac{(P_{jt}/\vartheta_j^C)^{-\theta}}{P_t^{-\theta}} C_t \quad , \quad Y_{jt}^{\,I} = \frac{(P_{jt}/\vartheta_j^I)^{-\theta}}{(P_t^{\,I})^{-\theta}} I_t \quad , \quad Y_{jt} = \frac{(P_{jt}/\vartheta_j^C)^{-\theta}}{P_t^{-\theta}} C_t + \frac{(P_{jt}/\vartheta_j^I)^{-\theta}}{(P_t^{\,I})^{-\theta}} I_t .$$

Aggregate output

(14b) $$\textstyle\sum_{j=1}^{M} \frac{P_{jt}}{P_t} Y_{jt} = C_t + \frac{P_t^{\,I}}{P_t} I_t = Y_t$$

and it is clear from (14b) that the price of a unit of capital is not 1 but rather $P_t^{\,I}/P_t$.

In the symmetric case which we mostly use $\vartheta_j^C = \vartheta_j^I$, $P_t^{\,C} = P_t^{\,I} \equiv P_t$, the demand functions are

(15a) $$Y_{jt} = \frac{(P_{jt}/\vartheta_j)^{-\theta}}{P_t^{-\theta}} Y_t \quad , \quad Y_t = C_t + I_t \quad , \quad P_t = [\textstyle\sum_{j=1}^{M} \vartheta_j (\frac{P_{jt}}{\vartheta_j})^{1-\theta}]^{\frac{1}{1-\theta}} .$$

(15b) $$\textstyle\sum_{j=1}^{M} P_{jt} Y_{jt} = \sum_{j=1}^{M} \vartheta_j (\frac{P_{jt}}{\vartheta_j})^{1-\theta} (\frac{1}{P_t})^{1-\theta} P_t Y_t = P_t Y_t .$$

We later assume production functions for intermediate goods therefore

(15c) $$Y_t = \textstyle\sum_{j=1}^{M} (\frac{P_{jt}}{P_t}) Y_{jt} \equiv \sum_{j=1}^{M} (\frac{P_{jt}}{P_t}) A_{jt} (K_{jt})^{\alpha} (N_{jt})^{(1-\alpha)} .$$

To see the effect of changed efficiency of capital goods as in (7a), note that steps (9)-(12) are the same and the difference in (13) is only for investment, not consumption. In that case

(16a) $$I_t = [\textstyle\sum_{j=1}^{M} \psi_t \vartheta_j^I [(\frac{P_{jt}}{\vartheta_j^I}\frac{1}{P_t^{\,I}})^{-\theta} \frac{\hat{P}_t^{\,I}}{P_t^{\,I}} I_t]^{\frac{\theta-1}{\theta}}]^{\frac{\theta}{\theta-1}} = [\textstyle\sum_{j=1}^{M} \vartheta_j^I (\frac{P_{jt}}{\vartheta_j^I})^{1-\theta}]^{\frac{\theta}{\theta-1}} \frac{1}{(P_t)^{-\theta}} \psi_t^{\frac{\theta}{\theta-1}} \frac{\hat{P}_t^{\,I}}{P_t^{\,I}} I_t .$$

(16b) $$Y_{jt}^{\,C} = (\frac{P_{jt}}{\vartheta_j^C P_t})^{-\theta} C_t \;,\; Y_{jt}^{\,I} = (\frac{P_{jt}}{\vartheta_j^I P_t^{\,I}})^{-\theta} \psi_t^{\frac{\theta}{1-\theta}} I_t \;,\; Y_{jt} = (\frac{P_{jt}}{\vartheta_j^C P_t})^{-\theta} C_t + (\frac{P_{jt}}{\vartheta_j^I P_t^{\,I}})^{-\theta} \psi_t^{\frac{\theta}{1-\theta}} I_t .$$

(16c) $$\textstyle\sum_{j=1}^{M} \frac{P_{jt}}{P_t} Y_{jt} = C_t + \psi_t^{\frac{\theta}{1-\theta}} (\frac{P_t^{\,I}}{P_t}) I_t = Y_t$$

and comparing with (14b) the change is only in the pricing of capital assets. Since equilibrium prices of intermediate good and consumption are bounded and since $\theta > 1$ and ψ_t rises, (16c) implies that the price of a unit of capital goods *declines.* This reflects Gordon's (1990) evidence for the decline in the price of fixed capital goods. The point is, however, that these assumptions do not alter the key distributional results shortly to be developed for the simplistic symmetric case.

We use mostly demand functions (15a)-(15b) but comment on the effect of other cases. To evaluate $(\lambda_t^C , \lambda_t^I)$, multiply (9a)-(9b) by (Y_{jt}^C, Y_{jt}^I) and add to deduce for the symmetric case

$$v_t P_t \lambda_t^v = \sum_{j=1}^M Y_{jt}^v P_{jt} \lambda_t^v = v_t^{\frac{1}{\theta}} \sum_{j=1}^M \vartheta_j (Y_{jt}^v)^{\frac{\theta-1}{\theta}} = v_t^{\frac{1}{\theta}} v_t^{\frac{\theta-1}{\theta}} \quad \Rightarrow \quad \lambda_t^v = \frac{1}{P_t} \quad , \quad v = C , I.$$

The share of the value of an intermediate good in value of total output $P_t Y_t$ is

$$\text{(15d)} \qquad s_{jt} = \frac{P_{jt} Y_{jt}}{P_t Y_t} = \frac{P_{jt}[(P_{jt}/\vartheta_j)^{-\theta}/P_t^{1-\theta}] P_t Y_t}{P_t Y_t} = \vartheta_j (\frac{P_{jt}/\vartheta_j}{P_t})^{1-\theta} = \vartheta_j^{\theta} (\frac{P_{jt}}{P_t})^{1-\theta}.$$

For our purposes this is all we need in order to proceed.

3.2 *Optimization by intermediate good producers*

Each firm j has a production function of the form

$$\text{(17a)} \qquad Y_{jt} = (\Psi_t \Psi_{jt})(K_{jt})^{\alpha}(N_{jt})^{(1-\alpha)} \quad , \quad A_{jt} = \Psi_t \Psi_{jt}$$

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

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

Our main approach is to study monopolistic competitive Nash Equilibrium and consider later the case of Cournot Nash Equilibrium. Hence, for now producers take aggregate income and price P_t as given and select their own prices and allocate labor and capital to maximize profits at each date:

$$\text{(17b)} \qquad \mathrm{Max}_{P_{jt}, N_{jt}, K_{jt}} \left[P_{jt} Y_{jt} - W_t N_{jt} - R_t K_{jt}] + \lambda_{jt} [\Psi_t \Psi_{jt} K_{jt}^{\alpha} N_{jt}^{1-\alpha} - Y_{jt}] \right] \quad , \quad Y_{jt} = (\frac{P_{jt}}{\vartheta_j P_t})^{-\theta} (C_t + I_t)$$

The first order conditions are then

$$\text{(17c)} \qquad (1-\theta)(\frac{P_{jt}}{\vartheta_j P_t})^{-\theta}(C_t + I_t) = \lambda_{jt} \theta (\frac{P_{jt}}{\vartheta_j P_t})^{-\theta}(C_t + I_t) P_{jt}^{-1} \Rightarrow \lambda_{jt} = P_{jt} \frac{(\theta - 1)}{\theta} \text{ all j}$$

$$\text{(17d)} \qquad W_t = P_{jt} \frac{(\theta - 1)}{\theta} (1 - \alpha) [\Psi_t \Psi_{jt}] (K_{jt})^{\alpha} N_{jt}^{-\alpha} = P_{jt} \frac{(\theta - 1)}{\theta} \frac{\partial Y_{jt}}{\partial N_{jt}}.$$

$$\text{(17e)} \qquad R_t = P_{jt} \frac{(\theta - 1)}{\theta} \alpha [\Psi_t \Psi_{jt}] (K_{jt})^{\alpha - 1} N_{jt}^{1-\alpha} = P_{jt} \frac{(\theta - 1)}{\theta} \frac{\partial Y_{jt}}{\partial K_{jt}}.$$

Conditions (17d)-(17e) do not depend upon the symmetry $\vartheta_j^C = \vartheta_j^I$. All variants discussed above impact only (17c) and since all income distribution results depend upon (17d)-(17e) they are invariant to the heterogeneity assumptions. Wealth distribution is impacted by these assumptions since they alter the market valuation of capital. Using the above, we now have:

Observation 1: In equilibrium

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

(18a) $$\frac{p_t^\star}{P_t} = [\sum_{j=1}^M \vartheta_j^\theta \Psi_{jt}^{(\theta-1)}]^{\frac{1}{\theta-1}} \equiv \vartheta_t^\star ;$$

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

(18b) $$Y_t = A_t(K_t)^\alpha (N_t)^{(1-\alpha)} \quad , \quad A_t = \vartheta_t^\star \Psi_t .$$

Proof: (i) From (17c)-(17e) we deduce

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

hence (K_{jt}/N_{jt}) is independent of j. By (17c)

$$\Psi_{jt}P_{jt} = p_t^\star = \frac{W_t}{(\frac{\theta-1}{\theta})(1-\alpha)\Psi_t(K_{jt}/N_{jt})^\alpha} \qquad \text{is also independent of j.}$$

Insert this result into (15a) to deduce

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

(iii) By (15c) 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:

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

where

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

and $Y_t = A_t K_t^\alpha N_t^{1-\alpha}$. ■

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

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

Observation 3 (without proof)**:** Suppose the size of competitors is large and gives rise to Cournot strategies. In such Nash equilibrium firms' marginal revenues differ from those in (17a)-(17e). Bertoletti and Etro (2016) show (page 799) that the marginal revenue of the firm is $P_{jt}\frac{(\theta-1)}{\theta}(1-s_{jt})$ (see (15d)), replacing the marginal revenue $\lambda_{jt} = P_{jt}\frac{(\theta-1)}{\theta}$. Hence, in a Cournot Nash equilibrium marginal revenue is smaller than in a Monopolistic competition Nash equilibrium. ■

A Cournot Nash Equilibrium has distributional properties which are similar to the Nash equilibrium, relative to total real output which is defined by a weighted aggregation as follows:

(i) $\Psi_{jt}\frac{P_{jt}}{P_t}(1-s_{jt}) = \upsilon_t^\star$ is proved to be independent of j and $A_t = \upsilon_t^\star \Psi_t$;

(ii) $Y_t = A_t \hat{K}_t^\alpha \hat{N}_t^{1-\alpha}$ where $\hat{K}_t = \sum_{j=1}^M \frac{1}{(1-s_{jt})} K_{jt}$, $\hat{N}_t = \sum_{j=1}^M \frac{1}{(1-s_{jt})} N_{jt}$.

Interpreting the assumption of a fixed number of firms M

Innovations entail great risks and high obsolescence rates, resulting in a birth and death of firms. Therefore, we interprets our model with fixed number of firms as a model of "sectors" or "dynasties." To illustrate, firms developing business computer technology started in the 1940's-1950's with main-frame computers (e.g. Univac, IBM, Burroughs, Sperry Rand). By late 1960's smaller and more flexible computers took over (e.g. DEC, Data General, Prime Computer) and these developments gave rise to the Personal Computer and then to mobile technology with cloud computing. Many firms rose and fell in the process but obsolescence of one resulted from innovations of the successors. As a result, knowledge and technology that each created was merged into the surviving firms and the wealth each created was invested in the next generation of innovators. Our focus on allocation and distribution is not concerned with the survival of any one firm or innovation but with the evolution of the technology and the wealth it creates. We therefore ignore the death and birth process and focus on the technology's evolution with the unit of analysis being the entire sequence-dynasty. Although each firm faces private risk of obsolescence, the dynasty incorporates new innovations that counter the risk of obsolescence faced by each firm.

3.3 Effects on the distribution of income and on dynamics of pricing power

We now explore central implications of the standard symmetric model (7) to income and wealth distributions, keeping in mind the empirical evidence we outlined in the introduction. Although we do not doubt other factors had an impact, we focus on the effect of a rise in monopoly power.

3.3a 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). Due to our different approach to the problem, there is little to gain from reviewing these alternative approaches. We start by noting that by (17d)-(17e) (with θ_t allowed to vary with time)

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

Observation 1 above then implies that the distribution of income is

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

Labor share is $\frac{\theta_t - 1}{\theta_t}(1-\alpha)$ and share of monopoly surplus is $\frac{1}{\theta_t}$. These results also hold for (7a) since they depend only on the first order conditions (17d)-(17e) and result (ii) of observation 2. We note that competitive conditions hold when $\theta_t \Rightarrow \infty$, $\frac{\theta_t - 1}{\theta_t} \Rightarrow 1$ and the model clearly does not nest these conditions with a finite θ_t. For this reason the model's accuracy falls close to competitive condition.

To use (20), note that a given labor share with knowledge of α 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

(21a) $\qquad$ Adjusted Payroll Share Excluding Self Employed $= (sh_w^{pr})/[1-(sh_w - sh_w^{pr})]$.

The second problem is that payroll share contains management compensation. As explained earlier, the wage component of this compensation is only a fraction of their income that includes the value of exercised granted stock and options (see Moylan (2008) and Elsby et. a. (2013)). Indeed, rising management compensation and large profits from the exercised stock options has slowed down the decline of labor share and this also explains the *rise of payroll labor* share during the dot com years of 1998-2002, a conclusion confirmed by Elsby et. al. (2013). As we explained in Section 2.3b, officers' compensation should be treated as profit sharing rather than wages and this is the second adjustment we make. 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 following definition of payroll share used in the computations of Table 3

(21b) $$\text{Adjusted Payroll Share} = (sh_w^{pr} - s_W^{of} sh_w)/[1-(sh_w - sh_w^{pr})] .$$

Inclusion of officers' compensation in surplus income may not be sufficient. In private communication Solow[6] argues that surplus income is routinely 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: Dynamics of Labor Share and Firms' Pricing 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
1990	0.56	5.88	0.170	2003	0.55	5.50	0.182
1991	0.55	5.76	0.174	2004	0.54	5.13	0.195
1992	0.55	5.68	0.176	2005	0.53	4.86	0.206
1993	0.55	5.52	0.181	2006	0.53	4.71	0.212
1994	0.53	4.94	0.202	2007	0.53	4.74	0.211
1995	0.53	4.80	0.208	2008	0.53	4.84	0.207
1996	0.53	4.74	0.211	2009	0.53	4.69	0.213
1997	0.53	4.80	0.208	2010	0.52	4.62	0.216
1998	0.54	4.97	0.201	2011	0.52	4.44	0.225
1999	0.54	4.99	0.200	2012	0.51	4.24	0.236
2000	0.55	5.55	0.180	2013	0.51	4.26	0.235
2001	0.55	5.76	0.174	2014	0.51	4.23	0.236
2002	0.55	5.66	0.177	2015	0.52	4.36	0.229

Table 4 reports our computed payroll labor share 1990-2015 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 θ_t=5.88 in 1990 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

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

use bonuses and stock options to compensate other employees besides officers.

We now have two quantitative descriptions of an important conclusions: pricing power of firms increased from 1970 to 2015, demonstrated by the rising proportion of surplus in Figures 1-3 and by falling labor share in Table 4. We thus write from now on θ_t instead of θ and this dynamic change is very important. In 2015 the share of monopoly rent in output of the non-financial corporate sector (about half of GNP) is 23%. But this share *is exactly the percentage by which the wage rate and capital rent are below their competitive levels.* But, although this wage is significantly low, we also find that the dynamics of wages is sluggish since, as seen in Appendix A, θ_t=6.35 in 1980 which is in conflict with the absence surplus wealth in 1980 as seen in Figure 1. The slow decline of labor share after 1990 also implies (see Table 4) relatively too slow rise of estimated monopoly power from 1990 to 2015. The decline is "too slow" since Figure 1 shows that total surplus was close to 0 around 1987 which implies θ_t should take large values. For this reason the next section will estimate monopoly surplus income via the alternative "profit share approach" rather the labor share.

3.3b Distribution of income II: the profits share approach

The implication of (20) is that $\frac{1}{\theta_t}Y_tP_t + fk_t\alpha\frac{\theta_t - 1}{\theta_t}Y_tP_t$ 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. Output value is defined by Y_tP_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 earlier, are the amounts the firm uses to protect its market power. We thus define

(22a) $\quad (\text{Net Profits})_t = \frac{1}{\theta_t}Y_tP_t + fk_t\alpha\frac{\theta_t - 1}{\theta_t}Y_tP_t$ - (Officers salaries)$_t$ - (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 as reported by the IRS was used before 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

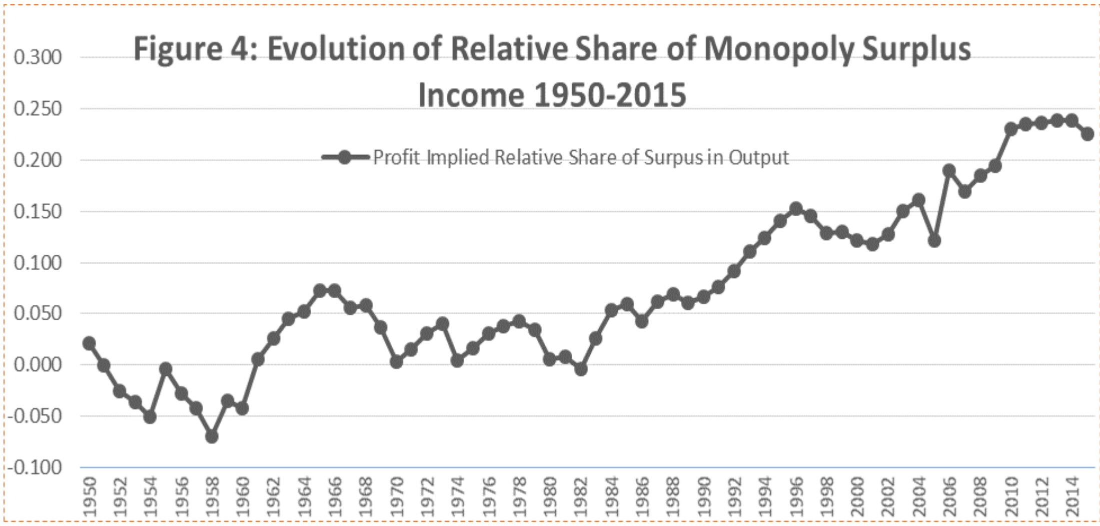
Year	Computed θ_t	Implied Share of Surplus Income	Year	Computed θ_t	Implied Share of Surplus Income
1986	23.675	0.042	2001	8.484	0.118
1987	16.179	0.062	2002	7.806	0.128
1988	14.591	0.069	2003	6.626	0.151
1989	16.610	0.060	2004	6.207	0.161
1990	15.005	0.067	2005	8.262	0.121
1991	13.074	0.076	2006	5.254	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 much sharper rise in monopoly pricing power from 23.675 in 1986 to 4.424 in 2015 with a corresponding rise of surplus relative share from 4.2% in 1986 to 22.6% in 2015. It is rather interesting that the results deduced from labor share and profit share are very close in recent years but very different in earlier years and we comment on this point later. The important fact to note is that we have *three* estimates of the share of monopoly income in output: one deduced from surplus wealth in 2.4c, the second from relative labor share in 3.3a and the third used the profit share approach in this section. Although these used different approaches and different data sources, we have the remarkable result that the three estimates are in the narrow range of 21%-23%. This same value is also close to Solow's (2017) estimate in the cited note.

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 evolution of the share of surplus income in value added of non-financial corporate sector for the entire period of 1950-2015. It shows that the share of surplus income was zero during 1970 - 1982 and then rose to high of 23.9% in 2014. But it also shows that this share was practically zero during 1950 - 1962 and rose to a high of 7.3% in 1965 before falling back to zero in 1970. These results show that monopoly pricing power rose significantly in the 1960's but they are consistent with the results in

[7] Series used in these computations are then: Gross value added-FA106902501.A; Taxes on production and imports - FA106240101.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.

Figure 1 that shows a sustained rise of (surplus wealth)/(market value) after 1882, reaching 79% in 2015 but also the positive surplus in 1962- 1970 when the (surplus wealth)/(market value) reached a high value of 32% in 1965 for non-financial corporate business. Although results based on asset prices exhibit high volatility of surplus value, the consistency between Figure 1 and Figure 4 is encouraging.



We now return to the difference between results deduced from labor share and those from profit share for the earlier years. Although Table 4 shows labor share is below its competitive level in 2015, it also shows it is low even in 1986 when surplus wealth is actually close to zero. Table 5 confirms this last fact and shows that surplus income share is indeed only 4.2% in 1986. Therefore, the results in Table 5, deduced from profit share, are consistent with all surplus wealth results in Figures 1-3 but is inconsistent with results in Table 4 for earlier years. The low 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 even 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. Hence, apart from rising monopoly power, other factors had an impact on the dynamics of wages and labor share which are not examined here.

Has the process of falling relative share of labor and rising surplus/wealth ratio run its course and come to an end? Relative labor share rose in 2015 but this is to be expected due to recovery from the Great Recession. As to the surplus/(market value) or surplus/wealth, Table 6 reports this last ratio for the non-financial Compustat samples in 1990-2015. During 2008-2015 we include the liquid assets held abroad as reported by Whalen and McCoy (2016). Rising stock prices lifted the surplus to excessive levels in the boom years of 1996-2000, while falling stock prices depressed the surplus in 2008-2011. Accounting for these factors we conclude that Tables 4, 5 and 6 offer similar views: up to 2015 we do not find compelling evidence in support of the hypothesis that the fall in relative labor share and the rise of surplus/wealth have come to an end.

Table 6: (Surplus Wealth)/(Total Wealth) of the Non-financial Corporate Sector, 1990-2015

Year	Non-financials (surplus/wealth)	Year	Non-financials (surplus/wealth)
1990	0.03	2003	0.40
1991	0.16	2004	0.40
1992	0.23	2005	0.39
1993	0.28	2006	0.41
1994	0.25	2007	0.40
1995	0.33	2008	0.35
1996	0.38	2009	0.45
1997	0.42	2010	0.47
1998	0.46	2011	0.45
1999	0.52	2012	0.47
2000	0.50	2013	0.50
2001	0.44	2014	0.52
2002	0.36	2015	0.52

3.3c Effects on the Natural Rate and Gap Between Wages and Output per Hour

We first rewrite the first order conditions (17d)-(17e) to permit the decline in θ_t

$$\frac{W_t}{P_t} = \vartheta_t^{\star}\frac{(\theta_t - 1)}{\theta_t}(1-\alpha)\Psi_t(K_{jt})^{\alpha}N_{jt}^{-\alpha} \quad , \qquad \frac{R_t}{P_t} = \vartheta_t^{\star}\frac{(\theta_t - 1)}{\theta_t}\alpha\Psi_t(K_{jt})^{\alpha-1}N_{jt}^{1-\alpha} .$$

Since $\frac{d((\theta_t - 1)/\theta_t)}{dt} = \dot{\theta}_t/\theta_t^2 < 0$ the real wage and the rental rate on capital have encountered two conflicting pressures: $d(\vartheta_t^{\star}\Psi_t)/dt > 0$ and $\dot{\theta}_t < 0$. It is easy to see that $\frac{R_t}{P_t} = r_t + \delta$ hence any pressure on the rental rate of capital has the effect to pressure the natural interest rate.

Interest rates are clearly altered by many factors such as productivity, international economic forces and policy. However, our model suggests the natural rate has been under added pressure of the rising pricing power which, by lowering $r_t + \delta$, contributed to lowering the natural rate to zero after 2008. To illustrate this effect in 2015, assume $\delta = 3.2\%$ (the BEA estimates, see McGrattan (1996)) and assume a natural real rate in the early 1970's of 2% thus avoiding a judgment of the equilibrium short rate in 1974. A 20% reduction in the 2015 value of $r_t + \delta$ must fall on the natural rate and amounts to (0.20)(5.2)= 1.04%. Hence, monopoly power reduces the natural rate from 2.0% to 0.96% which is significant. In addition, the ceteris paribus assumption implicit in this discussion obscures an effect that could be significant. We compare 1974 with 2015 during which things are not equal and the accumulation of a large surplus could have had a large secondary effects, particularly on the interest rate. As wealth grows in concentrated hands, a desire for diversification increases demand for riskless investments and this puts an added downward pressure on the interest rate, but this time from the lending side. This interaction between the surplus and the interest rate requires a separate formal analysis however, our comments do not consist a critique of work on the natural rate such as Holston et. al. (2016); it merely points out the existence of another factor implied by our theory.

Turning now 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

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

hence we can see that

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

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 $(W_{t_0}/P_{t_0})=(Y_{t_0}/N_{t_0}) = 100$ 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.

3.4 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

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

We illustrate the impact of this factor in Table 7 for 1990-2015 using the results in Table 5. Equation (23) 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 while in recoveries, when output grows faster than capital, standard productivity measure is biased downward**.**

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

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 the magnitude of this error increased with time (sine θ_t declined and became more important) so that over 200-2015 the mean error was 0.2251. The error was large during the sharp fall of output 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

The IT revolution has brought about improvements in living standards and its great technical achievements enjoy a very high level of consumer and political support. However, these sources of social benefits are also the cause of social losses and rising inequality that threatens the foudation of our democratic socieity. The uniqueness of this study is that it focuses on the effect of technological change on efficiency and distribution and although we show modern developments in IT enabled higher barriers to entry, rising market concentration and increasing monopoly power of firms, we have avoided a policy evaluation. Yet, although these developments enjoy substantial public popularity, it is only a matter of time before we shall need to debate the appropriate public policy in response to the social changes we face. To illustrate the need for some urgency consider the exmple of social networks. These are, in fact, privately owned public utilities. Subversive and terrorist groups have used the internet and social networks for coordinating their activities and these social networks have been a key tool for spreading rumors and conspiracy theories or, more generally, for the proliferation of "fake news." These are national security problems and are challenges to the proper functioning of an informative press in a Democracy. The question we face is who should make the decisions on how to respond to these problems? Today it is entirely up to the private firms who own these channels to formulate good public policy decisions. This is not likely to remain a satisfactory solution.

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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.

Individual files 1950-2015 will be available as Appendix B 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 1000 firms in the 1950's, exceeding 3000 in 1970 and rising further afterwards.

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/Market 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	3319521.03	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	14642876.42	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	18645872.8	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/wea lth	Cash Holdings Abroad	Non Financials Surplus Plus Foreign Holdings	Non Financial s Adjusted Surplus/ wealth	Growth Rate of Real Non Financials Wealth	Non Financials Wealth in 2015 prices	Our Adjuste d 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