Evidence on Inequality: Facts and Figures

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Introduction

Both in the policy world and the macroeconomics literature, increasing focus has been placed on the topic of inequality, be it in the realm of wealth, income, or opportunity. In this report, we promote this focus by highlighting some key facts pertaining to wealth concentration and income inequality, as well as the links of these topics to the macroeconomic forces of recessions, population dynamics, and technology. We first examine a popular theoretical understanding of the distribution of wealth using data from the United States. Second, we investigate how wealth concentration changed during the Great Recession. Third, we turn to inequality in income and compare inequality as measured by the Gini Coefficient to share of labor compensation in GDP across developed countries. Finally, to dive deeper into the drivers of income inequality, we will look into wages, output, and employment divided by high-tech and non-high-tech industries.

Keeping up with the Jones (2015)

Fact #1: While the Jones (2015) wealth distribution Pareto tail parameter has decreased over the past 35 years, the share of wealth held at the top percentile of the wealth distribution has increased — the opposite of what is implied by a Pareto distribution.

It has been broadly observed that wealth among the well-endowed is distributed Pareto with tail parameter η. Mathematically, since we have a proportion of people with wealth a greater than any level z of

$$\mathbb{P}(a > z) \propto z^{-\frac{1}{\eta}},$$

we expect the degree of concentration of wealth at the upper echelons of the wealth distribution to generally co-move with η — that is, with larger η, we should expect the share of wealth going to the very top to increase. Likewise, with smaller η, we should expect the share of wealth going to the very top to decrease.

The determinants of the tail parameter η have been subject to serious contention. Indeed, while Piketty (2015) suggests that much of the evolution of η (and thus the distribution of wealth) is governed by the growing disparity between interest rates and the rate of economic growth alongside shrinking population growth rates, Jones (2015) negates this notion, asserting instead that the parameter is best expressed as a function

of only population growth and death rates. More precisely, we have

$$\eta = \frac{n}{n+d},$$

where n is the net population growth rate and d is a constant annual probability of death across the population.

In doing so, Jones suggests that Piketty's function of interest rates, growth, and wealth consumption is held constant by exogenous factors, and that the income and substitution effects of adjustments to taxes on wealth cancel each other out to disarm the policy instrument, simplifying to a satisfying and parsimonious result.

Observing the evolution of the Jones (2015) parameter empirically, however, yields a less satisfying result. For all years 1990-2015, figure (1) maps both the tail parameter η suggested by Jones (2015), computed directly using the annual US population growth rate released by FRED[1] and the US crude population death rate released by the UN[2], alongside the share of US wealth belonging to the top percentile of wealth owners as released by FRED[3].

Surprisingly, the tail parameter and the degree of concentration of wealth at the upper end of the distribution seem to move in opposite directions over the 35-year period, calling into question the validity of the tail parameter governing the wealth distribution.

In fact, given the Pareto distribution of wealth at the top, we can use the tail parameter η to compute the share of wealth owned by the top percentile implied by Jones (2015). Note simply that this share is given by $100^{\eta-1}$. The implied share is mapped against the actual share in figure 2. Once again, we see that the implications of the parameter are not reflected in the data. The disparity in the two curves may be cause for a reevaluation of the Jones (2015) result.

Our theoretical understanding of what governs the distribution of wealth has serious policy consequences. Indeed, if Jones (2015) is wrong in concluding that wealth taxes have little impact on the share of wealth going to the top percentile, then the focus on wealth taxation made apparent in the circles of US Democratic presidential candidates may be justified. At the very least, the importance of a wealth tax should not necessarily

[1]World Bank, Population Growth for the United States [SPPOPGROWUSA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/SPPOPGROWUSA.

[2]United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

[3]Board of Governors of the Federal Reserve System (US), Share of Total Net Worth Held by the Top 1% (99th to 100th Wealth Percentiles) [WFRBST01134], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/WFRBST01134.

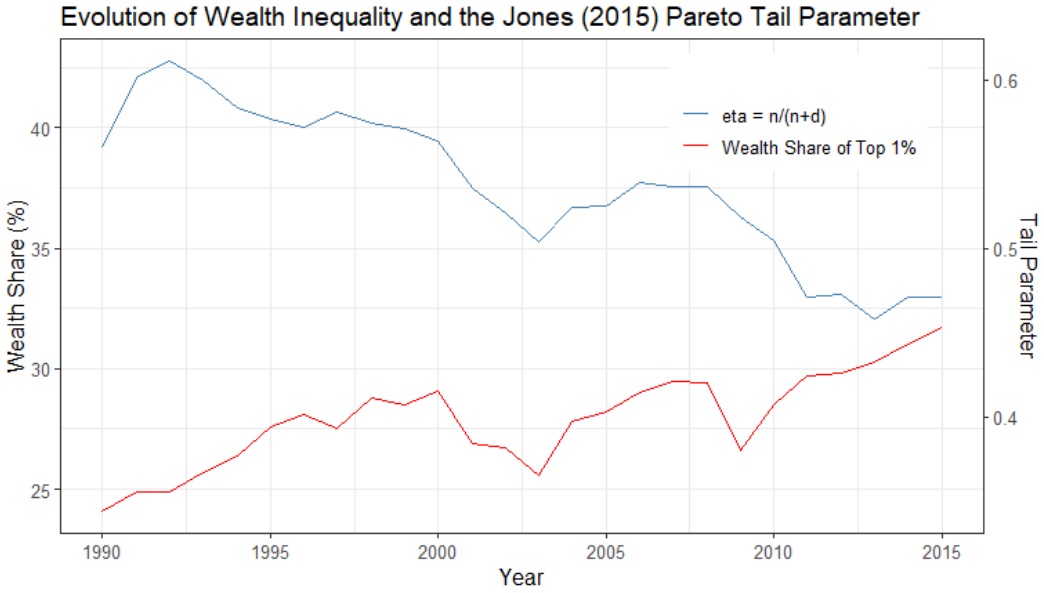

Figure 1: Movement in the share of wealth owned by the top percentile is mapped against the evolution of the Jones (2015) tail parameter, showing opposite trends.

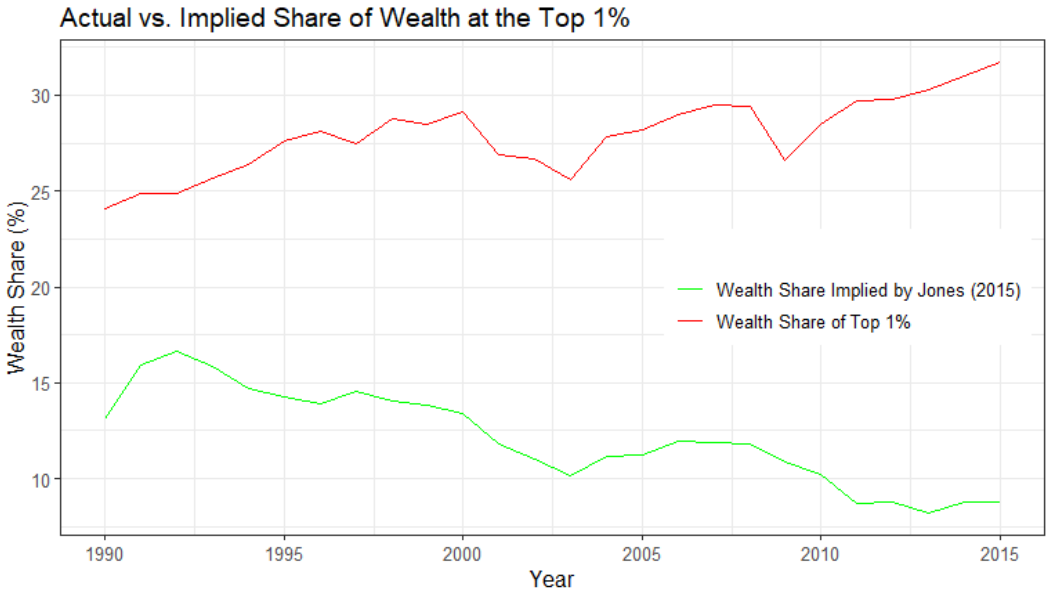

Figure 2: The evolution of the share of wealth owned by the top percentile in the US is mapped against the share implied by the Pareto distribution given the Jones (2015) tail parameter.

be dismissed in policy discourse.

Wealth Inequality and the Great Recession

Fact #2: The bottom 50% of households suffered higher losses in net worth[4] during the period of the Great Recession than the top 10% of households, further deepening the divide in wealth inequality relative to before.

Before we explore changes in wealth caused by the Great Recession, we first turn to figure 3, which shows the proportion of total wealth in the U.S. held by different wealth groups from 1990 to 2018. Each wealth group is defined as follows: "Top 1" (above the 99th percentile), "Next9" (99-90th percentile), "Next40" (90-50th percentile), and the "Bottom50" (50th percentile).

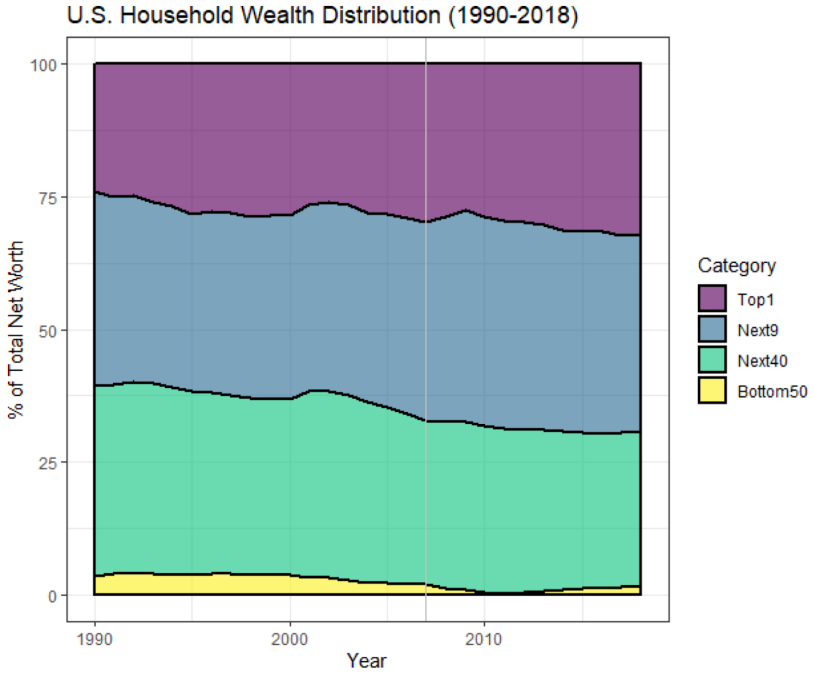

Figure 3: A decomposition of US wealth by wealth percentiles.

In general, the wealth share, which is the percentage of total wealth, has grown for the top 10% ("Top1" + "Next 9") from 60.6% in 1990 to 69.4% in 2018. In contrast, the bottom 90% ("Next 40" + "Bottom 50") has experienced a decline in wealth share from 39.4% in 1990 to 30.6% in 2018.[5]

Further, in figure 3, the grey vertical line represents an approximate start of the Great

[4]"Net worth" is the sole measure of household wealth based on the composition of assets less liabilities as outlined in the B.101.h Balance Sheet of Households located on the Federal Reserve Bank of St. Louis website.

[5]"Quarterly:B.101.h Balance Sheet of Households." FRED, Federal Reserve Bank of St. Louis

Recession at the end of 2007. In particular, for the bottom 50% (yellow area), there is a visible dip in wealth share immediately after the start of the Great Recession and appears to approach 0% wealth share. Therefore, we investigate how net worth varied immediately after the start of the Great Recession for the bottom 50% in comparison to the top 10% of households.

In figures 4 and 5, we compare net worth ($M) across the same time period (1990-2018) for the top 10% and bottom 50% of households, respectively.

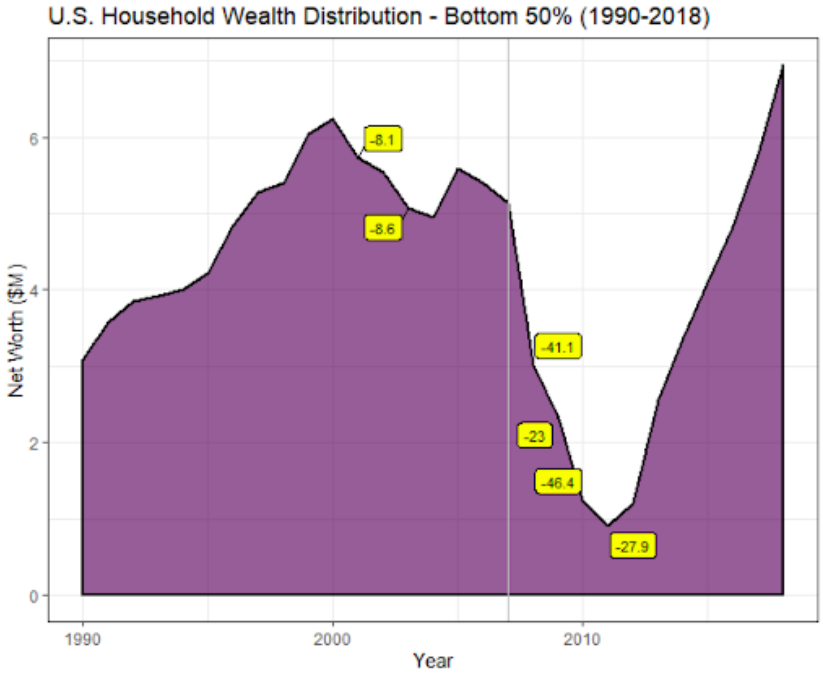

Figure 4: The evolution of the wealth held by the bottom half of the wealth distribution.

In figure 5, shortly after the start of the Great Recession, net worth declined by 6.7% from 2007 to 2008 and continued to decrease from 2008 to 2009 by 5.4%. However, after 2009, net worth rebounded with positive increases in wealth up until 2018.[6]

In contrast, figure 4 tells a significantly more dismal story for the bottom 50% after the start of the Great Recession. For the bottom 50% of households, net worth plunged, first with a decrease of 41.1% from 2007 to 2008 and another notable decline from 2009 to 2010 of 46.4%. The bottom 50% of households only began to recover in terms of positive net worth percentage growth from 2011 onward. The stark contrast in how the Great Recession affected net worth for the top 10% and the bottom 50% is largely influenced by a difference in the composition of assets between these two groups of households. For

[6]"Quarterly:B.101.h Balance Sheet of Households." FRED, Federal Reserve Bank of St. Louis

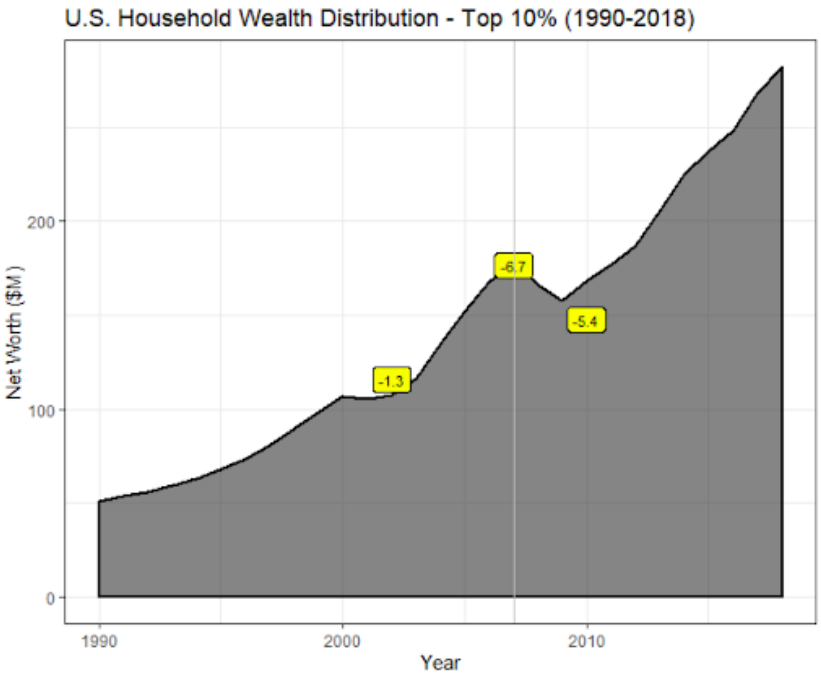

Figure 5: The evolution of the wealth held by the top 10% of the wealth distribution.

example, from 2007 to 2011, the bottom 50% of households on average held 57% of total assets in real estate followed by consumer durables at 20% and pension entitlements at 10%. Given the same time frame, the top 10% of households held a significantly smaller percentage in real estate, owning an average of only 19% of total assets, followed by categories such as equities and pension entitlements. In fact, from 2007 to 2011, home prices as measured by the U.S. National Home Price Index fell 22.6%.[7]

Given that the Great Recession led to severely depressed housing prices, the bottom 50% of households were "hit the hardest" given the lack of diversification in assets. The massive dent that the recession left unequally on the bottom half of Americans further continues to widen the wealth inequality gap. This key channel for inequality derived from the financial crisis contributes to the growing need for an analysis of what policy measures should be taken to correct for macroeconomic shocks as we recover from the recession, as well as the urgency for focus on wealth dynamics as we fall into future financial and economic crises.

[7]S&P/Case-Shiller U.S. National Home Price Index

Income Inequality and Labor

Fact #3: Labor Share and inequality are negatively correlated in cross sectional data across countries and in time series plots within countries.

Figure 6: A cross-country mapping of Gini indices to labor shares of GDP.

Figure 6 illustrates the share of labor compensation plotted against the Gini index for 32 Organizations for Economic Co-operation and Development (OECD) countries in 2010[8]. Four countries (Chile, Japan, New Zealand, and South Korea) were omitted due to lack of data for the year shown. Labor share[9] represents the amount of Gross Domestic Product (GDP) paid to laborers, as opposed to its counterpart- capital share. Figure 6 also shows the trend of interest is that when the share of labor compensation in GPD declines, the Gini index increases. The Gini index is a way to measure income and consumption inequality in a region, in this case, each country. The index measures deviation from perfect equality, thus higher measurements indicate greater inequality in that country. The graph conveys a negative correlation between labor share and Gini index. As the labor share declines, more money from GDP is directed to owners of

[8]World Bank, GINI Index for each country, retrieved from FRED, Federal Reserve Bank of St. Louis; e.g. https://fred.stlouisfed.org/series/SIPOVGINIUSA.

[9]University of Groningen and University of California, Davis, Share of Labour Compensation in GDP at Current National Prices for each country, retrieved from FRED, Federal Reserve Bank of St. Louis; e.g. https://fred.stlouisfed.org/series/LABSHPUSA156NRUG.

capital who continue to have capital gains and capital income as large proportions of their ever-growing income levels.

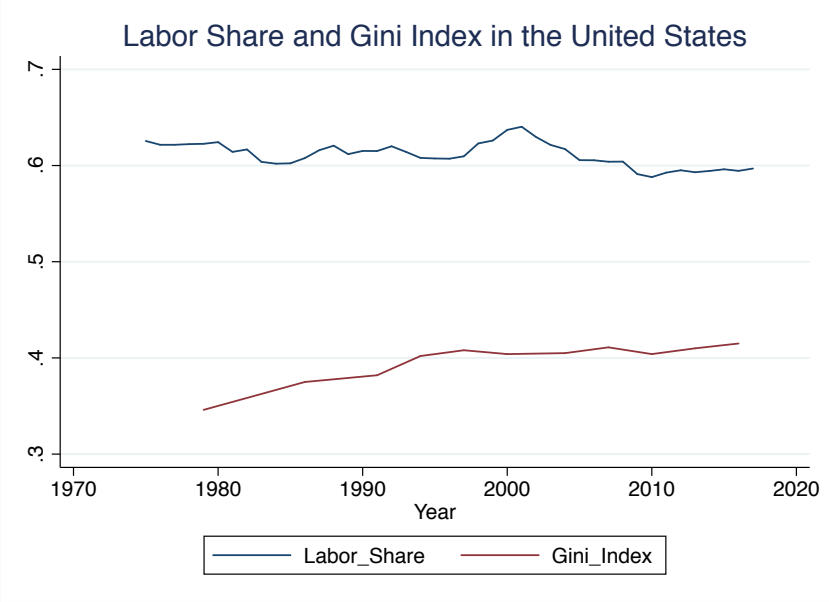

Figure 7: Movement in the labor share of income and Gini index in the US over time.

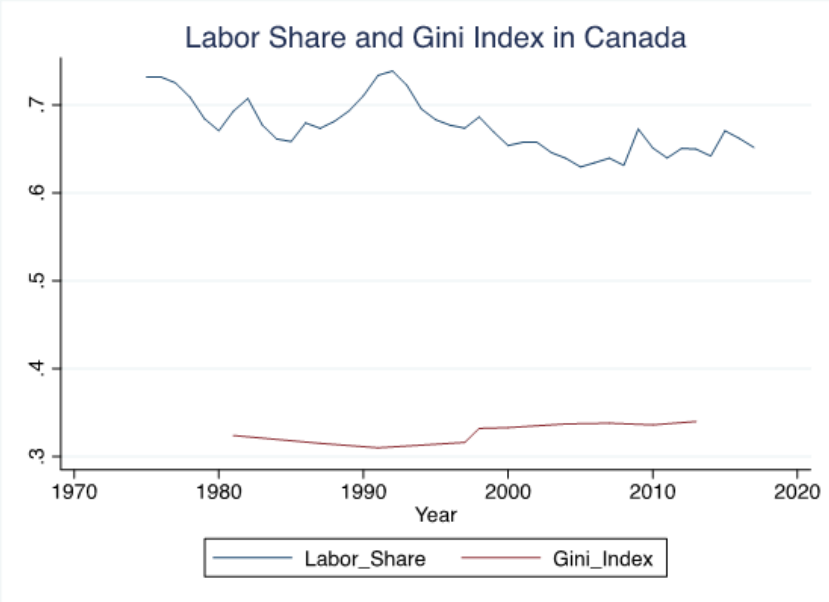

Figure 8: Movement in the labor share of income and Gini index in Canada over time.

Figures 7 and 8 show the dynamic relationship between labor share and Gini index in the United States and Canada respectively. In these graphs, the Gini index was scaled down by a factor of 100 to illustrate the variables on the same scale. Data from the Federal Reserve Economic Data (FRED) on labor share and Gini index was downloaded and imported to STATA in order to establish a time series relationship with year as the time variable[10] [11]. The line plot graphic was then utilized to portray the relationship seen here. Both show an overarching negative correlation between the two variables which aligns with the cross-sectional trend depicted in Figure 1. The narrative to go along with this relationship is outlined below.

One cause of growing inequality is increasing technology levels. This has two main effects on the labor force: first, it enables automation, second, skill biased technological change (SBTC) favors the highly-skilled. Since the productivity of labor dictates the wage of employees, and SBTC complements the duties of the highly skilled, they benefit more from this development. Highly-skilled workers are more likely to use the technology improvements such as IT developments in the workplace which increases their productivity and hence, wage. Abel and Deitz (2012) show that wage growth for high-skilled jobs has been the main force driving the increasing wage gap between jobs across skill levels in the United States.

In the case of middle-skilled workers, these technological improvements can help too much. Middle-skilled workers who perform routine jobs are easily replaceable with a machine or computer. This automation decreases labor share, increases capital share and increases inequality. Replaced middle-skilled workers are faced with two options in response: become highly skilled through education or become employed in jobs suitable for lower-skilled workers. Tüzemen and Willis (2013) find that men and women respond to this choice differently. Women have chosen to go back for additional schooling more so than men who have seen a more equal split between increased education and a shift into low-skill jobs. Regardless of which option these workers choose, job polarization, the phenomenon of a decline in middle-skill jobs in favor for the two opposite ends, creates a situation with more people located on the extreme ends of the income distribution. An economy facing a declining middle-skill labor force will see increasing inequality as seen in the graph. Understanding the forces behind this job polarization and increasing

[10]World Bank, GINI Index for each country, retrieved from FRED, Federal Reserve Bank of St. Louis; e.g. https://fred.stlouisfed.org/series/SIPOVGINIUSA.

[11]University of Groningen and University of California, Davis, Share of Labour Compensation in GDP at Current National Prices for each country, retrieved from FRED, Federal Reserve Bank of St. Louis; e.g. https://fred.stlouisfed.org/series/LABSHPUSA156NRUG.

inequality will be key to preparing an appropriate and effective policy response.

Skills, Education, and the Determinants of Inequality

Fact #4: The share of the labor force employed in STEM roles was 9.9% in 2016 and has remained stagnant since 2002, while the share of total US output attributed to STEM (High-tech industry) was 18.2% in 2016 and has hovered around that number since 2002.

Fact #5: The median wage for STEM roles is more than double the median wage for Non-STEM roles as of 2016.

To start, we segregated high-skilled and non-high-skilled workers based on technology. That is, we defined a high-skilled worker as a worker in a STEM role and a non-high-skilled worker as a worker in a Non-STEM role. We will refer to these as high-tech workers and non-high-tech workers respectively. Figure 9 shows the share of workers employed in high-tech roles since 1996[12].

Figure 9 also shows the share of total US output generated from high-tech industries (i.e. workers) since 1996. Figure 10 compares the median wage for a high-tech worker and a non-high-tech worker in 2016.

First, we note that since the end of the dot-com bubble in 2002, the tech industry has remained astonishingly stable and resilient within the broader economy. According to the Roberts and Wolf (2018), during the Great Recession the US economy lost 7.5 million jobs, whereas the tech industry lost 48,000. This is significant because maintaining consistent earnings builds long-term wealth. A large portion of high-tech workers maintaining earnings (and savings), while a large swath of non-high-tech workers temporarily stop savings increases income inequality in the short-run. Second, we note that 10% of the labor force is earning more than double the other 90%, per figure 10. Given that this 10% of workers is generating 20% of total US output, it is understandable that they are compensated more. What is significant is that this 20% of total output is being concentrated on a minority set of workers and the owners of their output. This further drives a wedge in wealth shares, as those in high-tech roles/industries capture a large portion of value creation as measured by total US output.

[12]Data from Brian Roberts and Michael Wolf, "High-tech industries: an analysis of employment, wages, and output," Beyond the Numbers: Employment Unemployment, vol. 7, no. 7 (U.S. Bureau of Labor Statistics, May 2018)

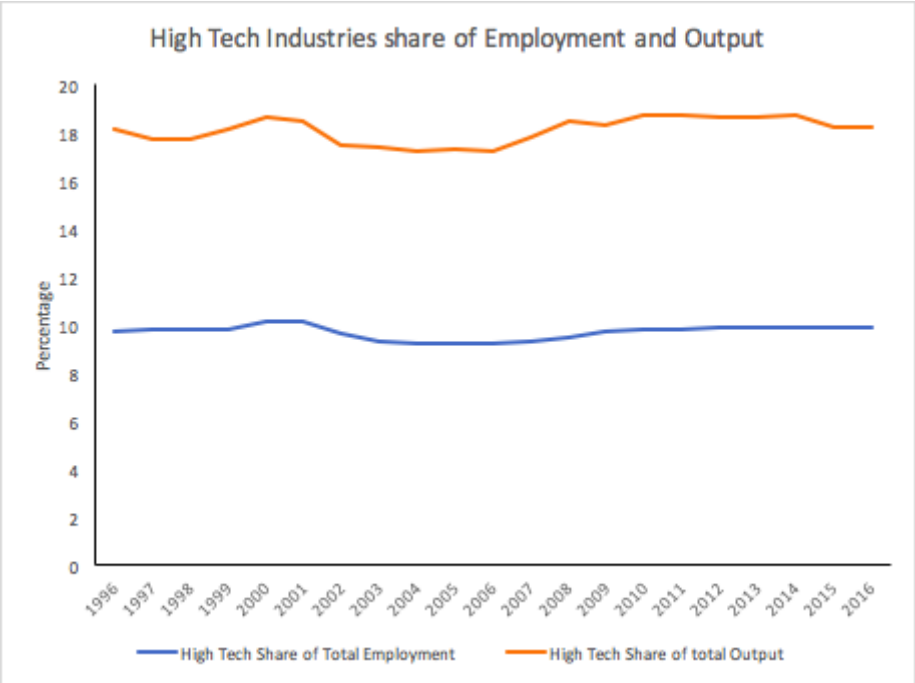

Figure 9: Tracking the evolution of employment and output in high-technology industries as a share of aggregate outcomes in the US.

Occupations	High-tech industries	Non-high-tech industries	% Difference
Total, all occupations surveyed by BLS	$70,230	$34,800	101.8
Business and financial operations	$131,410	$92,220	42.5
Computer and mathematical	$76,550	$62,580	22.3
Architecture and engineering	$89,450	$74,150	20.6
Life, physical, and social science	$81,900	$71,640	14.3
Production	$40,920	$32,260	19.1
Transportation and material moving	$39,890	$30,570	38.9

Figure 10: Wage Premia in High-Tech and Non-High-Tech Industries for selected Occupations

Given these observations, we may conclude that the universes of education, technological growth, and inequality are deeply intertwined. Consequently, we see a significant potential impact of both institutional and individual choices over educational and technological investment on the distribution of income. The interlinkage of these forces could be a potential focus for policies addressing and combating inequality in the future as well.

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