Income Polarization of the U.S. Working Class: An Institutionalist View

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Abstract: The paper provides an institutional insight into the trend of income polarization of the U.S. working class. In contrast to the previous industrial waves, the current and ongoing industrial revolution is characterized by the replacement of "creative destruction" with jobless growth. Instead of replacing the lost jobs with new ones, new disruptive technologies eliminate more jobs in traditional labour- and capital-intensive sectors than create jobs in new idea-intensive sectors. By examining the relationship between the income share of the bottom 50%, the middle 40% and the top 10% and technological progress, we obtain robust econometric results according to which the income polarization of U.S. workers can be associated with the shift of R&D activities from the public to corporate sector. The concentration of innovations by corporate capital limits the power of society to reduce inequality and provide greater social stability through "the incredible productivity" of technological progress.

Keywords: institutional theory of distribution, income polarization, working class, technological progress
JEL: B52, D63, O33, O38

Since the 1980's, the United States has been faced with the shrinking of its middle class. Although there is no consensus on the key force behind this downward trend, it is clear that the worsening of income distribution is a result of the interaction of a number of factors and that the influence of technological progress cannot be omitted. The impacts of technological progress on income distribution, however, is a controversial issue, since the benefits from innovation are not evenly distributed through society.

In this light, our aim in this paper is to point out the importance of considering the dynamics of private and public Research and Development (R&D) investment to understand the distributional effects of innovation better. That income polarization is related to public/private control on innovation should not come as a surprise: corporate capital and government do not have the same view on innovation. Taking into account these differences, the increasing concentration of innovation by the corporate sector should be considered as a factor that contributes to the income polarization of the U.S. working class.

Literature review

Efforts to explain parallel dynamics between income inequality and technological progress in the United States have resulted in an enormous and growing body of research. The dominant framing of the relationship between innovation and income distribution is the Skill Biased Technological Change hypothesis (SBTC), which argues that ongoing technological change is biased towards skilled workers, replaces tasks previously performed by unskilled workers and exacerbates income inequality (for overviews, see Katz 1999; Acemoglu 2002; Goldin and Katz 2009; Acemoglu and Autor 2011).

Although SBTC has been successful in explaining many decades of the dynamics behind inequality in the United States, SBTC not provide an explanation for the recent phenomenon of income polarization (Acemoglu and Autor 2011; Goos, Manning and Salomons 2014). Handel (2004) argues that SBTC is controversial because a large role in increasing income inequality are institutional factors, which are different than demand shifts in favor of educated workers or a shortage of human capital. The critique of conventional approaches to distribution issues reinforced the institutionalist perspective on income distribution, which emphasizes that the explanation for income polarization must involve institutional arrangements and power relationships. In contrast to the conventional theories of distribution, which focus mainly on functional income distribution, the institutionalist approach is more concerned with personal income distribution (Park 1996).

The basic institutionalist premise is that a distribution of income is not a natural and automatic outcome of market forces alone (Peach 1987). Income distribution stems from the way in which markets are instituted (Clark and Kavanagh 1996). Given the inseparability of distributive mechanisms from institutions, Brown (2005) argues that distribution is an instituted process. Income distribution is affected by institutional arrangements (Gordon 1973), which are in turn determined by conscious decisions of person with the power and position to do so (Peach 1987). In this tradition, Park (1996) claims that income distribution is determined by institutional arrangements, which also include power relationships in the society. Since power is a decisive factor in accounting for disparities, a theory of distribution should be indistinguishable from a theory of power (Brown 2005). Power is both a cause and effect of the distribution of income (Peach 1987). Today, power is shifting from the state to corporate giants (Loescher 1979), so that the corporate sector gains power over distributional arrangements (Peach 1987).

To make the institutionalist perspective on distributional issues persuasive requires a theoretical restatement, going beyond the usual appeal to institutions, politics, and history, as well as an empirical substantiation that is capable of accounting for the movement of inequality through time and in different national settings (Galbraith 2001). As our contribution to the existing literature, we attempt, from an

institutionalist perspective, to shed more light on the relationship between the concentration of innovation by the corporate sector and the income polarization of the U.S. working class.

Conceptual Framework and Stylized Facts

Thanks to innovation, modern industrial society is characterized by what Veblen called "the incredible productivity", but the possibility of a "society of abundance" is constrained by business institutions of capitalism (Peach 1987, 2003). The contribution of innovation to the welfare of a particular income class depends on the rate and the manner by which new processes and products diffuse throughout the economy. While innovation may lead to income polarization, the diffusion of innovation is generally associated with income compression. The diffusion of innovation is a complex process that is negatively associated with individualism and positively associated with collectivism (Meade and Islam 2006).

Society and corporate capital do not often share the same view on innovation. From a societal perspective, the emphasis is on the use of new technology whereas from the perspective of corporate capital, the emphasis is on the sale of new products. These differences are reflected in the different preferences of the society and corporate capital towards innovation. While the society prefers the diffusion of innovation, corporate capital shows a preference for monopolizing innovation.

Because of the growing interest of corporate capital in innovation, the ratio between private and public R&D investments has changed dramatically in the United States during the last three decades. Thus, in 1960 public expenditure on R&D was 2 times higher than private expenditure, in 1970 1.5 times, in 1980 public and private investment in R&D was approximately the same, whereas in 2014 private expenditure was 2.8 times that of the public sector (Bureau of Economic Analysis 2017). Consequently today, instead of the federal government operating as the main performer and funder of U.S. R&D, it is the corporate sector.

That private investment is growing faster than public investment in R&D, at the first glance, does not appear to be problematic. However, the technological dynamism of corporative capital is not only based on investment in R&D. As the period in which high profits are appropriated from innovations is shorted, corporative capital relies increasingly on lobbying the government (the extension of property rights, tax breaks or subsidies, for example) to keep a leading position and it relies on the acquisition of startups to develop new technologies.

Less public and more private investment in R&D has a strong impact on composition of R&D. Corporate capital is less interested in basic research and more focused on applied research and

development[1]. Less R and more D in R&D means that corporate capital shifts away from the creation of new processes and products and more toward the commercialization and protection of existing knowledge (Arora, Belenzon and Patacconi 2015).

Routinization and codification of production processes, as a feature of the current and ongoing industrial revolution, are the most obvious for the jobs performed by the middle-class workers. The negative effects of innovation on the working class are enhanced by the concentration on innovation by corporate sector. The high profits of new idea-intensive sectors are not translated into jobs as it was/is the case with traditional labour- and capital- intensive sectors[2]. Instead to investing huge profits, U.S. companies, which are considered to be innovation pioneers, are sitting on huge cash piles, replacing creative destruction with jobless growth.

The result of these processes is a gradual income polarization of U.S. workers (i.e. the reduction of the middle class in a way that workers are being concentrated at the lower and the upper end of income distribution). Since the jobs at the lower end of the U.S. income distribution are more labor intensive compared to the jobs at the upper end of income distribution, income reallocation of the U.S. working class is manifested more in an increase in low-income employment than in high-income employment.

Method and Data

The conclusion that may be drawn from the above discussion is that technological progress is a driver of economic progress but its contribution to individual and social welfare is determined by the speed and manner by which innovation diffuses throughout the economy. To check this point of view, we define the hypothesis that the shift of R&D activities from the public to the private sector slows down the diffusion of innovation and contributes to income polarization of the U.S. working class.

The hypothesis is tested with SUR (Seemingly Unrelated Regression) techniques and the U.S. data from 1970 to 2014[3]. The SUR system is consisted of the three regressions, which differ depending on whether we look at the determinants of the top 10%, the middle 40% or the bottom 50% income share.

The baseline model is:

[1] For example, in 2013, 88% of development research in the United States was conducted and 81% funded by the business sector, while universities and colleges remain the largest performers of basic research with the federal government as the main funder (National Science Foundation 2016).

[2] For illustration, in 1990, market capitalization of the top three carmakers in Detroit was $36 billion and they employed 1.2 million workers. In 2014, market capitalization of the top three firms in Silicon Valley was over $1 trillion, but they has only 137,000 workers (The Economist 2016).

[3] Before the model estimation, we test the presence of unit root, heteroskedasticity, autocorrelation and the independence of the errors in the set of SUR equations. Details about the test results are available from the authors.

$$LogTOP10_t=\beta_0+\beta_1\ LogTFP_t+\beta_2 LogR\&DRATIO_t+\beta_3 LogTFP*R\&DRATIO_t+\beta_4 LogTAX_t+\beta_5 LogPOP_t+\beta_6 LogETI_t+\beta_7 LogGROWTH_t+e_t$$

$$LogMIDDLE40_t=\beta_0+\beta_1\ LogTFP_t+\beta_2 LogR\&DRATIO_t+\beta_3 LogTFP*R\&DRATIO_t+\beta_4 LogTAX_t+\beta_5 LogPOP_t+\beta_6 LogETI_t+\beta_7 LogGROWTH_t+\beta_8 LogCOLLEGE_t+e_t$$

$$LogBOTTOM50_t=\beta_0+\beta_1\ LogTFP_t+\beta_2 LogR\&DRATIO_t+\beta_3 LogTFP*R\&DRATIO_t+\beta_4 LogTAX_t+\beta_5 LogPOP_t+\beta_6 LogETI_t+\beta_7 LogGROWTH_t+\beta_8 LogHIGH_t+\beta_9 LogUNION_t+e_t$$

The dependent variables are: the top 10%, the middle 40% and the bottom 50% income share (*TOP10, MIDDLE40, BOTTOM50*). In all the equations, primary variables are: *TFP* = total factor productivity, as a measure for technological progress; *R&DRATIO* = the ratio of private/public R&D investment, as a proxy for private sector domination in innovations. The control variables in all the equations are: *POP* = population growth; *TAX* = highest marginal personal income tax rate; *ETI* = Employment Trends Index; *GROWTH* = real GDP growth. The specific control variable in the second equation is the percent of the population with tertiary education (*COLLEGE*). In the last equation, there are the two specific control variables: percent of population with secondary education (*HIGH*) and trade union density (*UNION*). Subscript t stands for time period while e_t is the idiosyncratic error term. Data sources, definitions, and descriptive statistics are given in Table 1.

Table 1

In line with the hypothesis, distributional effects of technological progress depend on rate by which innovations diffuse throughout the economy. To evaluate this assumption, we include in all equations the interaction term created by multiplying the technological progress variable by the private/public R&D investment ratio (*R&DRATIO*TFP*). If this interaction is statistically significant, the argument about the conditional effect of technological progress on income distribution gains support.

The data spans the period from 1970 to 2014. Instead of annual data, three-year averages of all variables are considered for the two reasons. First, it is not realistic to expect that annual changes in explanatory variables have annual effects on changes in income shares. Second, by using means, the influence of the economic cycles is reduced, so that we can focus more on structural relationships. The explanatory variables are included in the equations as measured at the start of each three-year period. In that way, we control for the delayed impact on the dependent variable and the potential problem of endogeneity caused by reverse causation.

Our results are confirmed by various robustness tests. First, we conduct the robustness test by using alternative measures for innovation (the growth of labor productivity) as a primary variable. Second, the

model is re-estimated without insignificant variables from the baseline model. Third, we re-estimate the model by excluding one control variable after another[4].

Results and Discussion

The obtained results are consistent with the expectations (Table 2). All the right-hand variables have the expected sign and are statistically significant, except for the employment trends index in the top 10% equation.

Table 2

Concerning the primary variables, technological progress has a positive impact on the top 10% income share, while in the case of the middle 40% and the bottom 50% income shares this impact is negative. The effect of innovations on the income shares of the respective income classes varies depending on private/public R&D investment ratio. The domination of private over public investment in R&D increases the positive effect of innovations on the income concentration for the top 10%, while for the bottom 50% and the middle 40% income shares, this conditional effect is negative.

Figure 1, 2 and 3

Figure 1, 2 and 3 show in more detail the effects of innovation on the distribution of total income to income classes depending on private/public R&D investment ratio. The relationship between innovations and the top income share is predominantly positive and this effect is being enhanced by shift in R&D investment towards the private sector. The opposite is true when we consider the influence of innovations on the bottom 50% and the middle 40% income shares. Faster growth of private investment in R&D than growth in public investment appears to have neutralized the initially positive impact of innovation on low and middle income earners.

The explanation is that the dominance of private over public sector on innovation increases wage and profit differential between sectors and between jobs. High wages and profits are concentrating in new sectors that are intensive in knowledge and innovation, but not in workers. The result is wage polarization between relatively small number of workers in new sectors and many workers in traditional capital- and labor-intensive sectors (Josifidis et al. 2016; Josifidis and Supic 2016).

In parallel with the polarization of workers between sectors, there is also a polarization of workers between jobs. Routine-intensive jobs become increasingly exposed to automation and reallocation (outsourcing and off-shoring), while at the same time the importance of jobs intensive in cognitive and non-

[4] To save space, the results of robustness tests are not reported here but will be made available by the authors upon request.

routine tasks is increasing. Compared with the earlier period, when less-qualified and industrial workers were predominately affected by automation, a new wave of digital disruption affects workers in service sectors as well as highly-skilled professions and managers.

Polarization of workers between sectors and jobs has an influence on the nature of distributional conflicts. Instead of functional income distribution, the focus of distributional conflicts is moving towards personal income distribution (Josifidis and Supic 2017). The evolution of top income inequality in the United States reveals that capital owners are being replaced by the working rich at the top on income hierarchy (DiPrete, Eirich and Pittinsky 2010; Bakija and Heim 2012; Saez 2015) and that this trend should partly be related to innovation (Aghion et al. 2016). Formal and informal networks among the working rich leads to new social polarization between a small number of highly educated, well connected, well-paid and flexible meritocratic elites, and countless other workers that are less specialized, less networked, and less flexible.

Conclusion

Despite "the incredible productivity" of innovations, the United States, as a leader in innovation, is faced with a shrinking working class. In explaining the forces behind this trend, we argued, inspired by the institutionalist tradition, that the shift of R&D activities from the public to the corporate sector plays a significant role. This change has an impact on R&D composition, the diffusion of innovation, and ultimately leads to the reduction of potential welfare gains for workers at the middle and the lower end of the U.S. income distribution.

The results, obtained by using the SUR regression on the U.S. sample from 1970 to 2014, suggests that the influence of technological progress on the top 10% income share is positive, while in the case of the middle 40% and the bottom 50% income shares this effect is negative. The analysis of conditional marginal effects shows that the impact of innovation on the distribution of total income among income classes depends on the private/public R&D investment ratio. The faster growth of private than public R&D investment can be associated with a worsening income distribution in a way that the concentration of the top income is increased, while the bottom 50% and the middle 40% income shares are reduced.

There are two implications of this finding that deserve attention. First, the negative distributional effects of innovation are the most pronounced in the case of the working class. Second, the concentration of innovations by the corporate sector increases the power and discretion of corporate capital over "the common man" and the state, which limits the power of society to reduce inequality and provide greater social stability through new distributional arrangements.

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Table 1. Description of Variables

Name	Source	Description	Obs.	Mean	Std. dev.	Min.	Max.
Bottom 50%	The world wealth and income database	The proportions of total income earned by the bottom 50%	45	34.16	3.35	29.47	39.69
Middle 40%	The world wealth and income database	The proportions of total income earned by the middle 40%	45	43.49	1.21	41.26	45.30
Top 10%	The world wealth and income database	The proportions of total income earned by the top 10%	45	22.35	2.22	19.05	25.79
Private/Public R&D	Bureau of Economic Analysis - R&D Satellite Account	Ratio: Private/Public investment in R&D	45	1.52	0.63	0.65	2.85
Top marginal income tax	Tax Policy Center Urban Institute & Brookings Institution	Historical highest marginal personal income tax rate	45	46.65	15.24	28	71.75
GDP growth	Total Economy Database - Output, Labor and Labor Productivity, 1950-2016	Growth of GDP, percent change	45	3.01	2.09	-2.59	7.57
Total factor productivity	Penn World Table 8.1	Total factor productivity at constant national prices (2011=1)	45	0.85	0.10	0.71	1.01
Population growth	Penn World Table 8.1	Population growth	45	1.02	0.16	0.75	1.40
Employment trends index	The Conference Board	The Conference Board employment trends index	42	90.84	24.78	53.60	129.69
Colleague	U.S. Census Bureau	Completed 4 years of college	45	21.91	6.04	11	32
High school	U.S. Census Bureau	Completed 4 years of high school	45	54.68	4.11	44.20	58.70
Union density	Comparative Political Data Set 1960-2015	Union density (net union membership as % of employees)	41	17.41	5.22	11.38	27.43
Labor productivity growth	Total Economy Database - Output, Labor and Labor Productivity, 1950-2016	Growth of labor productivity per person employed, percent change	45	1.65	1.19	-2.01	3.40

Table 2. Innovations and Income Shares, United States, 1970-2014, 3-Year Averages

	(1)	(2)	(3)
VARIABLES	**The Top 10%**	**The Middle 40%**	**The Bottom 50%**
Private/Public R&D	-0.534*	0.332***	0.797*
	(0.312)	(0.0919)	(0.453)
TFP	0.468**	-0.251***	-1.222***
	(0.217)	(0.0553)	(0.358)
Private/Public R&D* TFP	75.30***	-62.99***	-81.43**
	(26.92)	(9.969)	(39.95)
Tax	-0.0283***	0.0233***	0.0235*
	(0.00941)	(0.00283)	(0.0129)
Popul. Growth	-0.0933***	0.0565***	0.0912***
	(0.0206)	(0.00833)	(0.0287)
Empl. Trend	0.0124	0.128***	-0.212***
	(0.0489)	(0.0254)	(0.0791)
GDP Growth	-0.535***	-0.207***	1.578***
	(0.197)	(0.0703)	(0.343)
Colleague		0.267***	
		(0.0387)	
High School			-0.402***
			(0.118)
Union Density			0.275***
			(0.0648)
Constant	0.0227***	-0.00627***	-0.0305***
	(0.00505)	(0.00133)	(0.00734)
Observations	11	11	11
R-squared	0.86	0.91	0.81
McElroy R- squared		0.68	

Source: Authors' calculation

*Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Figure 1. The Impact of Technological Progress on the Top 10% Income Share

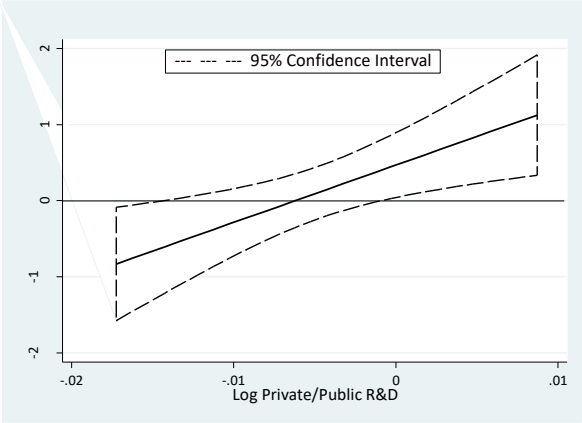


Figure 2. The Impact of Technological Progress on the Middle 40% Income Share

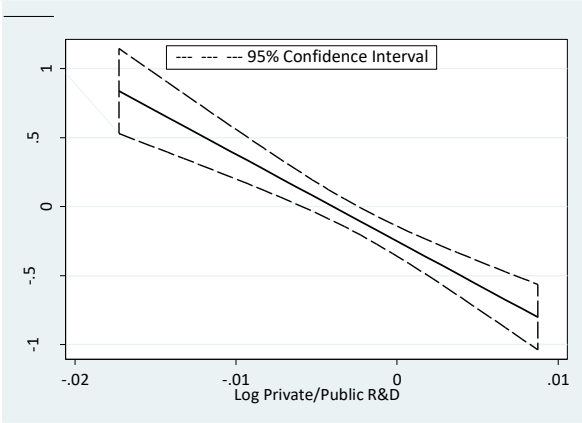
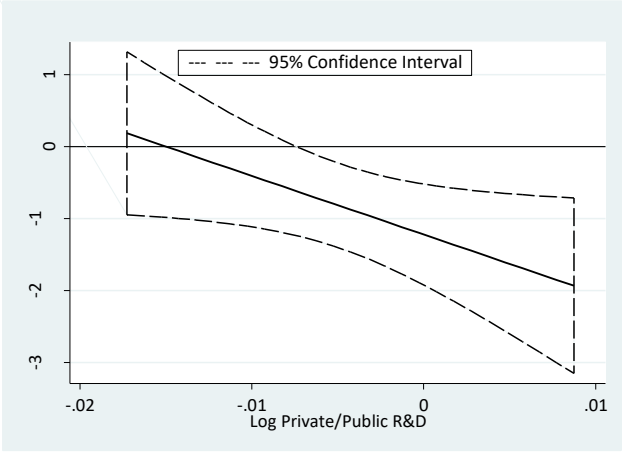


Figure 3. The Impact of Technological Progress on the Bottom 50% Income Share



Source: Authors' calculation