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How Does Industrialization Affect (Equitable) Income Growth? Evidence from U.S. Manufacturing During the Early 20th Century

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Abstract

This paper assesses how changes in labor productivity from the rise of industrialization impacted total, personal, and corporate income per capita at the state level from 1899-1940. Using hand-collected data from the Statistics of Income Report and the Statistical Abstract of the United States, we conduct OLS regressions and find a significant and positive relationship between labor productivity and our dependent variables. Personal income recorded the highest coefficient, demonstrating workers benefiting the most from increasing labor productivity. This finding allows for exploration into equitable income growth, as the growth in income benefits the workers more than large capital owners.

Keywords

industrialization, equitable income growth, labor productivity

Cover Page Footnote

I am indebted to great guidance, encouragement, and support from my thesis advisor, Dr. Dong Cheng (Union College). I also want to thank Professor Lewis Davis (Union College) and Professor Bradley Lewis (Union College) for their helpful comments.

I. Introduction

This paper looks at the early 20th century to study the relationship between an increase in labor productivity and its subsequent impact on personal, corporate, and total income per capita. Existing literature discusses information on the increase in manufacturing productivity and income, which coincides with the rapid industrialization the United States was experiencing throughout the first half of the 20th century. However, a close-up examination of labor productivity and income from disaggregated data at the state level remains largely unexplored.

Findings from this relationship provide new historical context such as an insight into the living standards of society in the early 20th century. From this insight, we are able to observe the impacts of increased labor productivity on income and the ensuing equity this brought between workers versus corporations. Additionally, the industrialization time period investigated in this study provides exploration into new historical context on the impacts of an industrial economy and the subsequent welfare provided.

Labor productivity improved as manufacturers began the shift from artisanal shops in the 19th century to assembly lines and "continuous and batch production" processes in the early 20th century (Goldin and Katz, 1998). Atkeson and Kehoe (2001) note a productivity growth increase in manufacturing industries for three time periods within 1869-1969. Mokyr (1998) also addresses growing industry size, stating that from the period of the second industrial revolution, specifically 1870-1914, one can notice industry growth and its impacts such as economies of scale. Miller (1978) expands on the idea of economies of scale, finding relationships between industries with increased productivity and wages.

Wages were also experiencing massive changes during the early 20th century. For example, Goldin and Katz (1998) mention wage premiums being set due to industries using purchased electricity. Jensen (1989) includes findings from Akerlof and Yellen (1986) that by the 1920s, firms were increasing their wages in order to boost profits with higher rates of productivity.

This paper therefore builds on existing literature to understand the relationship between manufacturing productivity and income at a state level, an analysis not yet explored by researchers and provides an opportunity to further the historical context of the early 20th century. From the Statistics of Income report and the Statistical Abstract of the United States, we hand-collect data on income and labor productivity for 49 states between the time period of 1899-1940. We then introduce several different channels that pose as potential hypotheses for predicting

how labor productivity affects income per capita. Three channels: output, human capital, and scale channel, are employed to establish a positive relationship between labor productivity and income. One additional channel, the max production channel, proposes a hypothesis of a negative relationship between labor productivity and income per capita.

After conducting a multitude of ordinary least square regressions, our results indicate a statistically significant and positive relationship between labor productivity and total, personal, and corporate income per capita. Therefore, this positive relationship signifies that an increase in labor productivity causes income per capita to increase as well. The regressions produce expected findings in regards to both the statistical significance level and relationship direction with other control variables: firm size, capital intensity, and urbanization.

Furthermore, the results from the relationship between labor productivity and income per capita reveal insights on equitable income growth occurring during the first half of the 20th century. Specifically, personal income per capita experiences the largest increase from labor productivity growth rather than corporate income per capita. It implies how workers profit to a greater extent due to the effects of increased manufacturing productivity, as compared to corporations, who hold large capital amounts. In other words, it suggests that the productivity improvement in manufacturing contributed to equitable growth in the early 20th century.

II. Literature

The rapid rise of industrialization in the 20th century pushed the U.S. to new heights in terms of productivity. In fact, Oshima (1984) uses data from Abramovitz and David (1973) to emphasize that the first half of the 20th century had a total productivity growth rate that was four times the size in comparison to the 19th century. With the rise of industrialization, a series of questions begin to generate in the process: How much did industrialization influence wages? What relationships exist between labor productivity and wage rate? These various queries help pose the central question that motivates the basis of this research: to what extent does the labor productivity generated from the increase of industrialization affect income?

Due to the vast amount of material available, we organize the literature review portion of this paper by various sections. While the research papers presented highlight critical findings, they do not illuminate detail on a state level.

Rather, most of the information currently available on the topic looks at the aggregate, national level. This paper instead aims to uncover findings by looking at closer, disaggregated data at the state level between 1899-1940.

II.1. Changes Within Manufacturing Industries

It is first helpful to understand some changes being made to manufacturing industries and shifts in the skill sets of workers. Goldin and Katz (1998) provide a timeline for manufacturing production into three segments, beginning with the 1830s through the 1880s which consisted of artisanal shops. The 1880s through the 1900s changed from artisanal shops to factories, and the early 1900s began assembly lines. The adaptation of assembly lines themselves would enable the U.S. for the mass production of goods, as seen with Cheng et al. (2019), who highlights the dominance of market share for the U.S. in automobile production between 1922-1938. In fact, Cheng and Trebino (2021) emphasize that the U.S. would produce more than 80% of world automobiles between 1900-1940.

Goldin and Katz (1998) address such changes in the manufacturing industry, finding that technology-based skills rose throughout manufacturing industries in the early 20th century due to the increasing popularity of "continuous and batch" process production methods. With the several different manufacturing industry methods outlined, Goldin and Katz (1998) bring up the rise of both skilled and unskilled workers needed in the different time periods. By looking at wages, employment, and education, Goldin and Katz (1998) write that there would be a demand for more skilled workers in manufacturing throughout the 20th century due to the nature of electrification and computerization advances.

II.2. Productivity Improvement During the Early 20th Century

Atkeson and Kehoe (2001) record a rise in growth productivity levels in the U.S. manufacturing industry over the time span of 1869-1969 using 1973 U.S. Department of Commerce Data. They record linear trends throughout three different time segments: 1869-1899, 1899-1929, and 1949-1969, showing the following growth increases: 1.6% to 2.6% to 3.3%. It is important to note that the data does not include the Great Depression and WW2. Oshima (1984) employs data from Abramovitz and David (1972) and states that the productivity growth rate in the United States throughout the 19th century was on average 0.4% each year and then rose to 1.8% in the 20th century (specifically 1905-1967). Oshima (1984) shows that the manufacturing sector makes the highest impact, with a 0.8% to a

2.8% growth rate in productivity and a 54% growth rate in employment. Oshima (1984) also finds that during the 1920s, manufacturing was averaging 5.3% productivity rate each year due to increases in output per labor which itself grew at 5.6%.

Taking a deeper look into understanding the rise of labor productivity, we can look at total factor productivity's contribution towards labor productivity. Bakker et al. (2017) provide important findings on total factor productivity (TFP) for the U.S. during the time period of 1899-1941. Bakker et al. (2017) find that capital inputs, growth of labor quality, and growth of TFP all contribute towards labor productivity growth in the time span of 1899-1940. Specifically, TFP impacts labor productivity by 60%. Although TFP had a smaller contribution than what previous studies included by Bakker et al. (2017) had found, we see that it still remains a leading factor on contributions to labor productivity.

II.3. Effect of Industrialization on Wages

As our paper aims to see the effects on wages from the increases in manufacturing labor productivity, there are important findings we can make note of regarding changes to wages in the early 20th century. Goldin and Katz (1998) look at data from the Census of Manufactures from 1909, 1919, and 1929 of blue-collar industry workers and wage correlations to the type of industry they are in. They find a positive relationship between the ratio of capital to labor and wages, in addition to positive correlations from wages and percentage power of horsepower from purchased electricity.

Wright (1990) draws upon the fact that American firms were paying the highest real wages in comparison to the rest of the world, resulting in industries that were able to gain more effort from the labor force. Addressing wages in relation to skill level, Wright (1990) notes that during the rise of industrialization in the U.S., it is wrong to think high wages equate to high skills utilized.

Jensen's (1989) paper includes important pieces of information from Akerlof and Yellen (1986). For instance, by the 1920s, firms could no longer increase profits through wage cuts. Rather, firms had to increase wages if they wanted to see higher profits. Jensen (1989) also includes that a firm's labor cost can decrease with rising productivity, noting that higher wages which increase productivity greater than the cost of the new wages themselves would lead to an industry's profitability. Nonetheless, he notes that high wages could decrease the

amount of jobs, as it attracts more talented workers capable of handling more work at once compared to a larger group of people.

Miller's (1978) paper looks at data from the 1972 Census of Manufactures, containing 450 industries, in order to understand the impact of economies of scale. Miller (1978) highlights that larger firms have higher labor productivity, finding that on average, the leading four firms were able to process 48% more material per worker than in smaller firms. In relation to wage, Miller (1978) finds that the greater productivity found at the large firms also signifies greater wages being paid to the employees. The yearly earnings per employee were on average higher in the leading four firms compared to 355 other industries (Miller, 1978). Specifically, earnings from production workers in the leading four companies were 17.2% higher than employees at other firms (Miller, 1978).

Strauss and Wohar (2004) look at 459 manufacturing industries between 1956-1996. Strauss and Wohar (2004) find that there is a relationship between productivity and real wages. However, they reject a one to one relationship between productivity and real wages. Strauss and Wohar (2004) conclude that labor productivity increases lead to a smaller increase on real wages, noting that the manufacturing industries from 1958 through 1966 have a labor share decline.

II.4. Summary of the Existing Literature

Existing literature allows us to understand the historical changes made to the manufacturing process and the subsequent changes on labor productivity and income during a time of rapid industrialization experienced by the U.S. With this insight, we can begin to address the research question: How does labor productivity affect income per capita?

As stated earlier, existing studies lack extensive insight into how labor productivity affected income at the state level, which is where we plan to fill in the gaps and uncover further information into the findings of the early 20th century. Additionally, information at the state level may produce new discussion for historical context, such as an understanding on the standard of living at the time period as well as any explanations surrounding the current status of labor and income relationships.

We can also build on the existing literature on wage inequality during the time period in order to look at equitable income growth. For example, Goldin and Katz (2001) explain how the first half of the 20th century can be remarked as one with relatively low wage inequality as compared to the second half of the century.

Goldin and Katz (1999) also discuss how manufacturing wages consists of greater equality between the time period 1890 and 1940. Such literature and the empirical results from this paper help build onto the topic of equity, as we look into how income increases from the rise in manufacturing productivity differently impacted workers and corporations.

III. Conceptual Framework

To help develop channels for the relationship between labor productivity and income per capita, we explore economic reasoning as well as the existing literature. We develop three hypotheses that deduce a positive relationship and one hypothesis that deduces a negative relationship.

Beginning with the positive hypothesis channels, one such channel is the output channel. By learning about the efficiencies of the new production methods throughout the industrialization sector, we can assume that an increase in labor productivity will boost output itself. Therefore, through economic reasoning, specifically the income approach, we know that total output equals total income. This channel shows us a direct effect occurring, as an increase in the total output is equal to an increase in total income.

Next is the human capital channel, which looks at how spillover effects have two indirect effects. One effect deals with how rising industrialization causes people to learn new skills as employers seek skilled workers, an idea previously mentioned by Goldin and Katz (1998) who discuss the rise of skilled workers due to technological strides. The second effect from spillover effects deals with innovation. New technologies produced from industrialization can lead to the possibilities of further inventions and developments to be produced, as explained by Sokoloff and Khan (1990) who highlight Mokyr's (1990) paper mentioning how developments in technology lead to additional uses. These two spillover effects provide the opportunity for income to further rise.

The final channel used to hypothesize a positive relationship between our variables is the scale channel. The framework for this channel stems from information around factory size. We recall Miller (1978), who looked at data from the 1972 Census of Manufactures containing 450 industries and found that firms who were larger in size and had high productivity rates were paying larger wages. Although Miller (1978) looked at a different time period than the one our paper focuses on, we can use such learnings to reason what we might observe between industry size and income in the early 20th century.

A final hypothesis we include is the mass production channel, which we use to propose a negative relationship between labor productivity and income per capita. Specifically, this channel raises observations on how an increase in mass production might actually decrease income. Mitchell (2001) makes the case that the returns to skills dropped dramatically as workers had to specialize in only one task due to assembly line developments in factories.

IV. Descriptive Statistics

In order to successfully retrieve results for this study, we first hand-collect data for our variables. Specifically, we use the Statistics of Income (SOI) report from the IRS to collect data on net income and income tax on both personal and corporate levels. A second source of data comes from the Statistical Abstract of the United States, which is used to collect decadal data for urban and rural population growth as well as extract an archive called "Summary of Manufacturing" from the Bureau of the Census, Department of Commerce. The information in the archive provides us detail using NIPA data in regard to providing manufacturing insights.

The dependent variable, income per capita, uses both the SOI report and population data from the Federal Reserve Economic Data to calculate personal and corporate gross income per capita. Therefore, personal gross income per capita is calculated by the addition of personal net income and personal income tax divided by population. Similarly, corporate gross income per capita is calculated by the addition of corporate net income and corporate income tax divided by population. Lastly, total gross income per capita is calculated by adding total net income and total income tax divided by population. Both personal and corporate net incomes will be used in order to discover if increased labor productivity from manufacturing has a greater effect on personal or corporate levels. Lastly, when running our regressions, income per capita will be in natural log. This is done to obtain elasticity effects, specifically the percent changes that labor productivity will have on income per capita.

Our key independent variable, manufacturing labor productivity, is defined in this study as the total output produced from a manufacturing plant per individual worker. We construct labor productivity by dividing the data that we have on "value added by manufacture" by the data on wage earners. To better understand what labor productivity is, we can look at the components that make up labor productivity: value added by manufacture and total labor. Value added by manufacture is defined as the new output generated from manufacturing once the

value of intermediate goods used in production are subtracted. Total labor is comprised of salaried employees and wage earners. However, the data records from the Statistical Abstract of the United States have missing information on salaried employees for the years 1923-1935, which is a large section of our investigation from 1899-1940. Therefore, for the purpose of this study, we will use wage earner data only. Comparing wage earner data with salaried employee data, we note that we have complete data of wage earners for the years 1899-1939 as well as wage earner data dominating in size. Wage earner data is also used due to the fact that wage schemes are more efficient for industries. Industries are flexible, therefore there are incentive structures with wages unlike fixed payments with salaries. Finally, we also use the natural log in the construction of labor productivity because it allows us to evaluate the elasticity effect in relation to our dependent variables.

We control for firm size, capital intensity, and urbanization. Beginning with firm size, we define it as the number of manufacturing workers per plant in the establishments in that state. We control for firm size due to the possibility that an establishment's size can impact income because of economies of scale, as read about in Miller (1978). Firm size will be constructed by using the data we collected on the value of products divided by the data we have collected on the number of establishments. We also control for capital intensity because changes to it may alter income per capita depending on the capital to labor ratio. We define capital intensity as the capital stock per wage earner. We will use horsepower as a proxy when controlling for capital intensity since we are unable to collect the entirety of the data for capital stock. There will be two separate constructions for capital intensity. One variable construction for capital intensity will be created by dividing the data collected on capital by the data we have collected on wage earners. The second construction for capital intensity will be using data collected on horsepower divided by the wage earner data. Lastly, decadal data for rural and urban population growth through 1900-1940 will be used in order to account for the vast geographic changes the U.S. experienced during this time period. In order to control for urbanization, we will have to copy and paste the decadal data in the years that correspond for that decade that we have data for in our other variables. This is done to help ensure that there is enough data for urbanization.

V. Empirical Model

With the use of hand-collected data, we focus on the time period of 1899-1940 and forty-nine U.S. states in order to run several OLS regressions to uncover

the relationship between our key independent variable, labor productivity, and dependent variables: total, personal, and corporate income per capita. That said, labor productivity will be abbreviated as "labprod" for the regression equations. For total gross income per capita, we abbreviate it as "totincpc" in our regression equation and is shown in the simplest form by the following:

$$totincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \varepsilon_{s,t} \quad (1)$$

For greater reliability in our results, we control for several variables that may skew the relationship between labor productivity and income per capita. While still retaining the total income for our dependent variable, we first control for firm size. As mentioned before, we control for firm size due to the fact that it can affect income per capita through economies of scale, which was read about in Miller's (1978) paper. Therefore, the control variable "firmsize," can be displayed by the following equation:

$$totincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \varepsilon_{s,t} \quad (2)$$

A second control variable that we will use in this study is capital intensity, which is abbreviated as "capint1". By controlling for capital intensity, we consider the way it can affect income per capita due to variations in capital stock and the number of wage earners. Unfortunately, there is a lack of complete data available for capital intensity measurements. Therefore, horsepower will be used as a proxy for the years where we do not have capital data. We will show horsepower being used as a proxy with the variable "capint2". Capital intensity, where "capint1" is used, is depicted by the following equation:

$$totincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \beta_3 * capint1_{s,t} + \varepsilon_{s,t} \quad (3)$$

Lastly, we control for urban population growth which is depicted by the variable "urbanization" and displayed below. Urbanization is controlled due to the expansion of cities that came from industrialization booms and the rapid shifts of geographic patterns possibly affecting income. Due to the availability of more data, we use "capint2" (horsepower used as proxy for capital) in the regression equation that controls for urbanization.

$$totincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \beta_3 * capint2_{s,t} + \beta_4 * urbanization_{s,t} + \varepsilon_{s,t} \quad (4)$$

As previously stated, our dependent variable consists of three different income per capita categories. Therefore, we can follow the above four equations to replicate the exact same regression equations by changing out the dependent variable for personal income per capita and corporate income per capita. If we recall, we use personal and corporate income per capita in addition to total income

per capita because it allows us to draw findings on knowing if labor productivity has a greater effect on personal or corporate income per capita. In addition, it allows us to discover information on equitable income growth and assess what happens to income per capita for workers versus corporations from the increases in manufacturing productivity. That said, we proceed with the personal income per capita, which is abbreviated as "personalincpc". Shown below is our regression, once again in the simplest form:

$$personalincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \varepsilon_{s,t} \quad (5)$$

We will also use the same control variables: firm size, capital intensity, and urbanization which can be seen with the following regressions:

$$personalincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \varepsilon_{s,t} \quad (6)$$

$$personalincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \beta_3 * capint1_{s,t} + \varepsilon_{s,t} \quad (7)$$

$$personalincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \beta_3 * capint2_{s,t} + \beta_4 * urbanization_{s,t} + \varepsilon_{s,t} \quad (8)$$

Lastly, the remaining category for income per capita, corporate income per capita, will follow a similar structure to the equations created and be abbreviated as "corpincpc". We begin with the simplest form of the regression:

$$corpincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \varepsilon_{s,t} \quad (9)$$

The same control variables will also apply to corporate income and will be demonstrated by the following:

$$corpincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \varepsilon_{s,t} \quad (10)$$

$$corpincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \beta_3 * capint1_{s,t} + \varepsilon_{s,t} \quad (11)$$

$$corpincpc_{s,t} = \beta_0 + \beta_1 * labprod_{s,t} + \beta_2 * firmsize_{s,t} + \beta_3 * capint2_{s,t} + \beta_4 * urbanization_{s,t} + \varepsilon_{s,t} \quad (12)$$

Table 1 lists the variable abbreviations for this study as discussed above and provides corresponding summary statistics of each variable.

Table 1. Summary Statistics

Variable	Number of Observations	Mean	Median	Std. Dev.	Min	Max
totincpc	1225	210	158	217	11.5	2744
personalincpc	1225	148	119	109	6.04	692
corpincpc	1225	62.2	34	142	0.123	2225
labprod	730	2.45	2.44	1.12	0.486	10.8
firmsize	734	202	188	132	10.5	943
capint1	98	13119	9909	9700	2772	53823
capint2	440	4.27	3.94	2.04	1.02	17.1
urbanization	735	44.3	39	22.1	6.2	100

VI. Results

VI.1. Regression Results For Total, Personal, and Corporate Income Per Capita

Our regression results provide specific information about the relationship between labor productivity and income per capita. Specifically, we focus on column 5 of Tables 2-4, as it includes the entirety of our control variables in addition to the use of "capint2," where there are more observations included for capital intensity when horsepower is used as a proxy. Beginning with column 5 in Table 2, we observe that a 1% increase in labor productivity increases total income per capita by 0.49%. This statistically significant result at the 1% level shows a positive relationship between labor productivity and income per capita.

Remaining on column 5 from Table 2, we see a significant relationship at the 1% level with the control variable "urbanization". As shown, a 1% increase in urbanization causes a 0.02% increase in total income per capita. A final observation indicates how adding urbanization as an additional control variable causes our adjusted r-squared value to jump to 71%, a large increase from columns 1 through 4, which hovered in the 20% range.

Table 2. Regression Results For Total Income Per Capita

	(1) log_totincpc	(2) log_totincpc	(3) log_totincpc	(4) log_totincpc	(5) log_totincpc
log_labprod	1.217***	1.068***	0.697**	1.037***	0.491***
	(12.93)	(11.26)	(2.49)	(7.14)	(4.47)
firmsize		0.00147***	0.00121*	0.00116***	0.000188
		(5.84)	(1.90)	(3.55)	(0.74)
capint1			0.00000942		
			(1.16)		
capint2				-0.0848***	0.00475
				(-4.88)	(0.35)
urbanization					0.0235***
					(16.41)
constant	3.804***	3.581***	4.057***	4.277***	3.587***
	(38.41)	(34.61)	(20.49)	(27.36)	(29.31)
N	535	535	98	245	196
adj. R^2	0.237	0.282	0.247	0.280	0.709

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 presents findings for personal income per capita. Focusing again on column 5, we see a positive and statistically significant relationship, where a 1% increase in labor productivity leads to a 0.5% increase in personal income per capita. The remaining independent variable, "urbanization" also displays a significant relationship at the 1% level, where a 1% increase in urbanization leads to a 0.02% increase in personal income per capita. In observing our adjusted r-squared values, we see once again how adding the control variable for urbanization drastically increased our adjusted r-squared value to 72%.

Table 3. Regression Results For Personal Income Per Capita

	(1) log_personalincpc	(2) log_personalincpc	(3) log_personalincpc	(4) log_personalincpc	(5) log_personalincpc
log_labprod	1.177***	1.089***	0.826***	1.059***	0.496***
	(13.53)	(12.19)	(2.94)	(7.45)	(4.84)
firmsize		0.000872***	0.000259	0.000628*	-0.000346
		(3.67)	(0.40)	(1.96)	(-1.45)
capint1			0.00000517		
			(0.63)		
capint2				-0.0703***	0.0180
				(-4.13)	(1.41)
urbanization					0.0238***
					(17.79)
constant	3.578***	3.446***	3.971***	4.025***	3.355***
	(39.07)	(35.37)	(19.92)	(26.28)	(29.36)
N	535	535	98	245	196
adj. R^2	0.254	0.271	0.192	0.245	0.723

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In Table 4 we note the findings on corporate income per capita by looking at column 5. For instance, a 1% increase in labor productivity leads to a 0.4% increase in corporate income per capita. Something important to note here is that this result is statistically significant at the 5% level rather than the 1% level as seen

with both total and personal income per capita results. The relationship between labor productivity and corporate income per capita once again helps support findings of a dominating trend that support positive hypothesis channels.

The variables "firmsize" and "urbanization" are statistically significant at the 1% level and showcase a positive relationship. For "firmsize," a 1% increase leads to a 0.001% increase in corporate income per capita. For "urbanization," a 1% increase leads to a 0.02% increase in corporate income per capita. Similar to Table 2 and Table 3, the urbanization control variable brings increases to the adjusted r-squared value, which is shown in column 5 to be at 61%.

Table 4. Regression Results For Corporate Income Per Capita

	(1) log_corpincpc	(2) log_corpincpc	(3) log_corpincpc	(4) log_corpincpc	(5) log_corpincpc
log_labprod	1.297***	0.933***	0.372	0.895***	0.398**
	(9.32)	(7.05)	(1.02)	(4.76)	(2.44)
firmsize		0.00359***	0.00448***	0.00261***	0.00172***
		(10.20)	(5.40)	(6.19)	(4.54)
capint1			0.0000124		
			(1.17)		
capint2				-0.133***	-0.0289
				(-5.90)	(-1.43)
urbanization					0.0242***
					(11.35)
constant	2.135***	1.591***	1.850***	2.853***	1.936***
	(14.59)	(11.03)	(7.16)	(14.11)	(10.65)
N	535	535	98	245	196
adj. R^2	0.139	0.278	0.369	0.297	0.607

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

VI.2. Equitable Income Growth Observations From Results

Corporate income per capita's coefficient's magnitude and statistical significance result reveal some interesting findings on how income was allocated from labor productivity increases. For example, one conclusion we can draw is that the workers, not the corporations, are benefiting more from the monetary gains associated with the increase in labor productivity. This can be seen with the fact that the relationship between labor productivity and corporate income per capita has a smaller coefficient and lower statistical significance than compared to the results from Table 3, which shows labor productivity and personal income per capita. Therefore, it indicates that the economic expansion from the increase in labor productivity was greater appreciated by workers, although corporations benefited as well.

This finding allows us to look into equitable income growth. In particular, the relationship between labor productivity and personal income per capita produced the largest coefficient in comparison to total and corporate income per capita. Additionally, we discussed that personal income per capita was statistically significant at the 1% level, which differed from corporate income per capita's statistical significance at the 5% level. These results help create a picture of the equity that resulted in income increases from manufacturing productivity rises experienced in the first half of the 20th century.

VI.3. Insight Into the Great Depression's Impact on Income

The time period looked at by this study covers major historical events such as the Great Depression, which poses an additional opportunity of exploration between labor productivity and income. As we know, the living standard in America was severely impacted by the Great Depression. That said, how did it affect equitable income growth for workers in comparison to corporations?

To uncover information for this question, we split our data into two time periods. One time period will cover the years 1899-1929, which will represent life before the Great Depression. The second time period will cover the years 1930 through 1940, which will capture the effects of the Great Depression. We follow the same regression equations as previously shown by our empirical models, except this time we look at two split time periods: 1899-1929 and 1930-1940. Below are Tables 5-7, which show the regression results with the two split time periods for our three income categories.

Table 5. Regression Results For Total Income Per Capita Before and After The Great Depression

	1899-1929		1930-1940	
	(1)	(2)	(1)	(2)
	log_totincpc	log_totincpc	log_totincpc	log_totincpc
log_labprod	1.063***	0.894***	1.268***	1.164***
	(8.81)	(6.95)	(9.36)	(9.02)
firmsize		0.00106***		0.00209***
		(3.36)		(5.58)
constant	4.143***	4.046***	3.534***	3.112***
	(32.24)	(31.22)	(25.16)	(20.42)
N	294	294	241	241
adj. R^2	0.207	0.234	0.265	0.348

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Regression Results For Personal Income Per Capita Before and After The Great Depression

	1899-1929		1930-1940	
	(1)	(2)	(1)	(2)
	log_personalincpc	log_personalincpc	log_personalincpc	log_personalincpc
log_labprod	0.999***	0.923***	1.253***	1.181***
	(8.60)	(7.34)	(10.48)	(10.12)
firmsize		0.000473		0.00146***
		(1.54)		(4.31)
constant	3.933***	3.889***	3.293***	2.998***
	(31.79)	(30.71)	(26.55)	(21.75)
N	294	294	241	241
adj. R^2	0.199	0.203	0.312	0.359

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7. Regression Results For Corporate Income Per Capita Before and After The Great Depression

	1899-1929		1930-1940	
	(1)	(2)	(1)	(2)
	log_corpincpc	log_corpincpc	log_corpincpc	log_corpincpc
log_labprod	1.193***	0.717***	1.271***	1.048***
	(6.89)	(4.12)	(6.12)	(5.66)
firmsize		0.00298***		0.00446***
		(7.01)		(8.30)
constant	2.491***	2.216***	1.857***	0.957***
	(13.51)	(12.64)	(8.62)	(4.37)
N	294	294	241	241
adj. R^2	0.137	0.259	0.132	0.324

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The first thing to note is how all three tables only use two models for observation, our independent variable, labor productivity, and our control variable, firm size. This was done because there were not enough statistical observations when running the regressions for the additional models for years 1930 and above.

Taking a look at the results from Tables 5-7, there are a few important things to mention. First, for all three categories of income, when we compare columns 1&2 for the pre-Great Depression time period to the post-Great Depression time period, we see an increase in the coefficient of labor productivity for the post-Great Depression period. Therefore, we note that the unit increases in labor productivity really amplifies increases in income per capita during the post-Great Depression period. This helps support literature mentioned previously, such as Jensen (1989), who stated that hourly wages were actually stable or increasing throughout the Great Depression.

While increases in income may at first seem promising for discussions towards equitable income growth, we must address the difference in the coefficients for personal income per capita and corporate income per capita in the pre and post-Great Depression time periods. Focusing on column 2 for Tables 6&7, we can first look at the coefficient differences in the result produced for the relationship between labor productivity and income per capita between both tables. Right away,

we see that in the pre-Great Depression period, workers gain more in income from the increases in labor productivity due the coefficient result of 0.92 compared to corporation's coefficient result of 0.72. Switching over for the post-Great Depression period, we see that the relationship between labor productivity and personal income per capita produced a coefficient of 1.18, compared to the coefficient of 1.05 when looking at labor productivity and corporate income per capita. Once again, workers gain more from unit increases in labor productivity in comparison to corporations.

When we subtract for the difference in these coefficients, we gain some insight into decreases of equitable income growth occurring. First focusing on the pre-Great Depression period, there is a 0.2 difference between personal income per capita and corporate income per capita as we subtract 0.92 and 0.72 found in Tables 6&7. Second, we shift to the post-Great Depression period and find a 0.13 difference after subtracting 1.18 and 1.05 from Tables 6&7. The decrease in the differences from 0.20 to 0.13 sheds light on how equity in income growth for workers is falling. The workers in the post-Great Depression are not prospering as greatly as before in the pre-Great Depression period when we account for this difference.

One final thing to note is that the falling equity experienced by workers in the post-Great Depression period allows us to assess the efficacy of governmental policies between pre and post-Great Depression time periods. For example, a major response to the Great Depression was the New Deal and the several developments this brought. However, the falling equity for workers after the Great Depression shows how workers themselves are not necessarily being aided by such governmental policies. This logic also allows us to explain that the period of time before the Great Depression, where workers were experiencing more equitable income growth, can reveal that governmental programs and policies helped aid workers. For instance, we know that in the time of 1899-1929, there were creations of governmental bodies such as the Federal Reserve. Therefore, we see how the creation of such governmental agencies as well as new policies set out before the Great Depression period had more of an impact in shaping equitable income growth for workers than compared to governmental developments after the Great Depression.

VII. Conclusion

The early 20th century United States marks an era of time known for its increases in labor productivity and subsequent changes to income. That said, this paper focuses on understanding how the rise in labor productivity from the increase in industrialization in the United States affects income per capita at the state level. Specifically, we use data ranging between the years 1899-1940 from 49 U.S. states to understand the relationship between labor productivity and three types of income: total, personal, and corporate income per capita. We control for firm size, capital intensity, and urbanization.

In all three income categories, our results show a positive relationship between labor productivity and income per capita. Both total income per capita and personal income per capita are statistically significant at the 1% level, whereas corporate income per capita is statistically significant at the 5% level. Furthermore, corporate income per capita also produces the smallest coefficient in its relationship with labor productivity, where all variables are controlled for. Not only do these results shed light on the relationship between labor productivity and income per capita at a period of time where the U.S. was undergoing massive industrialization, but they also help produce discussion into equitable income growth.

Specifically, our results show how workers seemed to benefit more financially from the increases in labor productivity than corporations did. This is displayed by both coefficient magnitude and statistical significance level, as personal income per capita has the largest coefficient. This result helps show equitable income growth in the sense that workers are reaping the benefits from increased manufacturing productivity, rather than only corporations.

We also see how our results prove a dominating presence for supporting positive hypothesis channels for all income categories. Previously listed in our conceptual framework section are three different hypothesis channels that support a positive relationship: output, human capital, and scale channels. Our study is limited in trying to differentiate exactly what hypothesis channel explains the positive relationship seen in our results. Nonetheless, it provides an interesting opportunity for further research on labor productivity and income relationships.

In all, our findings help provide further insight into life during the first half of the 20th century. We've taken an extensive look into the changes occurring to the United States during this time period and have further contributed to the existing literature with the use of disaggregate data. Our results open up areas where further research can be done, such as to uncover the specific channel that aligns with the

positive hypotheses explained in our conceptual framework. Additionally, this study opens up opportunities for further exploration into equitable income growth. Specifically, the results obtained can provide interesting analysis and benchmark for comparison into labor productivity and salary relationships today. For instance, the results from our study helps demonstrate that the manufacturing sector in the United States experienced more equitable income growth between 1899-1940. However, when we study the present-day United States, we become well aware of the rising inequality present with income growth (Schaeffer, 2020). For example, Schaeffer (2020) highlights how those in the top income brackets encounter a faster growth rate with their income.

We are even able to expand the scope of our results to understand equity throughout this time period amidst major historical events. Thus, we expand the scope of our results into two time period segments: 1899-1929 and 1930-1940, which allows us to account for the impacts of the Great Depression. We raise the finding that equitable income growth was falling for workers after the Great Depression, regardless of income increases experienced by both workers and corporations. Therefore, findings such as these open pathways into discussions of governmental actions, economic policies, and the changes throughout time that explain shifts within equitable income growth. Finally, this helps us enter an additional area for continued study: what are the most effective programs the U.S. can implement in order to promote continued equitable income growth?

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