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Economic growth and the functional distribution of income: A labor share Kuznets curve

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Abstract

Mainstream economics has until recently considered labor share as constant. However, early empirical evidence shows that labor share increased during the last decades of the nineteenth century and the first half of the twentieth century, and more recent empirical evidence shows that it has been declining since the 1980s in developed countries. This paper argues that the functional distribution of income is a function of the level of development of the economy, with labor share increasing in low income economies and decreasing for high levels of income. We test for the existence of a Kuznets curve for labor share using Penn World Table version 9.1 data for the period 1980–2017 for 50 developed and developing countries. We find the existence of an inverted U-shaped relationship between labor share and income, where the turning point is around $8,650 per capita (in 2011 dollars).

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1. Introduction

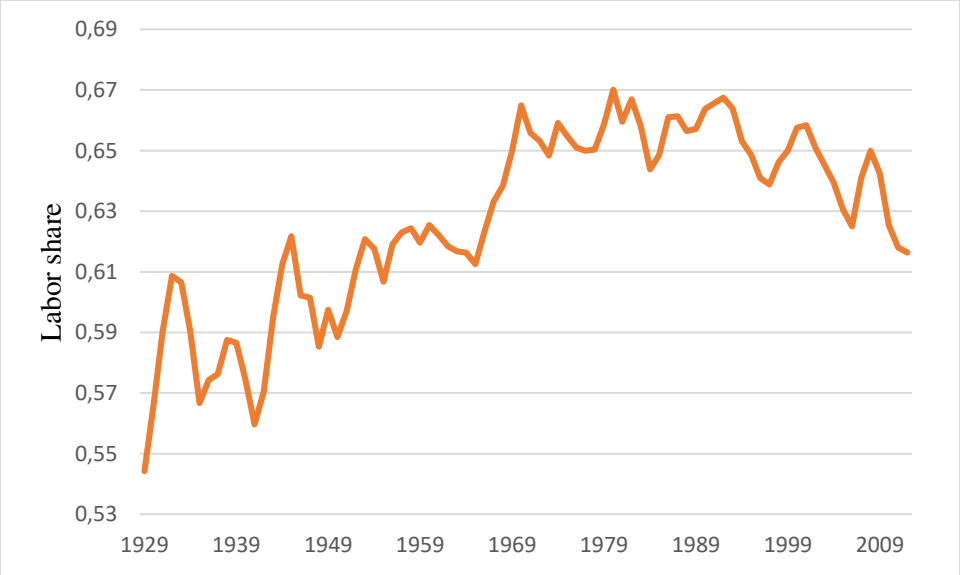
For several decades, mainstream economics has considered labor share and the functional distribution of income to have been roughly stable over time, a view consolidated by Gollin (2002). The hypothesis of the constancy of the labor share dates back to Ricardo (1821) and is one of the stylized facts enumerated by Kaldor (1957), first established as a regularity by Bowley (1937). However, this view has been questioned by both early and recent empirical evidence. The debate on the constancy of labor share is not new: this hypothesis was questioned by earlier works (Solow, 1958; Kravis, 1959; Budd, 1960).

Empirical evidence indicates that:

i. Labor share was increasing in the US during the last decades of the nineteenth century and the first half of the twentieth century (Solow, 1958; Kravis, 1959; Budd, 1960).
ii. Labor share has been decreasing in developing countries since the 1980s (Elsby, Hobijn and Sahin, 2013; Karabarbounis and Neiman, 2014; and Bridgman; 2017).
iii. Labor share is higher in developed than in developing countries (Izyumov and Vahaly, 2015).
iv. Labor share is increasing in developing countries with high growth rates such as China and India (Ahsan and Mitra, 2014; Kamal, Lovely and Mitra, 2019).

Combining all these pieces of empirical evidence, the complete picture seems to indicate the existence of a non-linear relationship between labor share and income. In this article we propose, and empirically estimate, a Labor Share Kuznets Curve (LSKC) that implies the existence of an inverted U-shaped relationship between labor share and GDP. Kuznets (1955) was the first to describe a non-linear relationship between income and inequality, and his work was later extended to environmental economics with the so-called Environmental Kuznets Curve (EKC) hypothesis (Grossman and Krueger, 1991, 1995).

Figure 1: Labor share in the U.S. 1929–2012



Source: National Income and Product Accounts (NIPA)

As a graphical example of our hypothesis, Figure 1 plots the labor share for the U.S. for the period 1929 to 2012. Whereas we observe a clear positive trend in the early years (consistent with the observations of Solow 1958 and Kravis 1959), after a period of constancy in the 1970s (consistent with Gollin, 2002), from 1990 onwards we observe a decline (consistent with recent empirical evidence by Karabarbounis and Neiman 2014 and Bridgman 2017). The figure shows, after correcting for cyclical fluctuations, an inverted U-shaped pattern, which supports our hypothesis that the relationship between labor share and output is positive for low output levels but negative for high output levels.

This article is structured as follows. Section 2 reviews the alternative explanations given in the literature for the movement in labor share. Section 3 presents the data and the econometric model. Section 4 presents the results. Finally, Section 5 concludes.

2. The functional distribution of income

One of Kaldor's (1957) stylized facts is that the functional distribution of income remains almost constant over time. However, Solow (1958) and Kravis (1959) questioned this fact, and earlier empirical evidence showed that the labor share was increasing in the US until the middle of the twentieth century. Kravis (1959) reported that employees' compensation share increased from 0.55 in 1900 to 0.67 in 1957, a trend associated with the decline of labor in agriculture and its increase in industry, and with the increase in self-employment. Budd (1960) showed that this upward trend in labor share can also be observed in the second part of the nineteenth century, and estimated that the labor share rose from about 0.43 in 1870 to around 0.48 in 1910.

However, that empirical evidence has so far been ignored, as labor share has been considered to be almost constant in developed countries, in spite of some additional empirical evidence indicating that this upward trend was continuing in the 1960s and 1970s (Glyn, 2006). The influential work by Gollin (2002) consolidated the view that labor share was almost constant for developed countries. However, more recent empirical evidence has again opened the debate by showing that labor share has been falling during recent decades, at least in developed economies (Elsby, Hobijn and Sahin, 2013; Karabarbounis and Neiman, 2014; Bridgman, 2017). Azmat, Manning and Van Reenen (2012) argue that the stability of labor share in recent years has shown important variations, with increases for the period of the 1960s and 1970s and declines since the 1980s for many countries of the OECD. On the other hand, Izyumov and Vahaly (2015) estimate that labor share is 10-15 percentage points lower in developing countries than in OECD countries.

Several explanations of this recent phenomenon have been proposed in the literature. Karabarbounis and Neiman (2014) argue that the decline in the relative price of investment goods induced firms to substitute from labor toward capital. A consequence was a reduction in the price of labor. They conclude that roughly half of the observed decline in the labor share can be attributed to this mechanism. Bentolila and Saint-Paul (2003) argue that the evolution of labor share in OECD countries is related to the capital/output ratio, but also to the price of imported material and to capital-augmenting technological progress. Piketty (2014) and Piketty and Zucman (2014) also argue that the decline in labor share is explained

by the increase in the capital/output ratio. Automation (Graetz and Michaels, 2018) and international trade (Azmat *et al.* 2012) have also been proposed as factors that explain the decline in labor share.

The functional distribution of income is an important macroeconomic variable for a number of reasons. First, it is important to know how the total income in an economy is distributed between productive factors, as a measure of the relative contribution of each productive factor to the final output. In general, total income is split between compensation to employees and returns to capital. Second, labor share is a variable affecting inequality (Piketty, 2014). Adams, Karabarbounis and Neiman (2014) show that the share of aggregate income paid as compensation for labor is frequently used as a proxy for income inequality. The reason is that capital is concentrated among high income agents, and the higher the capital share, the higher the differences in income with respect to workers. Piketty (2014) shows that, over time and across many countries, a higher capital share is associated with higher inequality in the personal distribution of income, although this direct relationship is questioned by Adams *et al.* (2014). Finally, the functional distribution of income is key for the calibration of the aggregate production function in macroeconomic models. Labor share has been considered to be a deep parameter of the production function (the Cobb–Douglas function), and, hence, constant over time. The accepted decline in labor share casts doubts not only on the calibration of the elasticity of output to inputs but also on the adequacy of the assumption of a Cobb–Douglas production function.

3. Data and empirical model

The data set used in the analysis comes from the Penn World Table (PWT) database, version 9.1, which includes data for the period 1950-2017 for a total of 111 countries (see Feenstra, Incklaar and Timmer (2015) for a full description of this database). However, the labor share is not available for all countries and for the whole period. Given the data limitations, we choose a sample period of 1980-2017, and included a total of 50 countries, both developed and developing economies. The selection of only 50 out of the 111 countries has been done based on data availability of labor share. In the PWT 9.1 database, labor share was estimated as a constant for a large number of countries and periods. These constant values for labor shares for several years at the beginning of the sample period appear not only in the case of developing economics but also for the case of some developed economies. Given this data-quality limitation, those countries for which the labor share was constant during a long fraction of the sample period were eliminated from the sample, but keeping the focus on the fact that the sample of countries should contains both high- and low-per capita income countries. After eliminating the countries with the lowest quality information for labor share, it resulted a reduced sample of 50 countries (although some of them still present a constant labor share for some of the first years of the sample period). However, it is worth noting that this sample selection procedure, based on data availability, is not random and may lead to spurious results (see the data appendix for a description of the sample selection and the list of countries).

The data demonstrate the following. First, the labor share in developing countries is lower than the labor share in developed economies, confirming the previous findings of Izyumov and Vahaly (2015). Second, the decline of the labor share in developed countries has been

very severe during the period, a pattern not observed in the developing economies. Third, as a consequence of the different evolutions in the labor share across countries, the difference in the labor share between developed and developing countries has fallen dramatically during the sample period.

Based on the existing, old and new, empirical evidence, our hypothesis is that the relationship between labor share and income forms an inverted U-shape. We used the standard specification in the literature for estimating a Kuznets-type curve that relates income to the variable to be explained, for instance, environmental quality (see Grossman and Krueger, 1991, 1995). The model to be estimated is the following:

$$S_{L,i,t} = \beta_{0,i,t} + \beta_1 \log Y_{i,t} + \beta_2 \left[\log Y_{i,t}\right]^2 + \beta_j X_{j,i,t} + e_{i,t} \quad (1)$$

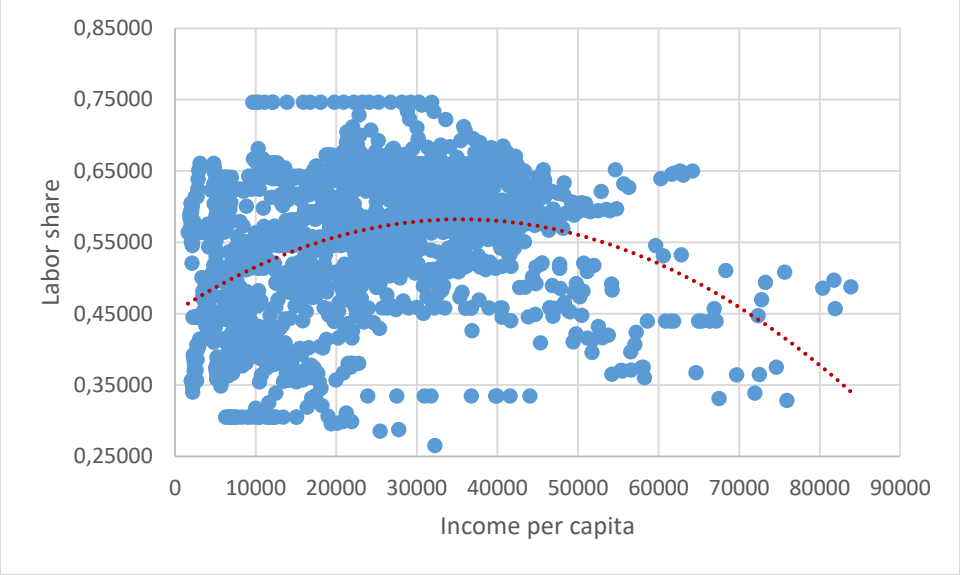
where $S_{L,i,t}$ is the labor share of country *i* at time *t*, $\log Y_{i,t}$ is the log of per capita income, and $X_{i,t}$ is a vector of control variables, including the main determinants of the movement in labor share suggested by the literature. $\beta_{0,i,t}$ is the intercept parameter, which varies across countries and years, and $e_{i,t}$ are random disturbances with zero mean. The country fixed effects control for differences in labor shares common to all countries and the year fixed effects account for any time-varying difference in labor shares common to all countries. We focus on the estimated parameters, β_1, β_2. For the existence of a LSKC, the estimated coefficients must fulfill the condition $\hat{\beta}_1 > 0, \hat{\beta}_2 < 0$.

Table I: Summary statistics

Variable	Description	Mean	Std. Dev.	Min	Max
S_L	Labor share	0.541	0.096	0.265	0.746
$Y_{i,t}$	Per capita income (2011 dollars)	22,058	14,599	1,605	83,851
$K_{i,t}/Y_{i,t}$	Capital/output ratio	5.027	1.856	1.223	12.810
$K_{i,t}/L_{i,t}$	Capital/labor ratio	0.235	0.140	0.014	0.566
$L_{i,t}/N_{i,t}$	Labor/population ratio	0.436	0.078	0.229	0.718
$PI_{i,t}$	Price of investment	0.786	1.873	0.121	3.565

Table I shows the mean, standard deviation, minimum and maximum for labor share, per capita gross domestic product, capital/output ratio, capital/labor ratio, labor/population ratio and the relative price of investment. As a preliminary analysis, the scatter plot in Figure 2 shows labor share and per capita income for the whole sample set. The scatter plot includes a second-order polynomial regression fit to the data. As it can be observed, an inverted U-shaped relationship emerges between labor share and per capita income after adjusting a second-order polynomial, even taking into account low quality of labor share data for some countries and for some years of the sample.

Figure 2: Labor share versus per capita income (dot-line indicates the fit of a second-order polynomial).



Source: Penn World Table 9.1

4. Results

Table II summarizes the results of the econometric estimation for the different specifications of equation (1). It is assumed that the intercept is a time invariant fixed parameter, but differs with cross-section units (fixed effect model) based on relevant statistical tests. The shape of the estimated relationship is determined by the coefficients β_1 and β_2. Specification (a) estimates the LSKC with per capita income and per capita income squared as the only explanatory variables. We find that $\hat{\beta}_1 > 0$, and $\hat{\beta}_2 < 0$, and that these coefficients are statistically significant, indicating that the fitting curve is an inverted U-shape. The estimation results support our hypothesis that there is an LSKC, indicating that labor share increases with income until a threshold point (the turning point), after which labor share is a decreasing function of income, as both the coefficients are statistically significant and have the expected sign. This result is robust to all alternative econometric specifications, which give very similar estimation results regardless of the inclusion of control variables, confirming the existence of an inverted U-shaped relationship between labor share and income.

The coefficient for the capital/output ratio is statistically significant in all specifications, with a negative sign as expected, consistent with the capital-deepening and capital-augmented technological progress hypothesis of Bentolila and Saint-Paul (2003). We also control for the capital/labor ratio and the labor/population ratio. Both coefficients are statistically significant at 10%, with a positive impact on the labor share for the capital/labor ratio, whereas the labor/population ratio has an estimated negative sign. Finally, we find support for the arguments of Karabarbounis and Neiman (2014) that the price of investment is one of the

main explanatory factors for labor share decline, as the estimated coefficient for investment price is statistically significant and has a negative sign, as expected.

Table II. Panel Data Estimates

Dependent Variable: Labor share	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**
Income	0.417***	0.421***	0.437***	0.416***	0.405***
	(0.033)	(0.033)	(0.035)	(0.033)	(0.032)
Income squared	-0.023***	-0.023***	-0.024***	-0.023***	-0.023***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Capital/output ratio	--	-0.005***	--	-0.005***	-0.006***
		(0.001)		(0.001)	(0.001)
Capital/labor ratio	--	--	0.042*	--	--
			(0.026)		
Labor/population ratio	--	--	--	-0.046*	--
				(0.024)	
Price of investment	--	--	--	--	-0.004***
					(0.000)
Turning point (2011 dollars)	8,649.15	9,434.92	8,992.68	8,463.16	6,663.15
R^2	0.869	0.871	0.869	0.871	0.875
Observations	1,900	1,900	1,900	1,900	1,900

Note: Robust Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

The turning point is calculated as $\exp(-\frac{\beta_1}{2\beta_2})$. In table II we estimate that the labor share peaks when per capita income is in the range \$6,663 to \$9,435 (2011 US dollars), with a value of around \$8,650 for specification (a). Our results are consistent with the findings of Izyumov and Vahaly (2015), who estimate that an increase in real GDP of \$10,000 (in 2005 PPP \$) is associated with a labor share increase of 3-4 percentage points.

5. Conclusions

This paper studies the relationship between labor share and income. Labor share is not only an indicator of the functional distribution of income but is also a key part of macroeconomics models. Mainstream economics has, since the work of Johnson (1954), considered the functional distribution of income to be constant. However, existing empirical evidence, old and new, questions this hypothesis, with evidence that the labor share was increasing during the last decades of the nineteenth century and the first decades of the twentieth century, and has then been decreasing from the 1980s in some developed countries. We interpret this as evidence of the existence of a non-linear inverted U-shaped relationship between labor share and income. Based on the evidence, we test empirically for the existence of a Labor Share Kuznets Curve. The results presented here are, to our knowledge, the first evidence of the existence of an inverted U-shaped relationship between labor share and income, with a turning point at around \$8,650. Our results also explain why labor share is larger in developed

countries than in developing countries, as indicated by Izyumov and Vahaly (2015), and they also explain the observed reduction in that difference. However, it is worth noting that the selection of countries has been done based on a data quality criterion regarding labor shares, and hence, empirical findings are conditioned to the sample selection.

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Data Appendix

Data source: World Penn Table version 9.1.

Sample period: 1980-2017.

Raw variables: Gross Domestic Product, Population, Employment, Capital Stock, Labor share, and Price of investment.

Selection of countries: Countries has been selected depending on the availability of data. Whereas quality of data is high for developed economies, for developing economies labor share estimates are constant for a large number of years. Given this limitation we have not considered those countries for which labor share is constant for a large fraction of periods of the sample period. For some countries, labor share remains constant for a number of the early years of the sample, but they have been included in the analysis in order to have a large enough selection of both developed and developing economies.

Selected countries: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Cabo Verde, Canada, China, Hong Kong SAR, Colombia, Cyprus, Denmark, Ecuador, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Luxembourg, Malaysia, Malta, Mexico, Namibia, Netherlands, New Zealand, Norway, Panama, Poland, Portugal, Republic of Korea, Romania, Senegal, Singapore, Spain, Sweden, Switzerland, Taiwan, Thailand, Trinidad and Tobago, the United Kingdom, the United States, and Venezuela.